Normal and Therapeutic Nutrition

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Publisher - Oxford
Edition - 1967

Acc.No -30226

Chapter 1

FOOD AND ITS RELATION TO HEALTH

THE MEANINGS OF FOOD, NUTRITION, AND DIETETICS

What does food mean to you? When you sit down to your next meal you will have definite feelings about that meal and the specific foods which are served to you. By your eyes you will delight in the texture variations and color combinations of the food, the artistic touch of a garnish, and the beautiful table appointments; or perhaps you may be repelled because the food lacks color and is carelessly served. By your nose you will enjoy the tantalizing odors of meat or of freshly baked rolls, or the fragrance of fully ripened fruit; or po the odor of grease which has been too hot or of vegetables which ked too long may bring about anorexia and nausea. By your you will experience countless flavors—the salty, sweet, bitter, variations; you will feel the textures of smooth or fibrous, y or oily, moist or dry foods.

one do not describe what your next meal, or any meal, ieal merely a way of staying alive and keeping in health. owsl ir family and frien

UNIT I

Introduction to the Study of Nutrition

Chapter

1 FOOD AND ITS RELATION TO HEALTH
2 GROWTH OF THE SCIENCE OF NUTRITION
3 INTRODUCTION TO THE STUDY OF NUTRITIVE PROCESSES
4 DIETARY GUIDES AND THEIR USES

PART ONE
NORMAL NUTRITION

You bring to the study of nutrition and dietetics your lifetime experience with food which may serve you well in further improving your nutrition and the nutrition of your fellowmen. But it may also be that you have many incorrect ideas and such strong feelings about food that it will take much patience and perseverance on your part to change your attitudes and motivations. As you enter upon your study of nutrition and dietetics it is well for you to examine carefully your present feelings about food, as well as your knowledge of nutrition, so that you can build upon what is best in your dietary pattern and correct that which is undesirable.

Nutrition and dietetics defined. *Nutrition* is the "combination of processes by which the living organism receives and utilizes the materials necessary for the maintenance of its functions and for the growth and renewal of its components."* One of the newest of the biologic sciences, nutrition is based on and integrated with the sciences of chemistry, biochemistry, and physiology. During the last 50 years, more advances have been made in the understanding of nutrition than in all the preceding centuries of recorded history. (See Figure 1–1.)

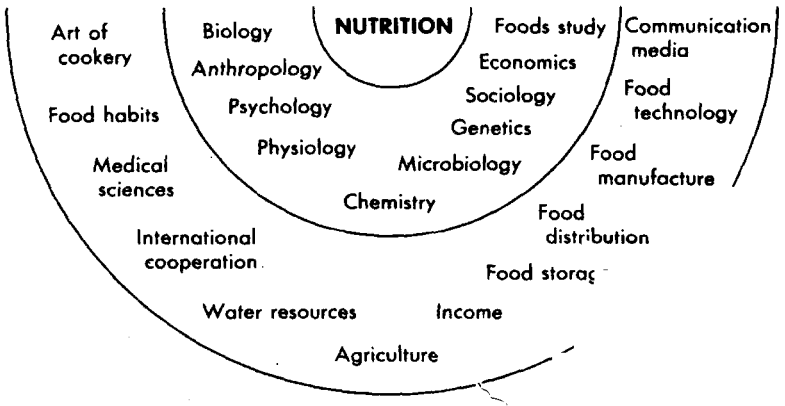


FIG. 1–1. Good nutrition for everyone is dependent up(ciples of many sciences and the coordination of many d

Dietetics is "the combined science and art under different economic or health conditio nutrition and management."† It includes co for the well and the sick, together with the serving of foods with due emphasis or factors.

Good nutrition: what is it? The con Health Organization of the United N

* Turner, D. F.: *Handbook of Diet T* Chicago, 1959, p. 208.

† *Ibid.*, p. 204.

mental and social well-being an erely the absence of disease or infirmity."* Nutrition and health are not synonymous, but without good nutrition health cannot be at its best.

The terms *normal, adequate,* and *optimum* are often used to describe nutrition, yet these are inexact. What is normal? By adequate, do we mean the prevention of disease, or some more positive attribute? How does one determine when optimum nutrition has been achieved? Nutrition relates, of course, to the constituents in food, collectively known as *nutrients,* which must be supplied to the body in suitable amounts. These include water, proteins, fats, carbohydrates, minerals, and vitamins. But these alone do not constitute good nutrition, for their use in the body determines the quality of nutrition. Numerous conditioning factors such as activity, climate, daily stresses of living, disease, and so forth, which may alter one's requirements for the nutrients, must be carefully considered.

Nutritional status is the condition of the health of the individual as influenced by the utilization of the nutrients. It can be determined only through taking a careful medical and dietary history, a thorough physical examination, and appropriate laboratory investigations, and correlating the information so obtained. Specific criteria concerned with nutritional status will be discussed in the chapters on nutrients which follow.

The achievement of good nutrition implies: (1) suitable agricultural methods which produce plant and animal foods of high nutritive value; (2) economic situations which make it possible to procure the necessary foods at a cost within reach of all; (3) controlled industrial procedures in which foods are selec ad processed with the greatest possible retention, or restoration, alue; and (4) conscientious and informed homemakers as ublic eating places who will select, store, prepare, and on a safe, physiologically adequate, socially appealing, ound basis. Only when these concepts are brought to te ideal of good nutrition and its benefits to everyone— cy, longevity—be fully realized. Obviously, individ- enefit by an increased knowledge of the principles

TIONAL PROBLEMS IN THE

alf a century the United States Depart- on the food supplies available per per- how much food is actually consumed,

What It Does, How It Works. Leaflet

or the relative adequacy of intake by various segments of the population. But as they include the quantities and kinds of foods available, they do provide a clue to the trends in the American diet. (See Figure 1–2.)

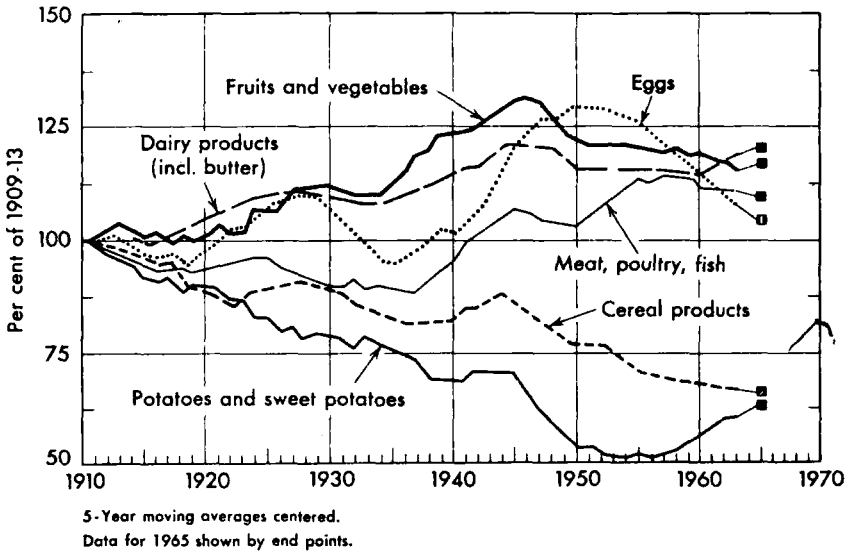


FIG. 1–2. Trends in food consumption since 1910. Per capita civilian consumption—using constant retail prices as index weights. (*Courtesy, Economic Research Service, U.S. Department of Agriculture.*)

Numerous surveys have been conducted by research workers to determine the actual intake of food by individuals in various age groups and under differing socioeconomic situations. Some of the[illegible]veys have been based upon an individual's recall of food eaten in the [illegible]24 hours; others required a seven-day written re[illegible] entailed the weighing of food in the [illegible]rmination of foo usage by [illegible]

in four regions—Northeast, North Central, South, and West—in such a manner that the results of the survey would be representative of practices throughout the United States. Trained interviewers obtained information on (1) family characteristics—size, income, and so forth, (2) the quantities of food purchased during the preceding seven days, (3) the expenditures for food purchased, (4) practices with respect to certain foods during the preceding year, (5) the number of meals eaten away from home by each individual during the preceding week, and (6) the expenditure for food eaten away from home. Some of the results of this survey will be referred to from time to time in this and succeeding chapters.

Changes in patterns of living. The population of the United States has shifted from rural to urban centers; but even on the farm most families now purchase much more of their food than was customary half a century ago. Americans have the benefits of many labor-saving devices in their occupations and in their homes. They work fewer hours in a week so that the way in which they spend their leisure may be decisive in determining their food needs. Leisure, to many people, means little activity—riding rather than walking, watching television rather than leading an active outdoor life, and so on.

Greater numbers of married women are working away from home than ever before, which means that there is less time for food preparation, more expensive ready-prepared foods are used, and shopping is less frequent. Husbands, as well as wives, are shopping for and preparing foods; sometimes children, especially teen-agers, may be given too much freedom in their food choices thus resulting in poor nutrition. Marriages occur at an earlier age with pregnancy often presenting an additional stress on the young woman who has not fully matured and who may have been the victim of poor dietary practices.

The average American family of today has a higher income and is spending more of it for food. With this higher income, more meals are eaten in restaurants. More workers are receiving meals at their place of work rather than carrying lunches, and m[illegible] ren are parti[illegible] ool lunch programs. The family eats f[illegible] ther, anc[illegible] milies some meals [illegible] shipped f[illegible] ro[illegible] eal, [illegible] hap

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ilk and milk products, citrus fruits and
bles, fats, and sugars than they did 50,
the more costly foods. On the other

hand, only half as much of two important food groups—breads and cereals, and potatoes—is eaten as 50 years ago.

Dietary adequacy. During the 1930's, a survey indicated that a third of the diets in the United States were classed as "poor." In 1955, the diets in only 10 per cent of the households could be classed as poor. Few families had diets which provided less than two thirds of the Recommended Dietary Allowances for one or more nutrients (see Figure 1–3). This improvement which occurred

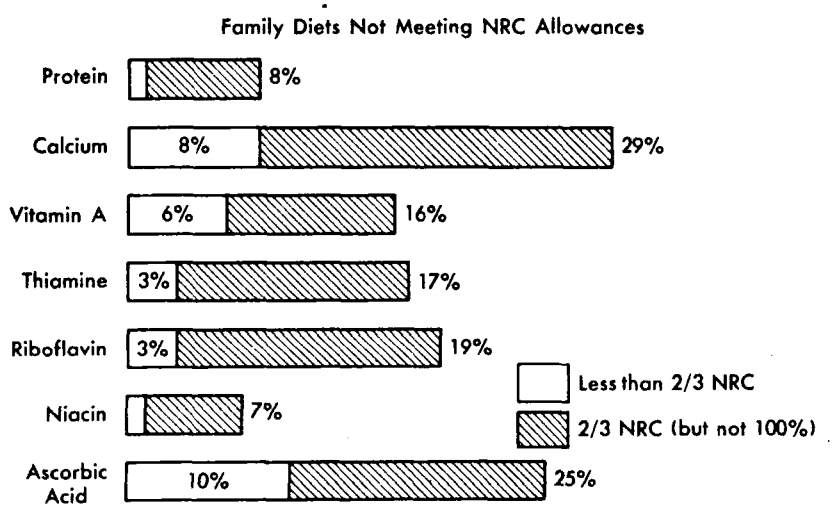


FIG. 1–3. Need for improved diets. Calcium and ascorbic acid are the nutrients most frequently supplied at levels below the Recommended Dietary Allowances according to data from the family dietary survey of 1955. (*Courtesy, Agricultural Research Service, U.S. Department of Agriculture.*)

from the mid-thirties to [illegible] period was the result of better economic conditions, the bre[illegible]ichment program, improvements in [illegible] levels in 1955, however [illegible] of 1948, thus indica[illegible] in s[illegible]te of the f[illegible] b[illegible]

trol of deficiency disease has been realized so that overt clinical signs of nutritional deficiency are rare. Today, as never before, the American public has become aware of the importance of good nutrition. Nevertheless, there are still nutritional problems of major importance to be solved in the United States.

1. Obesity is recognized to be the chief nutritional problem in this country.[4] It has been estimated that every fifth person over 30 years of age is overweight. Increasing numbers of children and young people are entering the overweight category. The association of obesity with degenerative diseases is well established.

2. Iron-deficiency anemia, especially in infants and young women, is more widely prevalent than it needs to be.

3. Cardiovascular diseases, gallbladder disease, diabetes, and cirrhosis of the liver occur with frequency. The role of diet as a possible etiologic factor in cardiovascular and other degenerative diseases is receiving major attention by investigators.

4. The role of nutrition in the process of aging and in mental health is little understood.

5. Dental caries is of almost universal occurrence.

6. The extent of so-called subclinical deficiencies cannot be measured. Certainly a good deal of lowered resistance to infection, slow convalescence from illness and injury, lost time from school and work, inefficiency, and unhappiness are due to poor nutrition alone.

7. Superstitions concerning foods, fad diets, and unjustified claims for certain foods and mechanical devices by unscrupulous quacks are an increasing menace. Millions of dollars are spent annually by persons of limited income for products selling at exorbitant prices, so that there is often too little money left for the purchase of an adequate diet. Even more serious is the faith that some people place in some specific product as a cure for disease; such mised faith may mean that medical advic

PROBLEMS IN N



FIG. 1–6. Biochemical studies of the nutritive values of foods are basic to understanding ways to improve dietaries. (*Courtesy, College of Home Economics, Drexel Institute of Technology.*)

patient to the bedside, but that she also has some responsibility for effecting the smooth transition of the patient from the hospital to his home. To implement continuity of care, she knows that with respect to nutritional needs the patient may require instruction in the proper choice of foods in the market, assistance in planning for the best use of his food money, and practical sug-

gestions for food preparation with meager facilities, or in the face of physical handicaps. Some of the assistance required by the patient may be provided by the nurse, but more often a team effort—nurse, dietitian, social worker—is needed.

In the community the nurse is often the coordinator of services. The public health nurse encounters a legion of problems and needs related to nutrition: perhaps she needs to show one mother how to prepare an infant formula; another person needs to know how to budget her limited income so that she can buy enough milk; another needs actual instruction in food preparation for an ill member of the family; another has been given a diet that does not fit in with the religious practices of the family; or a pregnant woman may need to know what foods she must eat and how to provide for them in her budget. (See Figure 1–7.)

Objectives for the student. Among the goals the student might set for himself in the study of nutrition are the following:

1. Acquire the proper attitude and convictions relative to the importance of nutrition in regulating one's own health, that of the family, and individuals in the community.
2. Learn the role of food in body structure and function, and become familiar with the contributions of various foods with respect to the food constituents.
3. Obtain knowledge of the functions, digestion, absorption, and metabolism of protein, fat, carbohydrate, minerals, vitamins, and water in the body and the way in which these nutrients are interrelated.
4. Recognize the nutritive requirements of individuals and the variations that may be imposed on the food needs by activity, climate, pregnancy, lactation, growth, old age, or disease.
5. Obtain theoretic and practical knowledge in the planning of meals together with the selection, purchase, care, preparation, and service of foods most commonly used and be able to apply the knowledge under varying circumstances.
6. Learn to appreciate the importance of economic, social, and psychologic factors in the feeding of people.
7. Learn to teach nutrition and its applications to individuals and to groups, using accepted techniques of teaching and approved teaching materials.
8. Become familiar with agencies concerned with nutrition and health in order to utilize their services and contribute to their functioning.
9. Know where to look for reliable sources of information, and how to evaluate publications on food and nutrition and the claims of advertising.

PROBLEMS AND REVIEW

1. What is your understanding of the following terms: nutrition; optimum nutrition; malnutrition; dietetics; foodstuff; nutrient; health; food?
2. Industrial and economic developments have been a powerful factor in the changing



FIG. 1–7. Nutrition education: classes in nutrition are held in rural villages to stress the best use of local foods. This demonstration is being held in Thailand. (*Courtesy, United Nations Children's Fund.*)

of our food habits. List several of these which have had an influence on our dietary habits within your lifetime.

3. Within your experience give an example of a situation in which the community has fostered better nutrition.

4. Select an article related to food from the daily newspaper or a popular magazine and discuss its merits.

5. In what ways is a knowledge of the following sciences helpful in the study of nutrition: bacteriology; chemistry; sociology; psychology?

6. What is the difference between a dietary survey and a nutritional status study?

7. *Problem.* Start a list of resources for the study of nutrition and dietetics. Add to this list as you continue in your study. Include only those books and journals which you have examined. Include the names of official and voluntary agencies in your own community, at state, federal, and international levels as you become familiar with the work they do in the area of nutrition.

8. *Problem.* Compile a list of characteristics which describe a person who is in good nutritional status. How do you measure up with this?

9. *Problem.* Review the suggested objectives for study in this chapter. Then prepare a statement in your own words which best describes the goals you think are most important. Limit your statement to 300 words; be concise but exact.

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Chapter 2

GROWTH OF THE SCIENCE OF NUTRITION

All recorded history shows that food has played an extraordinarily vital role in the rise and growth or the fall and decline of nations because of its effect on health and efficiency; in fact, the history of the world could probably be written in terms of food. Since earliest times food has been considered in the light of both cause and cure of disease, and few stories are more fascinating than the gradual evolution of the science of nutrition from the maze of sage philosophy, countless fads, and bizarre superstitions which have grown up through the centuries. A complete history of nutrition would occupy volumes. The material which follows merely provides some glimpses of the evolution of the science of nutrition. It is hoped that the student will find encouragement in reading detailed works on the various aspects of food and nutrition history, since such endeavors can become an absorbing hobby and inevitably strengthen the understanding of nutrition itself.

Early beginnings. The ancient Egyptians chiseled drawings on stone some 5000 years ago which depicted the grinding of flour, the making of bread, and the slaughtering of cattle.[1] Grain and pottery have been found in the tombs. The most remarkable record of an ancient people is available to all who would read it, namely the record of the Hebrew people in the Old Testament of the Bible. There one can learn much of the laws and traditions for the use of food and the kinds of food available at that time.

Medical literature from the time of Hippocrates has been replete with advice for the use of food in disease and as a measure to prevent disease. There was little true understanding of what happened to food in the body until the science of physiology explained the processes of digestion, circulation, and respiration. On the other hand, the careful observations of many people gradually led to much information which proved to be fairly sound.

People are seldom reluctant to express ideas concerning diet, whether or not they are authorities on the subject. American students may be especially interested to know that one of the heroic figures in American history, namely Benjamin Franklin, expressed himself in no uncertain terms concerning the

role and use of food, and that he was a close friend of the chemists who founded the science of nutrition. The advice he gave with regard to food and eating typifies many comments that can be found in the literature of that period, and some of it is still good advice today. For example, we read:

> Exercise should precede meals, not immediately follow them; the first promotes, the latter, unless moderate, obstructs digestion. If, after exercise, we feed sparingly, the digestion will be easy and good, the body lightsome, the temper cheerful, and all the animal functions performed agreeably. Sleep, when it follows, will be natural and undisturbed; while indolence, with full feeding, occasions horrors inexpressible; we fall from precipices, are assaulted by wild beasts, murderers and demons, and experience every variety of distress. Observe, however, that the quantities of food and exercise are relative things; those who move much may, and indeed ought to eat more; those who use little exercise should eat little. In general, mankind, since the improvements of cookery, eat about twice as much as nature requires. Suppers are not bad, if we have not dined; but restless nights naturally follow hearty suppers after full dinners. Indeed, as there is a difference in constitutions, some rest well after these meals; it costs them only a frightful dream and an apoplexy, after which they sleep till doomsday. Nothing is more common in the newspapers, than instances of people, who, after eating a hearty supper, are found dead abed in the morning.*

The science of nutrition is founded. During one of his trips to London, Franklin met Joseph Priestley (1733–1804), a Unitarian clergyman who was destined to become his lifelong friend. Through Franklin, Priestley became interested in electricity, and while attempting to write a history of this subject was led to wider experimentation. As so often happens, it was a chance experiment of his which made such a change in the course of chemistry. Seeing a lighted candle in a room he inserted it into a closed jar of "fire air" (oxygen) and found that the candle would burn more brightly for a time but would eventually be extinguished. He then inserted a mint plant into a jar and found at the end of 10 days that the air had been restored and the candle would burn as brightly as before. He not only established the necessity of oxygen for the burning candle, but he determined its importance for animals. Priestley was the victim of religious persecution and fled to America where he was widely hailed. Today, one can visit his home in Northumberland, Pa., where the chemists of America maintain a permanent memorial.

During the years when he represented this country in France, it was natural that Franklin should seek out the company of scientists. One of those whom he visited and came to know well was Antoine Laurent Lavoisier (1743–1794), who was as versatile as Franklin and who was one of the greatest men France has ever produced. Lavoisier laid the sure foundation for the knowledge of burning (oxidation), which he described as the union of the burning substance with oxygen, the name he gave to "fire air." He introduced

* Franklin, B.: "The Art of Procuring Pleasant Dreams, 1786," in *The Ingenious Dr. Franklin*, N. G. Goodman, ed. University of Pennsylvania Press, Philadelphia, 1931, p. 35.

new chemical terminology so that the confusing and often meaningless writings of earlier scientists were clarified. With his delicate balances and his thermometers he started experiments which led to our present concepts of energy metabolism, and thus he came to be known as the "Father of the Science of Nutrition." In one of these experiments together with Laplace, another French worker, he constructed a chamber for the measurement of the amount of carbon dioxide given off by a guinea pig in 10 hours. This was found to be equal to the burning of 3.33 gm of carbon in a closed vessel. He next determined the amount of ice which the guinea pig's body would melt in 10 hours. The amount of heat necessary for melting the ice was found to be almost identical with that given off in burning 3.33 gm of carbon. It was then concluded that the carbon dioxide expired by the guinea pig came from burning the equivalent of 3.33 gm of carbon. Lavoisier was in the midst of an experiment of this nature on one of his co-workers when the terrorists of the French Revolution carried him away—and thus the famous mathematician, physicist, chemist, philosopher, politician, and humanitarian became another victim of the guillotine.

Studies in metabolism. An Englishman, William Prout, in 1827 set forth the doctrine that living things need "the saccharine, the oily and the albuminous." * This teaching was frequently challenged until a German, Justus von Liebig (1803–1873), showed beyond doubt that protein, fat, and carbohydrate are burned in the body. He developed methods for the analysis of foods, body tissues, urine, and feces and gave to the world its first idea of food composition. He knew that protein contained nitrogen and suggested that the amount of nitrogen in the urine might be a measure of the protein destruction in the body. Two other Germans, Bidder and Schmidt, showed this idea to be fact when they found that almost all of the nitrogen contained in the meat fed to dogs could be accounted for in the urine and feces. Liebig's most famous pupil was Carl von Voit, who extended the experiments on protein and who firmly established the determination of nitrogen in food and in urine and feces as a method for the measurement of protein metabolism. (See Figure 2–1.)

In 1849 two Frenchmen, Regnault and Reiset, constructed a chamber for the measurement of oxygen intake and carbon dioxide output in small animals. At the suggestion of Voit, a Munich physicist by the name of Pettenkofer in 1862 constructed a large chamber which would accommodate a man. In the United States similar chambers were constructed, first by Atwater and Rosa and then later by Benedict.

Max Rubner, one of Voit's pupils, was the first to prove that the animal body is subject to the *law of conservation of energy*. He showed that the heat production of the animal body is proportional to the surface area. He determined the fuel values for pure protein, fat, and carbohydrate.

* McCay, C. M.: "Seven Centuries of Scientific Nutrition," *J. Am. Dietet. A.*, **15**:648, 1939.

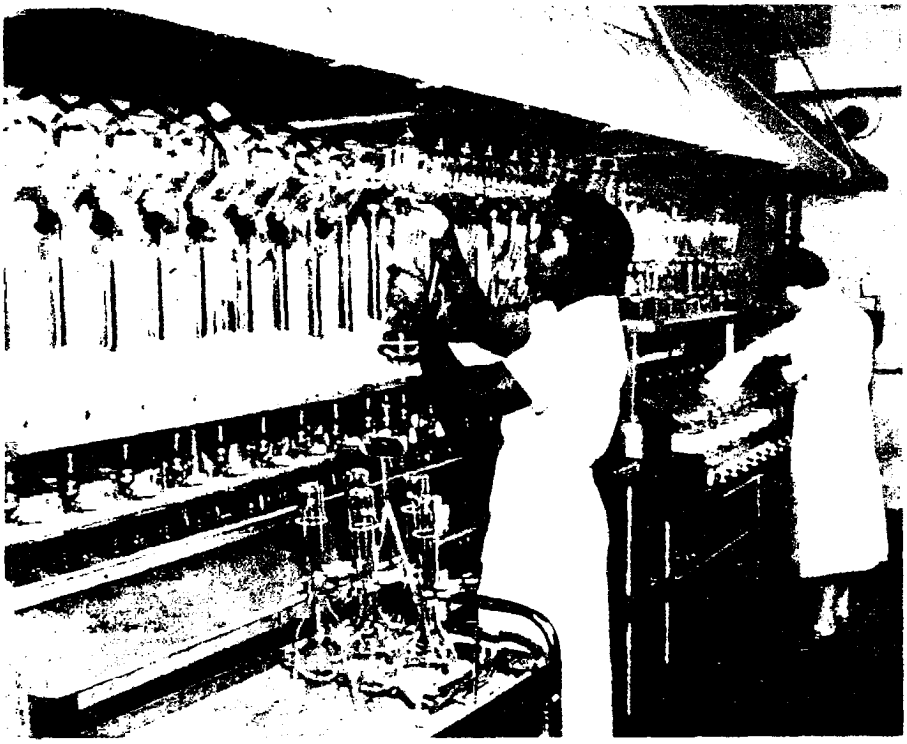


FIG. 2–1. Determination of nitrogen in food and excretions as a measure of protein metabolism was started in the mid-1800's. Investigators are shown in the Food and Nutrition Laboratories of the U.S. Department of Agriculture. (*Courtesy, U.S. Department of Agriculture.*)

Thus, at the beginning of the twentieth century the science of nutrition, whose groundwork had been well laid in France, was carried forward in Germany, and destined to reach greater heights in England and America through the studies of men and women such as Chittenden, Atwater, Benedict, Carpenter, Du Bois, Lusk, Mitchell, McCollum, Hart, Osborne, Mendel, Murlin, Sherman, Rose, and many others. (See Figure 2–2.)

Importance of minerals in the diet is recognized. That the chief compounds in bones and teeth are calcium phosphate and calcium carbonate was well known as early as 1799.[2] In fact, a book on the composition of bones appeared in 1844.

In 1840 a study by Charles J. Chossat, a physician in Genf, France, won a prize for showing that a diet of wheat and water must be supplemented with calcium carbonate if the bones of a growing pigeon are to develop.[3] For the first time the importance of calcium in the diet was thus shown. This was confirmed in 1843 by J. B. Boussingault, another Frenchman, who performed calcium-balance studies on animals.



FIG. 2–2. The albino rat has been used for many kinds of nutritional studies since the beginning of the twentieth century. (*Courtesy, Food and Drug Administration.*)

The occurrence of goiter is as old as history itself. It apparently was always extremely common, for many paintings show individuals with the enlarged thyroid gland. In 1822, Boussingault, while on a trip to South America, observed that villagers who used salt containing iodine were free of goiter, but that those who used plain salt were afflicted. He pointed out the importance of iodine in goiter prevention and the need for keeping the intake at low levels. Because the amount subsequently used was excessive, the therapy was soon discarded, and almost 100 years elapsed before Marine and Kimball found a direct relation between the incidence of goiter and low intake of iodine.

In 1838 Berzelius, a famous Swedish chemist, concluded that the iron in hemoglobin made it possible for the blood to absorb much oxygen. Iron in its various forms had long been used as a therapeutic agent for anemia, but that it had any direct relation to diet became more apparent when Bunge in 1889 reported a case of anemia which developed in a young man on an exclusive milk diet. Bunge noted further that mice would also develop anemia on an exclusive milk diet, and that pure iron salts would not cure the anemia but that egg yolk would. He therefore concluded that some union of iron with the protein of egg was responsible for the efficiency of the cure. Thirty-five years later Hart and his associates at the University of Wisconsin again found that white rats develop anemia if fed a milk diet, that the anemia was not cured by iron salts alone, but that the ash of lettuce was an effective cure. The unknown substance present in lettuce ash was found to be copper.

Mere traces of copper added to pure iron salts were found to be adequate for cure of iron-deficiency anemia. This was another illustration of the importance of traces of certain elements in body metabolism.

Discovery of vitamins. Dr. Eijkman, a Dutch biologist, in 1897 showed that beriberi occurred when people ate rice which was polished, but that the disease could be prevented if the rice with its bran was used. He showed definitely that beriberi, or a disease showing similar symptoms of nerve disturbance, could be produced or cured at will in hens by changing the diet of unpolished rice to milled rice, or the reverse. In 1906 he wrote: "There is present in rice polishings a substance of a different nature from proteins, fats, or salts which is essential to health and the lack of which causes nutritional polyneuritis." * At the same time J. Gowland Hopkins of England and others found that laboratory animals could not live or thrive on purified mixtures of proteins, carbohydrates, fats, and inorganic salts. Fed such a diet, the animals ceased to grow, sickened, and eventually died unless the purified ration was changed. Hopkins established beyond a doubt that these "accessory factors" in foods are essential to life, and he is generally credited with the discovery of vitamins. Casimir Funk applied the name "vitamine" to these substances in 1911, the final "e" being dropped some years later when it became evident that the chemical nature of these substances was not what Funk had supposed it to be.

In the meantime Holst and Frölich, two workers in Norway, had succeeded in producing symptoms which resembled scurvy in guinea pigs by using an experimental diet that contained no fresh foods. All through history scurvy had plagued people who were forced to eat a diet devoid of fresh foods for long periods of time; the sailor, explorer, and adventurer were especially susceptible. A British physician, Dr. Lind, in 1757 had shown the efficacy of citrus fruits in both curing and preventing scurvy. The New England pioneers recognized the value of potatoes and fruits in preventing this condition. Then in the twentieth century, with the production of scurvy in the guinea pig, the way was paved for the studies on vitamin C and its later isolation and synthesis.

While the studies on the factor which would prevent beriberi were progressing, McCollum and Davis, and Osborne and Mendel had observed that animals which received diets containing lard instead of butterfat would cease to grow and would eventually develop an inflammation of the eye. When butterfat was used, the condition was corrected; cod-liver oil was found to be very effective. These discoveries led to the recognition of "fat-soluble A" and "water-soluble B" as the factors were then designated.

In the 40 years that have elapsed since the first vitamin was discovered, the growth of the vitamin family, the isolation and determination of many vitamins, the partial solution of the puzzle of vitamin functions in the body,

* Eijkman, P., quoted in Harris, L. J.: *Vitamins in Theory and Practice*. Cambridge University Press, London, 1935.

the discovery of the amazing therapeutic value of minute quantities of these vitamins in the cure of deficiency disease, the numerous determinations of food composition with respect to vitamins—all are stories which excite the imagination. It is no wonder that the subject of vitamins touched popular fancy, and that they have often been overemphasized. There is not space here to tell the story of the development of knowledge concerning vitamins, but some of these aspects will be hinted at in the chapters on vitamins (Chapters 10, 11, and 12). Further details can be obtained by consulting references suggested in the bibliography.

Early beginnings of dietetics in America. Knowledge of food and its preparation for all in the family, whether they be well or sick, has at all times been considered a necessary training for the homemaker, to be handed down from generation to generation. The earliest cookbooks included reference to the special food needs of those who might be ill. More learned works for physicians likewise contained suggestions for diet in various disturbances. In the hospital, the feeding of patients was left to the nurses, some of whom might be especially assigned to the administration of the dietary department.

A number of cooking schools, notably in New York, Boston, and Philadelphia,[4,5] which arose during the last quarter of the nineteenth century, seem to have laid the basis for the profession of dietetics in this country. One of these, the New Century Cooking School, was founded in 1878 by a group of wealthy women in Philadelphia. Sara Tyson Rorer was graduated from the first course in this school—a course consisting of two practical lessons a week for 3 months and 24 demonstrated lectures. She succeeded Miss Devereaux, the school's first principal, after a year and worked out a "course of lectures" for the students at Woman's Medical College and the nurses at the Woman's Hospital. After 3 years she founded her own Philadelphia Cooking School. It was not long before a number of renowned physicians of Philadelphia came to her to ask if she would start a diet kitchen where food would be well prepared for special diseases so that patients who were from out-of-town and staying at hotels could be properly fed. Such a kitchen was founded and was later combined with the cooking school. Miss Rorer can, no doubt, be given the distinction of having been the first American dietitian.

One of the graduates of the first "normal class" in Miss Rorer's school, Martha G. Byerly, taught a class of senior nurses from the Pennsylvania Hospital in 1892; then, in 1893 she became superintendent of diet at the Presbyterian Hospital and continued to teach the nurses at the Pennsylvania Hospital. At the same time Mary A. Boland, who was instructor in cooking at the Johns Hopkins Hospital Training School for Nurses, wrote a *Handbook of Invalid Cookery*. These classes during the nineties seem to have been the earliest attempt to give organized instruction in dietetics to nurses.

The American Dietetic Association. At the invitation of Miss Lenna F. Cooper of the Battle Creek Sanitarium and Miss Lulu G. Graves of Lakeside Hospital, Cleveland, a conference of 98 dietitians was held in October,

1917, in Cleveland. The purpose of this meeting was to discuss how dietitians could best serve during the war both at home and overseas, and to effect better communications among dietitians. An organization called the American Dietetic Association with the stated purpose "to benefit as many as possible" was established at this conference with 39 charter members. Now the membership totals about 19,000. The four sections, Community Nutrition, Diet Therapy, Education, and Food Administration, represent the varied aspects of the dietitian's work. Recently, the history of the association and its work has been written by Mary I. Barber.[6]

Growth of research. Without the faithful workers in the research laboratories and the countless numbers of experimental animals used, very little of our present nutrition knowledge would now be available. It has taken combined research in the sciences of physiology, biology, and chemistry to develop the complicated story of nutrition on a physiologic basis, but the whole program of nutrition research is even more extensive than that. For example, agriculture has undergone a remarkable change in the last few decades. Some varieties of plants are now known to be a better source of nutrients than others. Composition of the soil, fertilizers, and climate are all known to influence the amount of food produced. The control of plant pests, the adaptation of plant variety to growing conditions, the improvement of animal feeds, and the use of antibiotics to accelerate the growth of animals are but a few examples of the areas of progress.

The way in which a product is handled from the time it is gathered by the farmer until it is eaten by the consumer is known to influence nutritive value, and so there have been many studies of the effects of drying, canning, freezing, irradiation, storage, atmospheric conditions, and various methods of cookery on the retention of food values. (See Figure 2–3.)

Dietary surveys and studies of nutritional status have been made in many parts of the United States and in other areas of the world by public health nutrition workers. Such studies serve to correlate dietary intakes with health and thus provide further evidence for the establishment of minimum requirements and adequate allowances for long-time health. These investigations are also providing a wealth of information relating to food habits and psychologic factors in feeding.

Problems in nutrition are challenging. Every question which has been answered in the science of nutrition seems to have raised a host of new ones. Of immediate interest is the question of variations in food values with changing conditions of food gathering, storage, processing, and cookery. The data now available for some nutrients such as amino acids, fatty acids, sodium, and others must be extended to give greater significance to the average values cited in food tables.

Although a great deal is known about the amounts of various nutrients which are needed to prevent various deficiency diseases, complete information is lacking on the requirements of the optimum diet. Sherman has shown that



FIG. 2–3. The tenderness of a product is important to its acceptability. A food scientist measures the tenderness of broccoli using a shear press. (*Courtesy, U.S. Department of Agriculture.*)

improvement of an already adequate diet can prolong the length of life and the prime of life in experimental animals, but there is scarcely any research on man as yet that supports this important finding.

That nutrients cannot be put into so many convenient pigeonholes but are interrelated substances with regard to requirements and function is known. Thus, carbohydrate spares protein; tryptophan, an amino acid, can replace niacin, a vitamin; thiamine is necessary for carbohydrate metabolism, and so on. The full significance of these interrelationships is just beginning to be appreciated.

Detailed descriptions of many classic deficiency diseases have been available for a long time. On the other hand, we know little of how to diagnose deficiency at early stages either by clinical observation or by laboratory tests. The effects of nutrition on the incidence and course of degenerative diseases such as cancer, cardiovascular disease, and arthritis are now being extensively studied.

Some of the nutritional problems such as dental caries are essentially unsolved. One might also ask: What is the relation of diet to tumor development? Why do some people like certain foods and others do not? In what

way might mental health be influenced by diet? What are the best methods for changing the food habits of people who have been accustomed to faulty dietary patterns over long periods of time? In what ways can education be made more effective to reduce the large number of the misfed? These are but a few of the many problems waiting for solution.

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Chapter 3

INTRODUCTION TO THE STUDY OF NUTRITIVE PROCESSES

Most students who are using this text undoubtedly have had some prior study of metabolic processes in a high school or college course in biology or physiology. The purpose of this chapter is to correlate some of the more important aspects of these processes so that they can be related to the study of nutrition. The details of digestion and intermediary metabolism for the several nutrients are appropriately included in the chapters which follow. Nevertheless, it is important to recognize that metabolic activities pertaining to protein, fat, and carbohydrate are occurring simultaneously, and that the pathways for each often merge into a common system. Moreover, variations in the utilization of any one nutrient affect the rate and degree of utilization of another.

Composition of the body. Water accounts for roughly two thirds of the body weight and is distributed in all tissues. About three fourths of the water is in the *intracellular* compartment (fluid within the cells), while one fourth is in the *extracellular* compartment which includes the blood circulation, the lymph, and the interstitial fluids which bathe all cells. Tissues vary considerably in their water content with bones, teeth, and adipose tissue, for example, containing appreciably less than muscle and nervous tissue.

Proteins and fats each account for about 15 per cent of body weight, with considerable variations depending upon the amount of fat deposition. The percentage of fat in the newborn infant is relatively low, but in the obese adult the percentage of fat may exceed that of protein by a wide margin.

Only about three fourths of a pound of carbohydrate is present in the body. This is chiefly in the form of fuel storage, with only a small amount being involved in the structure of the tissues.

The predominating chemical elements in the body are oxygen, 65 per cent; carbon, 18 per cent; hydrogen, 10 per cent; and nitrogen, 3 per cent. Together they represent about 96 per cent of body weight. The remaining 4 per cent is made up of the mineral elements, of which calcium and phosphorus account for three fourths.

Many of the most important body constituents are organic compounds present in such small amounts that they have no significant effect on the total body weight. Among these are the vitamins, hormones, and enzymes.

Metabolism. The series of processes necessary for the building of body tissues and their continuous functioning is known as *metabolism*. This broad term implies the coordination of a number of body processes:

1. Ingestion or the intake of food.
2. Digestion which prepares foods for their use by the body.
3. Absorption of nutrients from the gastrointestinal tract into the circulation.
4. Transportation by the circulatory system of nutrients to the sites for their use, and of wastes to the points of excretion.
5. Respiration, which supplies oxygen to the tissues for the oxidation of food, and which removes waste carbon dioxide. The circulatory system is again responsible for transportation of these gases.
6. Use of materials: oxidation to create heat and energy; incorporation into new cells and tissues.
7. Excretion of wastes: undigested food wastes and certain body wastes from the bowel; carbon dioxide by the lungs; nitrogenous, mineral salt, and other wastes from metabolism by the kidneys and by the skin.

Numerous physical and chemical methods have been developed for measuring the metabolic changes which occur with variations in nutrition. Analyses of blood, urine, and, somewhat less frequently, of feces for various constituents are utilized in nutrition research. Part of the study of nutrition is concerned with a knowledge of such changes and an interpretation of their significance in assessing the quality of nutrition.

Functions of food. "You are what you eat" is, in a sense, true inasmuch as food supplies the nutrients needed as a source of energy for activity of the body, and as structural materials for every cell of the body. In the latter capacity, not only do the nutrients furnish the materials that give the body its structure and proportions, but they are used for the synthesis of the numerous regulatory substances that are essential to life.

The nutrients that supply energy include carbohydrates, fats, and proteins. In forming body structures, water, proteins, fats, carbohydrates, and minerals all participate. All nutrients—water, amino acids, fatty acids, sugars, mineral elements, and vitamins—are involved in the innumerable regulatory activities.

The nature of enzymes. All living tissues, plant and animal, produce thousands of enzymes without which the myriad chemical reactions could not take place. Enzymes are organic catalysts of a protein nature which remarkably increase the rate of reactions without becoming a part of the reaction products. When the protein is denatured (as by heating), the enzyme activity is lost. A small amount of enzyme will accomplish a chemical change on a great deal of substance. Some digestive enzymes have been known to hydrolyze as much as 4,000,000 times their own weight of substance. Enzymes, like all

organic materials, are gradually used up, and therefore they must be continuously synthesized by the living cell.

Some enzymes are simple proteins, while others consist of a protein and another grouping which is loosely or firmly bound to the protein molecule. In an enzyme system the protein molecule is called the *apoenzyme;* its attached grouping is called the *prosthetic group.* For many enzyme systems the prosthetic group is comprised of *coenzymes* which are organic compounds, including several of the vitamins. The same *coenzyme,* it should be noted, may be used in different enzyme systems; it is the protein molecule that gives an enzyme its particular specificity. Some enzymes may require the presence of a *cofactor* (e.g., a mineral element) for their proper functioning.

Some enzymes are produced in an inactive form known as *proenzyme* or *zymogen* and require some other substance to activate it. For example, trypsinogen is a proenzyme secreted by the pancreas. Before it can act upon the protein molecule during digestion it must be activated by enterokinase.

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Trypsinogen (proenzyme or zymogen) —enterokinase (activator)→ Trypsin (active enzyme)

Protein + water (substrate) —trypsin→ Proteoses, peptones, polypeptides

Most enzymes participate in only one chemical reaction on a single substance, although some act on a class of compounds. Thus, a single liver cell is estimated to contain about a thousand enzymes that are responsible for as many different actions. An enzyme, such as *lactase,* will only split the sugar lactose; it has no action on the sugar sucrose, or upon any other sugar, protein, or fat. The enzyme which converts the amino acid phenylalanine to another amino acid, tyrosine, cannot be replaced by any other enzyme; if it is missing, the congenital condition known as *phenylketonuria* exists.

Enzymes are classified broadly by the functions they perform. Among the many important functions are hydrolysis, oxidation, dehydrogenation, and transfer of chemical groupings; thus, hydrolases, oxidases, dehydrogenases, and transferases. The nomenclature of the enzyme will usually give a clue to its exact activity. In many of them the ending *-ase* is added to the root word of the substrate upon which the enzyme acts. For example, a transaminase would be an enzyme involved in the transfer of an amino group; lactase is the name for the specific enzyme which splits the sugar lactose to glucose and galactose in the intestine.

One of the conditions for maximum activity of an enzyme is the correct temperature. For each 18° F increase in temperature within a given range, the chemical activity is doubled; thus at body temperature the reactions take place twice as rapidly as they would at 80° F, and four times as rapidly as at 62° F. This rate of reaction helps to explain why fresh foods such as vegetables, fruits,

and meats deteriorate rapidly at warm room temperatures but are much more slowly affected at low temperatures. Enzymes are inactivated but not destroyed at freezing temperatures; they are destroyed at the temperatures at which proteins coagulate.

Enzyme activity is affected by the pH (hydrogen ion concentration) of the medium. Pepsin, which digests proteins in the stomach, is one of the few enzymes active in the very acid reaction of the stomach, while the enzymes found in the intestines are active at a somewhat alkaline pH.

DIGESTION

Only water, salts, vitamins, monosaccharides, and a few organic compounds of low molecular weight can be utilized by the body as they are consumed. Other substances must be hydrolyzed or split into smaller units before the body can use them. *Digestion* includes the mechanical and chemical processes whereby these nutrients are broken down into small units of structure so that absorption can take place from the intestinal wall into the blood stream. By *mechanical* means the food is finely divided and propelled along the intestinal tract, so that by *chemical* means it may be readily hydrolyzed into water-soluble products suitable for absorption.

The chemical changes that take place during digestion are brought about by hydrolyzing enzymes. In the presence of water these enzymes split up proteins, fats, and carbohydrates into units that are suitable for absorption. See Table 3–1 for a summary of digestive enzymes.

Digestion in the mouth. Food in the mouth is cut and ground into smaller pieces by the teeth. Mastication, especially of crisp, hard foods which require longer chewing, together with psychic factors such as sight, taste, odor, and memory of agreeable foods stimulates the flow of saliva by three pairs of salivary glands, the parotid, submaxillary, and sublingual. Saliva is made up of water, mucin, inorganic salts, and enzymes known as amylase (ptyalin), and possibly maltase, which act on starch and maltose, respectively. It is weakly acid to weakly alkaline in reaction. About 1000 to 1500 ml are secreted daily.

Saliva serves several purposes in digestion: (1) it moistens and softens the food, thus assisting in mastication; (2) the mucin lubricates and assists the food in its passage down the esophagus; (3) the amylase acts upon cooked starch and changes it to the sugar, maltose. However, there is not a great deal of chemical change brought about in the starches, owing to the limited time they remain in the mouth.

Food does not remain in the mouth long enough to become completely liquefied, but it is softer and more easily swallowed. Peristaltic constrictions occur in the walls of the esophagus which propel the mass into the cardiac region of the stomach.

Table 3–1. Summary of Digestive Enzymes

Enzyme	Secreted by	Substrate	Products of Enzyme Activity
Salivary amylase (ptyalin)	Salivary glands	Cooked starch	Dextrins and maltose
Rennin	Gastric mucosa	Milk casein	Calcium caseinate
Pepsin		Protein	Proteoses and peptones
Lipase		Emulsified fats	Fatty acids and glycerol
Trypsin	Pancreas	Protein	Proteoses, peptones, polypeptides
Chymotrypsin		Protein	Proteoses, peptones, polypeptides
Pancreatic amylase (amylopsin)		Cooked and raw starch	Dextrins and maltose
Pancreatic lipase (steapsin)		Fats	Simple glycerides, fatty acids, glycerol
Enterokinase	Intestinal mucosa	Trypsinogen	Trypsin
Peptidases (erepsin—a group of enzymes)		Peptones, polypeptides, dipeptides	Amino acids
Nuclease—a group of enzymes		Nucleic acid and derivatives	Phosphoric acid, carbohydrates, purine, and pyrimidine bases
Invertase (invertase)		Sucrose	Glucose and fructose
Maltase		Maltose	Glucose
Lactase		Lactose	Glucose and galactose

Digestion in the stomach. The fundus of the stomach serves as a reservoir for food (see Figure 3–1). Food coming into the stomach expands the stomach walls, and each addition pushes the mass preceding it forward toward the central part of the organ. Digestion of starch which was begun in the mouth is continued in the center of the food mass for one-half hour or more. Salivary amylase reacts best in a faintly alkaline to faintly acid medium but is quickly inactivated as the food mass is mixed with the strongly acid gastric juice.

Small regular contractions begin at about the middle of the stomach and increase in rate and intensity as digestion progresses. As a result, the food is broken up still further, mixed with the gastric juice, and finally reduced to a thin souplike composition called *chyme*. The deep peristaltic wave which carries the food toward the pylorus has its beginning in the central portion of the stomach. The pyloric valve which separates the stomach from the small intestine opens from time to time to allow chyme to pass through.

The emptying time of the stomach depends upon the character, type, and amount of food eaten. Liquids begin to leave the stomach in from 15 minutes to ½ hour, a fact which explains why liquid diets do not have great satiety value. Carbohydrates, when eaten alone, leave the stomach more rapidly than do proteins. Fats check the secretion of gastric juices and retard peristaltic movement, and consequently they remain in the stomach longer than the other nutrients. Mixtures of the three nutrients remain longest in the stomach. A

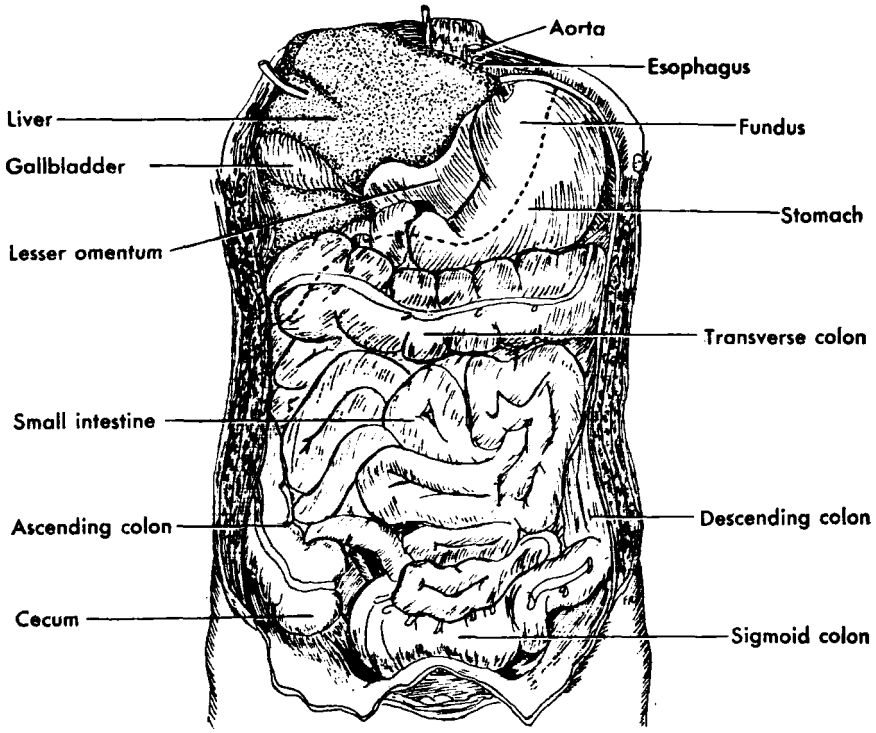


FIG. 3–1. The stomach and intestines, front view, the great omentum having been r moved and the liver turned up and to the right. The dotted line shows the normal positio of the anterior border of the liver. (*From Kimber, D. C., Gray, C. E., Stackpole, C. E Leavell, L. C., and Miller, M. A.:* Anatomy and Physiology, *15th ed. The Macmilla Company, New York, 1966.*)

normal stomach should empty itself in from 4 to 6 hours. A small meal shoul pass out of the stomach in from 1 to 4 hours. Longer than 7 hours' emptyin time indicates impairment of tone and motility.

Chemical changes in the stomach are brought about by the action of th gastric juice which is secreted by cells in the middle region of the stomacl Psychic stimulation of secretion of the juice is started by the sight, odo taste, or thought of food. Further secretion occurs as food enters the stomacl Gastric juice is made up of water, mucinlike proteins, hydrochloric acid, i organic salts, and the enzymes rennin, pepsin, and lipase. Rennin and peps are secreted in their inactive forms, prorennin and pepsinogen. The *intrins factor* essential for the absorption of vitamin B_{12} is also a constituent of gastr juice. The amount of gastric juice secreted depends upon the amount ar nature of the food to be digested. Gastric juice has a strong acid reactio equivalent to 0.1 normal solution (0.4 per cent) of hydrochloric acid.

Hydrochloric acid serves several purposes in digestion: (1) it swells th protein, making it more easily acted upon by the enzymes; (2) it conve

inactive pepsinogen and prorennin to active pepsin and rennin, respectively; (3) it brings about the inversion of cane sugar, making the disaccharide more easily convertible into the monosaccharide in the intestine; (4) it serves as a disinfectant, destroying some of the bacteria which enter the stomach with food; (5) it stimulates the opening of the pyloric valve in the early stage of digestion; and (6) it provides the correct reaction for the absorption of iron.

The chief digestive change in the stomach is the partial hydrolysis of proteins to proteoses and peptones through the action of protease, pepsin. Although gastric juice contains a lipase, its action in the stomach is not important.

Digestion in the small intestine. There are two types of movement in the small intestine: (1) peristaltic waves and (2) rhythmic segmentation. Peristaltic waves carry the food mass slowly down the tract, while the segmentary wave divides the food mass into numerous segments (see Figure 3–2). This process not only mixes the food with the juices, allowing the enzymes free access to the nutrients present, but also spreads the digested materials over a large portion of the absorbing intestinal wall. The unabsorbed contents of

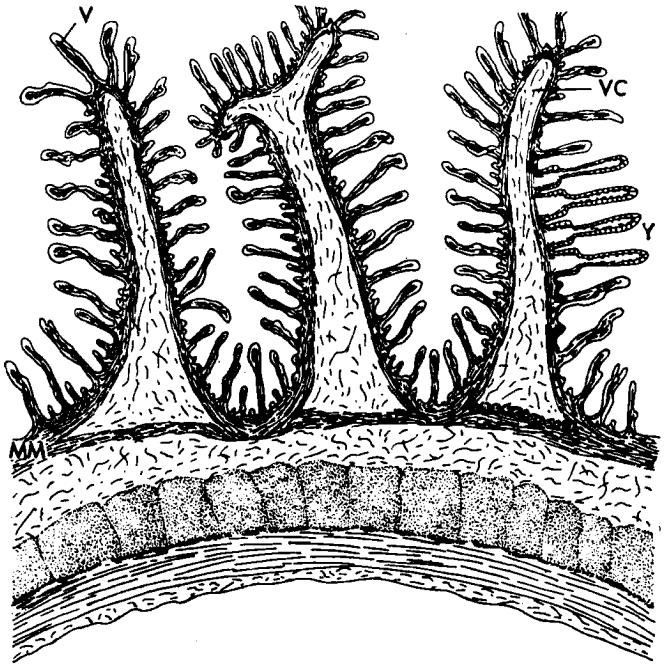


FIG. 3–2. Longitudinal section of small intestine. Three valvulae conniventes (*VC*) are shown. Many villi (*V*) are shown on the valvulae and between them. At *Y* four villi with glands between them have been diagrammed; (*MM*) muscularis mucosae. *From Kimber, D. C., Gray, C. E., Stackpole, C. E., Leavell, L. C., and Miller, M. A.:* Anatomy and Physiology, *15th ed. The Macmillan Company, New York, 1966.*)

the small intestine begin to pass through the ileocecal valve (the valve dividing the small from the large intestine) in from 2 to 5½ hours. From the time of eating, 9 hours or more are required for the last of a large meal to pass into the large intestine. Fiber, by reason of the pressure it exerts upon the intestinal walls, has a tendency to stimulate peristalsis, thus promoting elimination of waste material.

As chyme enters the intestine, it contains partially hydrolyzed proteins, chiefly proteoses and peptones; carbohydrates in various stages of hydrolysis including incompletely digested starch, dextrins, sugars, and cellulose; and fats, a few of which are emulsified. Digestion in the small intestine is the result of the simultaneous action of bile and the enzymes secreted in the pancreatic and intestinal juices. Since the pancreatic and bile ducts open into the intestine only a few inches beyond the pylorus, the digestive juices quickly neutralize chyme acidity and maintain the appropriate alkaline reaction for the intestinal enzymes.

Bile is secreted by the hepatic cells and is concentrated and stored in the gallbladder. The presence of fats in the small intestine causes a hormone *cholecystokinin* to be produced in the intestinal mucosa. This hormone stimulates the contraction of the gallbladder and the flow of bile into the duodenum by way of the common duct. Bile is composed of bile acids, bile pigments, mucin, neutral fats, cholesterol, phosphatides, lecithin, nucleoproteins, and inorganic salts. The bile salts effectively emulsify fats, thus greatly increasing the surface area so that lipase can rapidly bring about hydrolysis to fatty acids and glycerol.

The acid reaction of the chyme stimulates the production in the intestinal walls of a hormone, *secretin,* which is carried by the blood stream to the pancreas. Secretin in turn stimulates the cells of the pancreas to secretory activity. The pancreatic and intestinal enzymes complete the digestion to the end products, namely, simple sugars; fats, fatty acids, and glycerol; and amino acids. (See also Chapters 5, 6, and 7.)

Functions of the large intestine. Most of the available nutrients are absorbed from the small intestine. The cecum fills slowly, and the waves which carry the mass toward the rectum, together with the antiperistaltic waves which force it back, spread the mass over the absorbing walls of the large intestine, thus giving the unabsorbed material an opportunity to pass through the walls of the large intestine. Considerable amounts of water from the digested food mass, including the digestive juices, are absorbed from the large intestine.

The emptying time of the large intestine depends upon the amount and type of food eaten. Concentrated foods leaving little residue stay a longer time in the colon than foods rich in fiber, the increase in bulk acting as a stimulus to the muscular contractions which constitute evacuation, or normal bowel movement. The feces contain not only the residues of food digestion but also dead and live bacteria, residues from the digestive juices, and certain wastes of metabolism.

There are no enzymes of digestion in the large intestine; the secretions there show much mucin and are alkaline in reaction.

Factors affecting digestion. The term "digestibility" generally refers to the comfort or ease of digestion and to the rapidity with which food leaves the stomach rather than to the completeness of its digestion. Therefore, any factor that either speeds up or slows down the emptying time of the stomach may be considered influential in digestion.

CONSISTENCY, DIVISION, AND TYPE OF FOOD. Foods that need little if any breaking up before they are ready to be absorbed may be said to be readily digestible. For example, liquids leave the stomach rapidly and are more quickly available for absorption than are foods requiring mechanical division. Mastication plays an important part in digestion because it stimulates the flow of saliva, which softens the finely divided food and makes it accessible to the action of the enzymes which occur in the digestive juices. The amount and type of food taken at one time affect digestion. Fats digest slowly and when taken with other foods have a tendency to retard their digestion also. Of the carbohydrate foods, those rich in sugar digest quickly and completely, leaving no residue in the intestinal tract, while the starchy foods, though almost completely digested, pass through the tract more slowly. Foods rich in cellulose digest more slowly than those free from fiber, the cellulose itself not being digested at all. Cellulose adds bulk to the food mass, however, and stimulates its passage down the tract.

BACTERIAL ACTION. Bacteria of various types inhabit the human alimentary tract shortly after birth and become so firmly established therein that they are considered almost a part of it. The types most commonly found are (1) fermentative, (2) putrefactive, and (3) bacteria of coli type. The latter exhibit characteristics of both the other types. Under normal conditions there is not much bacterial action in the stomach since the hydrochloric acid acts as a germicidal agent. However, when there is a decrease in the acid secretion, fermentative bacteria may grow rapidly, especially when excessive amounts of carbohydrate are taken.

Much fermentation of carbohydrate residues and putrefaction of protein residues occurs in the large intestine, but these reactions cause no trouble under normal conditions.

CHEMICAL FACTORS. Strong acids, meat extractives, spices, caffeine, and other substances stimulate the flow of juices in the stomach, while fats retard the flow.

PSYCHIC FACTORS. Anger, fright, and worry delay digestion by reason of their depressing effect upon the secretions. The first two emotions take immediate effect, slowing down or even stopping temporarily the process of digestion, while worry is probably responsible for a more lasting as well as more detrimental effect because it interferes with general nutrition by depressing normal appetite. On the other hand, the sight, smell, and taste of palatable food stimulate the nerves and cause a flow of saliva in the mouth and of gastric juice in the stomach.

COEFFICIENT OF DIGESTIBILITY. Although many factors may influence the comfort of digestion, the completeness of digestion is not necessarily so influenced. The coefficient of digestibility is a measure of food absorbed in relation to food consumed. For example, if the feces contain 5 per cent of the fat of the diet, the coefficient of digestibility is said to be 95 per cent. Although there are variations among foods, in general the coefficient of digestibility for protein is 92 per cent; for fat, 95 per cent; and for carbohydrate, 98 per cent.

ABSORPTION AND INTERMEDIARY METABOLISM

Absorption. Almost all of the soluble nutrients are absorbed from the small intestine. Absorption is a selective process in which the end products of digestion are permitted to enter the circulation. The four or five million *villi* or tiny, finger-like projections which constitute the walls of the small intestine, together with the great length of this organ, give an enormous area from which absorption can take place. Each villus is supplied with (1) capillaries, (2) lacteals which are part of the lymphatic system, and (3) tiny muscles which contract to mechanically assist absorption. The almost continuous contractions of the intestinal wall force the blood and lymph containing the nutrients into the general circulation, while relaxation allows fresh blood and lymph to collect more nutrients.

Absorption is accomplished, in part, by a simple diffusion of nutrients into the circulation and in part by active transport as a result of chemical transformations which speed up the rate. Amino acids, simple sugars, and some short-chain fatty acids, and water-soluble vitamins and minerals are carried to the liver by the portal circulation, while fats are transported by the lymphatics to the thoracic duct where they enter the blood circulation in the left subclavian vein.

Intermediary metabolism. The physical and chemical changes that occur in the body are the sum total of the activities occurring within each cell. One may think of the cell as being a chemical factory, for literally thousands of reactions take place within each of them. The nature of the activities as well as the physical make-up of the cell vary greatly. For example, the cells in liver, muscle, skin, nails, and nerves are not only different as viewed under a microscope, but they are equally varied in their functions.

Each cell is dependent upon its external environment for its existence. The nutrients diffuse from arterial capillary blood into the interstitial fluid surrounding the cells and thence into the cells. Likewise, the cells dispose of waste materials to the interstitial fluid and in turn to the venous circulation.

The enzyme systems of a given cell determine the specific functioning of that cell. A compound—for example, glucose—which is to be utilized by the cell is attacked by one enzyme after another in assembly-line fashion until the desired end product has been achieved. If a single enzyme in the cell is missing,

there is a breakdown in the assembly line and all sorts of problems may arise. During the last decade a better understanding of enzyme activities has led to the identification, and in some cases effective treatment, of the so-called inborn errors of metabolism seen in far too many infants. The condition *galactosemia* results from the lack of a specific enzyme needed for using galactose. *Lactose intolerance* may be caused by the absence of the enzyme lactase in the small intestine.

THE METABOLIC POOL. The term *metabolic pool* is often used to refer to the total supply of a given nutrient that is momentarily available for synthetic purposes. For example, the metabolic pool of amino acids at any given moment would include all the amino acids available from the diet plus all the amino acids available through the breakdown of cells. From this mixture of amino acids the cells have available the appropriate ones for synthesizing a new protein. The metabolic pool should not be thought of as having specific physical boundaries from which materials may be drawn, but rather as constituting the environment for specific tissues.

DYNAMIC EQUILIBRIUM. Cellular materials are continually being broken down (catabolism) and are equally rapidly synthesized (anabolism). The rate of cellular turnover in some body tissues is exceedingly high. For example, the liver cells are completely replaced about every ten days or so; the mucosal wall of the intestine has an equally rapid rate of turnover. In spite of this remarkable rate of turnover, the body tends to maintain a state of equilibrium, which is often referred to as a state of *dynamic equilibrium* or *homeostasis*. The maintenance of equilibrium is governed by an adequate supply of nutrients, by a normal complement of enzyme systems, and by the secretion of hormones that regulate metabolic rates. These topics will be discussed in greater detail in the chapters which follow.

PROBLEM AND REVIEW

1. What is meant by the following terms: digestion; coefficient of digestibility; peristalsis; segmentation?
2. An enzyme is a catalyst produced by living cells. Name five characteristics of enzymes.
3. In what way does the chewing of food aid digestion in the stomach?
4. It is important that foods be attractively served. How does this facilitate good digestion.
5. Pepsin is a proteolytic enzyme which is secreted by the gastric mucosa as a proenzyme, pepsinogen. How is the pepsinogen activated? What is the substrate on which pepsin acts?
6. Many pediatricians permit children to have foods such as fruit and bread or crackers between meals but advise against the use of milk for such feedings. Why would milk be more likely to interfere with the appetite for the following meal?
7. In what ways would a deficient secretion of hydrochloric acid interfere with digestion?
8. *Problem.* A meal consisted of 25 gm protein, 35 gm fat, and 50 gm carbohydrate. Using the coefficients of digestibility typical of American diets, calculate the amounts that would be actually absorbed.
9. What conditions are necessary so that the tissues can maintain homeostasis?

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Chapter 4

DIETARY GUIDES AND THEIR USES

STANDARDS FOR DIETARY ALLOWANCES

Recommended Dietary Allowances. Late in 1940, the Food and Nutrition Board of the National Research Council was organized to guide the government in its nutrition program. One of the first activities of this board was the careful review of research on human requirements for the various nutrients. This research led to the publication of the Recommended Dietary Allowances in 1943. Since that time the board has continued to function in the evaluation of new research on nutritional needs and has published revisions of the standards in 1945, 1948, 1953, 1958, and 1963. In the most recent bulletin* the purposes and intended uses of the allowances are stated as follows:

> . . . These formulations were designated "Recommended Dietary Allowances" in order to indicate that they were value-judgments based on the existing knowledge of nutritional science and subject to revision as new knowledge became available. The allowances are intended to serve as goals toward which to aim in planning food supplies and as guides for the interpretation of food consumption records of *groups* of people. Actual nutritional status of groups of people or individuals must be judged on the basis of physical, biochemical, and clinical observations combined with observations on food or nutrient intakes. If the recommended allowances are used as reference standards for interpreting records of food consumption, it should not be assumed that food practices are necessarily poor or that malnutrition exists because the recommendations are not completely met. . . .
>
> . . . The allowances recommended are those which, in the opinion of the Food and Nutrition Board, will maintain good nutrition in essentially all healthy persons in the United States under current conditions of living.
>
> . . . For proper understanding, application, and interpretation of the recommended allowances, it is necessary to appreciate how the allowances are related to estimates of average physiological requirements.

* Food and Nutrition Board: *Recommended Dietary Allowances—Sixth Revised Edition, 1964*. Pub. 1146. National Academy of Sciences, National Research Council, Washington, D.C., 1964, p. v.

The allowances are designed to afford a margin of sufficiency above average physiological requirements to cover variations among essentially all individuals in the general population. They provide a buffer against the increased needs during common stresses and permit full realization of growth and productive potential; but they are not to be considered adequate to meet additional requirements of persons depleted by disease or traumatic stresses. On the other hand, the allowances are generous with respect to temporary emergency feeding of large groups under conditions of limited food supply and physical disaster.

The margin of sufficiency above normal physiological requirements is different for each nutrient because of differences in the body storage capacity, in the range of individual requirements, and in the possible hazard of excessive intake of certain nutrients.

Patterns of food consumption and food supplies in the United States permit ready adaptation to and compliance with the recommended allowances. The final objective of the recommended allowances is to permit and to encourage the development of food practices by the population of the United States that will allow for greatest dividends in health and in disease prevention.

A statement of the correct interpretation of these allowances concludes the description presented in the bulletin:*

The recommended dietary allowances have been used widely both here and abroad as official guides in planning nutritionally adequate diets for population groups. They have also been used widely as a guide in the interpretation of the adequacy of nutrient intakes of individuals in dietary surveys of population groups. As stated in the Introduction, allowances should serve only as a reference, and deviations of individual intakes from the recommended nutrient allowances are significant only in terms of the individual's total health status. In determining the nutritional status of an individual, the current and past nutrient intake, as well as nutrient tissue level, urinary level, and clinical signs and symptoms, must be fully evaluated. Because, as already emphasized, the nutrient allowances are intended to meet the needs of essentially all individuals in the population, it is self-evident that they are in excess of need for the majority of the individuals in such a population.

The student should form the habit of referring to Table 4–1 when planning diets for individuals in various categories. The "reference" man and woman weigh 70 and 58 kg, respectively, and are considered to be 25 years of age, to live in a temperate climate, and to be moderately active. Adjustments would be made for body size, for change in environment, and for change in activity.

The bulletin by the Food and Nutrition Board[1] gives a full description of the bases for establishing these recommendations and also includes a discussion of the needs for many nutrients such as fat, carbohydrate, water, and many minerals and vitamins not listed in the table. When diets are planned to meet the recommended levels set forth in the table, it is safe to assume that the body's needs for the nutrients not listed will also be met. The allowances for specific nutrients, and factors which modify the needs, are discussed in succeeding chapters.

* *Ibid.*, p. 46.

Table 4–1. Food and Nutrition Board, National Research Council Recommended Daily Dietary Allowances, Revised 1963.[1]

Designed for the Maintenance of Good Nutrition of Healthy Persons in the U.S.A.
(Allowances are intended for persons normally active in a temperate climate)

	Age[2] years	Weight kg (lb)	Height cm (in.)	Calories[3]	Protein gm	Calcium gm	Iron mg	Vitamin A I.U.	Thiamine mg	Riboflavin mg	Niacin[4] mg equiv	Ascorbic Acid mg	Vitamin D I.U.
Men	18–35	70 (154)	175 (69)	2900	70	0.8	10	5000	1.2	1.7	19	70	
	35–55	70 (154)	175 (69)	2600	70	0.8	10	5000	1.0	1.6	17	70	
	55–75	70 (154)	175 (69)	2200	70	0.8	10	5000	0.9	1.3	15	70	
Women	18–35	58 (128)	163 (64)	2100	58	0.8	15	5000	0.8	1.3	14	70	
	35–55	58 (128)	163 (64)	1900	58	0.8	15	5000	0.8	1.2	13	70	
	55–75	58 (128)	163 (64)	1600	58	0.8	10	5000	0.8	1.2	13	70	
		Pregnant		+ 200	+20	+0.5	+5	+1000	+0.2	+0.3	+3	+30	400
		Lactating		+1000	+40	+0.5	+5	+3000	+0.4	+0.6	+7	+30	400
Infants[5]	Up to one year	8 (18)		kg × 115 ± 15	kg × 2.5 ± 0.5	0.7	kg × 1.0	1500	0.4	0.6	6	30	400
Children	1–3	13 (29)	87 (34)	1300	32	0.8	8	2000	0.5	0.8	9	40	400
	3–6	18 (40)	107 (42)	1600	40	0.8	10	2500	0.6	1.0	11	50	400
	6–9	24 (53)	124 (49)	2100	52	0.8	12	3500	0.8	1.3	14	60	400
Boys	9–12	33 (72)	140 (55)	2400	60	1.1	15	4500	1.0	1.4	16	70	400
	12–15	45 (98)	156 (61)	3000	75	1.4	15	5000	1.2	1.8	20	80	400
	15–18	61 (134)	172 (68)	3400	85	1.4	15	5000	1.4	2.0	22	80	400
Girls	9–12	33 (72)	140 (55)	2200	55	1.1	15	4500	0.9	1.3	15	80	400
	12–15	47 (103)	158 (62)	2500	62	1.3	15	5000	1.0	1.5	17	80	400
	15–18	53 (117)	163 (64)	2300	58	1.3	15	5000	0.9	1.3	15	70	400

[1] The allowance levels are intended to cover individual variations among most normal persons as they live in the United States under usual environmental stresses. The recommended allowances can be attained with a variety of common foods, providing other nutrients for which human requirements have been less well defined. See forthcoming text for more detailed discussion of allowances and of nutrients not tabulated.

[2] *Entries on lines for age range 18–35 years represent the 25-year age. All other entries represent allowances for the midpoint of the specified age periods, i.e.,* children 1–3 years is for age 2 years (24 months); 3–6 years is for age 4½ years (54 months); and so on.

[3] See text for caloric adjustments for weight and age.

[4] Niacin equivalents include dietary sources of the preformed vitamin and the precursor, tryptophan (60 mg. tryptophan equal 1 mg. niacin).

Dietary guides in other countries. The Committee on Nutrition of the British Medical Association has published dietary standards since 1933.[2] These standards are intended to maintain good nutrition in representative individuals or groups, and are set up in terms of six activity categories for men and five for women. Substantially, the recommendations for nutrient levels are similar to those in the United States, except that in the United Kingdom the allowance for ascorbic acid for the adult has been set at 20 mg.

The Canadian Council on Nutrition[3] has published a revised standard to be used for planning diets for groups of healthy individuals. For adults the standards are set up for three weight levels for men and women, based upon desirable weight at age 25 years. For each of the weight levels the energy allowance and the corresponding needs for thiamine, riboflavin, and niacin have been set up for five activity categories. The standards are considered to be adequate for the maintainance of good health by the majority of Canadians, while the standards in the United States are considered to provide a large enough margin for practically all individuals in the population. By comparison, the Canadian standards are lower in all nutrient categories. For example, for a woman weighing 124 pounds, the allowances are protein, 39 gm; calcium, 0.5 gm; iron, 10 mg; vitamin A, 3700 I.U.; thiamine, 0.7 mg; riboflavin, 1.2 mg; niacin, 7 mg; ascorbic acid, 30 mg; calories, 2400.

The Food and Agriculture Organization has published tables of calorie and protein requirements.[4,5] Many countries have set up standards for nutrient intake and food guides adapted to the local needs and food resources.

Labeling guide. For the purpose of labeling foods—especially those for which some therapeutic claims are made—the federal Food and Drug Administration many years ago set up a table of Minimum Daily Requirements. The nutrient levels in this table differ in many respects from the Recommended Dietary Allowances; moreover, they are not necessarily "minimum" in the context of body requirements. Consequently, consumers find the interpretation of nutrient data on labels of food products to be confusing. A proposal is now under consideration whereby the Food and Drug Administration would use the Recommended Dietary Allowances as the guide for labeling purposes.

A DAILY FOOD GUIDE

Foods as sources of nutrients. Some foods are desirable because they promote all three functions of food, while others contribute primarily to energy production. Even a food like milk, which is generally considered to be the most nearly perfect food, does not contain all the food constituents in optimum amounts. Milk is an excellent source of protein for tissue building, it provides more calcium than any other food for bone and tooth formation, and it gives the most abundant supply of riboflavin. In other minerals and vitamins, too,

milk is relatively rich. However, its ascorbic acid content is low, so that the need for citrus fruits or tomato, which are vitamin-C-rich foods, becomes readily apparent. If one goes further, he can see that additional iron is needed because milk does not supply much of it; thus, the place of egg, green leafy vegetables, fruits, and meats becomes evident. One could continue in this manner to analyze each of the foods. A variety of foods becomes one of the best guarantees that a diet will be adequate.

All foods provide for the energy needs of the body. Some foods which have a high concentration of fats and carbohydrates are high in calories; other foods with a high proportion of water, such as fruits and vegetables, are relatively low in calories.

Four Food Groups. A standard such as the Recommended Dietary Allowances is of practical value only when it is interpreted into a selection of foods to meet the recommended levels. This may be accomplished through dietary calculations as described in the next section of this chapter. However, simple guides for the public are essential, and these have been developed by nutrition committees of government agencies and others.

One of these guides, "A Daily Food Guide" (Table 4–2, and Figure 4–1),

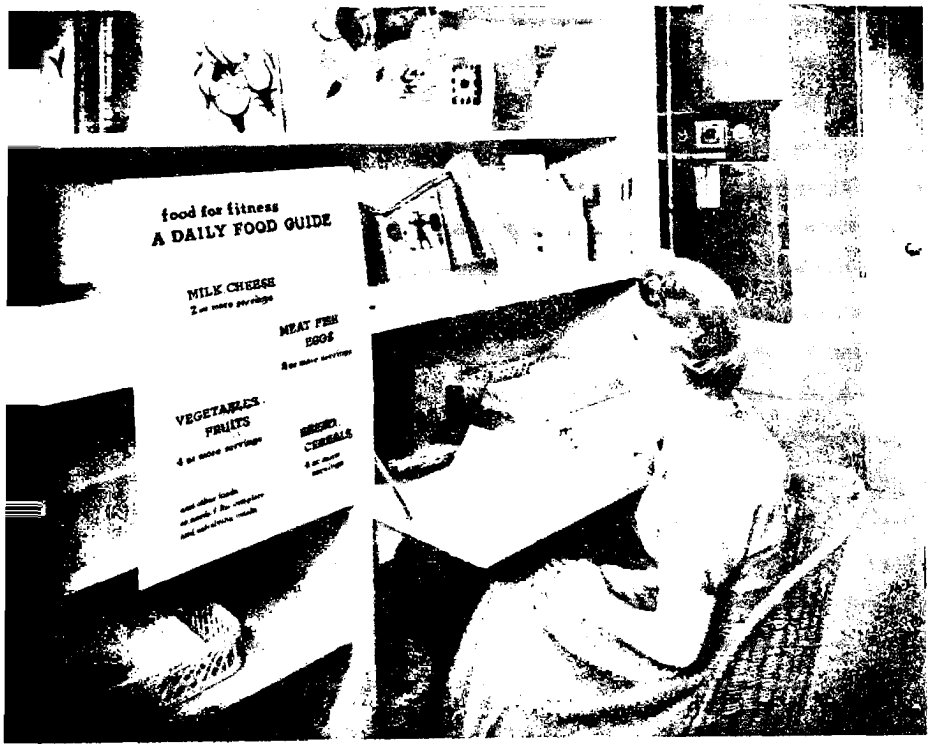


FIG. 4–1. Selecting foods from the Four Food Groups of the Daily Food Guide helps to ensure nutritious meals. (*Courtesy, U.S. Department of Agriculture.*)

Table 4–2. A Daily Food Guide*

Milk group (8-ounce cups)
2 to 3 cups for children under 9 years
3 or more cups for children 9 to 12 years
4 cups or more for teen-agers
2 cups or more for adults
3 cups or more for pregnant women
4 cups or more for nursing mothers
Meat group
2 or more servings. Count as one serving:
2 to 3 ounces lean, cooked beef, veal, pork, lamb, poultry, fish—without bone
2 eggs
1 cup cooked dry beans, dry peas, lentils
4 tablespoons peanut butter
Vegetable-fruit group (1/2 cup serving, or 1 piece fruit, etc.)
4 or more servings per day, including:
1 serving of citrus fruit, or other fruit or vegetable as a good source of vitamin C, or 2 servings of a fair source
1 serving, at least every other day, of a dark-green or deep-yellow vegetable for vitamin A
2 or more servings of other vegetables and fruits, including potatoes
Bread-cereals group
4 or more servings daily (whole grain, enriched, or restored). Count as one serving:
1 slice bread
1 ounce ready-to-eat cereal
1/2 to 3/4 cup cooked cereal, corn meal, grits, macaroni, noodles, rice, or spaghetti

*"A Daily Food Guide" in *Consumers All*, Yearbook of Agriculture, 1965, U.S. Department of Agriculture, Washington, D.C., 1965, p. 394.

has been recently revised by nutrition specialists in the U.S. Department of Agriculture[6] to conform to the 1963 Recommended Dietary Allowances. The Four Food Groups provide a foundation for a day's meals and include food choices which permit flexibility for seasonal, regional, and budgetary considerations. The specific nutrient contributions made by foods in each of the Four Food Groups will be discussed in the chapters on the nutrients (see also Table 14–2 for calculations).

The basic diet. The minimum number of servings for the adult of each of the Four Food Groups will be used as a basis for dietary planning throughout this text. The protein, mineral, and vitamin needs are substantially met by this plan (see Table 14–2), while the caloric levels are approximately sufficient for the basal metabolism. The size of the portion will obviously need to be modified for preschool and school children and for teen-agers to provide the correct amounts of the various nutrients.

To fully meet the energy needs, additional foods may be selected from the fats, sweets, or from one or more of the four groups. The nutrient intake will remain essentially at the level calculated for the basic diet if additional energy is provided chiefly from fats and sweets, but the further selection of foods from one or more of the four groups will substantially increase the nutritive value of the diet.

Eleven food groups. The Daily Food Guide is easily remembered and provides a convenient way to plan for the inclusion of foods that are nutritionally essential. However, when food plans are to be developed at various cost levels, a guide is required that includes all food groups, including fats and oils and sugars and sweets. Nutritionists of the U.S. Department of Agriculture have developed food plans at five cost levels for 20 age-sex categories, using eleven food groups. (See also Chapter 17.)

A comparison of the Four Food Groups and of the Eleven Food Groups is presented in Table 4–3 for women 18 to 35 years of age. It should be especially noted that the recommendations for servings of food from the Four Food Groups are on a daily basis of consumption, while the recommendations from the Eleven Food Groups are on a weekly basis of food purchases. The latter would make allowance for usual waste encountered in preparation prior to consumption.

Table 4–3. Comparison of Four Food Groups and Eleven Food Groups
(Based upon allowances for woman 18–35 years)

Four Food Groups	Daily Allowance	Eleven Food Groups (Moderate-Cost Plan)*		Daily Allowance
Milk group	2 cups	Milk, cheese, ice cream	qt	3½
Meat group	2 servings	Meat, poultry, fish	lb–oz	4–12
		Eggs	—	8
		Dry beans, peas, nuts	lb–oz	0–4
Vegetable-fruit group				
Good source of vitamin C	1 serving	Citrus fruit, tomatoes	lb–oz	2–4
Dark-green and deep-yellow vegetables	1 serving	Dark-green and deep-yellow vegetables	lb–oz	1–8
Other vegetables and fruits	2 servings	Potatoes	lb–oz	1–8
		Other vegetables and fruits	lb–oz	5–12
Bread-cereal group	4 servings	Flour, cereals, baked foods	lb–oz	2–4
		Fats, oils	lb–oz	0–8
		Sugars, sweets	lb–oz	0–14

* See Table 17–2 for Moderate-Cost Food Plan.

COMPOSITION OF FOODS

Factors affecting food composition. The nutritive values of foods are determined, for the most part, by chemical methods. In some instances, such as the

determination of vitamin D or the evaluation of digestibility, animal feeding (bioassay) is used. Certain of the B vitamins and some of the amino acids are best determined by observing the reproduction, or selected metabolic processes, of microorganisms (microbiologic assay).

The values for nutrients in tables of food composition are customarily expressed as averages of analyses of food samples. For some nutrients numerous analyses have been made, while for other nutrients the number of determinations has been much more limited. Obviously, the actual nutritive value of a food may be expected to vary more or less widely from the average. Some of the more important factors which account for variation in food composition are discussed briefly below.

The nature of the soil might be expected to produce variations in the composition of foods. However, at the present time, the only correlation that has been fully established is that a low-iodine content of the soil is reflected in a low-iodine content of foods. The quantity of vitamins, or of other nutrients, has been found to be largely independent of the soil composition. Contrary to certain cultists who criticize the use of chemical fertilizers and who emphasize so-called organic farming, Maynard[7] presented evidence that soils that are chemically fertilized are highly productive of foods of good nutritive value.

The variety of plant and the climate are important determinants of nutritive value. The latter cannot be controlled, but nutritionists and agriculturists know that the selection of the appropriate variety of plant may be a vital consideration for dietary adequacy in those parts of the world where the food supply is otherwise poor.

The conditions of storage may modify the nutritive value of foods. Some nutrients such as ascorbic acid are rapidly lost when the temperature is high or when foods are bruised. Other nutrients may be lost to a varying degree but not quite so readily as ascorbic acid.

Divergent procedures in food preparation are major factors that affect the nutritive value of a food as it is consumed. Losses in food preparation may be brought about through solubility of the nutrient in water, or through destruction of the nutrient. The latter is increased with high temperature and is also dependent upon the pH of the medium in which it is cooked. The amount of peelings removed, the size of pieces subjected to cooking, the temperature used, the length of time for cooking, the amount of water used, the length of time food is held after cooking—as on a steam table—are but a few of the many variables which may result in wide differences between two foods that were identical at the start of the cooking procedure.

Processing techniques may enhance or interfere with the nutritive value of foods. Dehydration, canning, and freezing yield foods of high nutritive value, but each, in certain ways, modifies somewhat the nutrient contribution of a given food. No doubt this list could be lengthened, but it should suffice to emphasize to the student that any given value represents an approximation and not a precise value.

Tables of food values. In view of the foregoing discussion, one might be tempted to ask what values there are in using a table of food composition. First, the tables serve as a basis for comparing one food with another; for example, milk is clearly seen to be the best source of calcium. Although we would not expect every medium-sized orange to provide *exactly* the same number of milligrams of ascorbic acid, the tables do give information which makes it safe to say that oranges, let us say, are a better source of the vitamin than applesauce. Second, the use of tables provides a means whereby the adequacy of diets may be estimated although not precisely stated. Thus, the legitimate use of tables necessitates an understanding of their values in assessing nutritive values of foods and diets as well as an appreciation of the limitations.

The nurse, dietitian, and home economist will find consistent use of tables of food composition essential for intelligent planning of diets. Moreover, the tables provide a ready reference to answer numerous questions concerning the nutritive value of foods, and thus they are, in themselves, an effective means for counteracting food misinformation.

The several tables of food values in the Appendix have been derived from compilations made from time to time, chiefly by investigators in the U.S. Department of Agriculture. Just as the purchase of food involves certain units of measure such as ounces, pounds, pints, quarts, so the amount of nutrients in a food is expressed in certain units—grams (gm), milligrams (mg), sometimes micrograms (mcg), and international units (I.U.). In Table A–1 of the Appendix the nutritive values are expressed for the edible part of household portions of food, thus making it simple to determine the contribution of full or fractional portions of food. Other tables give the nutritive values for 100 gm edible portion of food.

DIETARY EVALUATION

Purposes of dietary evaluation. Before beginning the evaluation of any diet, the goals to be achieved must be set, since the nature of the study is thereby determined. A dietary evaluation may be qualitative—that is, through questioning of the subject it may be established that certain kinds of foods are, or are not, being included; recommendations for dietary improvement can often be made on such a basis without the necessity of detailed calculations.

This section, however, is concerned with dietary calculations, since the student and professional worker must often resort to more quantitative approaches. Food tables may be used for the determination of the adequacy of a particular diet—either normal or therapeutic, or for the control of a specific nutrient such as sodium or fat. The student should keep a number of goals in mind as she acquires experience in the calculation of diets, since she may otherwise become discouraged at the amount of time involved in the mechanics

of arithmetic! She must remember that the calculations are merely a means to an end. Among the outcomes from experience in dietary calculations are the following:

1. A greater consciousness of food habits and their relation to nutrition and health;
2. Familiarity with tables of food composition and the kinds of information they provide;
3. Facility in using food tables whether to calculate a complete dietary or to seek specific answers concerning nutritive values of a single food;
4. Knowledge concerning the important sources of each of the nutrients;
5. Ability to make recommendations for the improvement of dietaries based upon the calculation of dietary intakes;
6. Appreciation of the importance of keeping orderly and accurate records of dietary intake so that any calculations may be as reliable as possible;
7. The habits of preparing neat and concise reports which have been carefully checked for their accuracy so that co-workers may use the information with complete confidence.

Calculation of the nutritive value of a diet. The method described below may be applied to the diet for a day, for one meal, or for a recipe. It may be used for the calculation of a single nutrient such as protein or for all nutrients listed in a given table. Sample calculation of a breakfast is shown in Table 4–4 and illustrates the procedures to be used.

1. Study the arrangement of Table A–1, noting especially the units of measure for each nutrient.
2. Keep an accurate record, in household measures, of the foods eaten at each meal. Record the information directly after each meal if at all possible; do not rely on the memory. Include any foods or beverages taken between meals. Specify the exact kinds of foods eaten. In the example given note the descriptive terms: *scrambled* eggs; *cooked* prunes; *light* cream; *enriched* toast. These descriptions enable anyone who is making the evaluation to select the correct items from the table of food composition.
3. If the evaluation is for an entire day, list the total amount, in household measures, for the same foods eaten at different meals. For example: one slice enriched bread at breakfast, ¾ slice at lunch, and ½ slice at dinner would be recorded on the calculation sheet as 2¼ slices.
4. Calculate the nutritive values for each food of the diet or recipe by multiplying the values for the stated portion in Table A–1 by the amounts actually eaten. For example, if 3 cooked prunes are eaten, all nutritive values shown in the table would be multiplied by 1/6, since the values are given for 17 to 18 prunes.
5. When recording the results of your calculations, use only as many decimal places as appear in the original table. For example, 11.3 gm fat is recorded as 11 gm fat; but 11.5 gm fat would be recorded as 12 gm. A calculated value for thiamine of 0.074 mg would be recorded as 0.07 mg since the table lists only two decimal places for thiamine.

Table 4–4. Nutritive Value of a Breakfast

Food	Household Measure	Weight	Energy	Protein	Fat	Carbohydrate	Minerals		Vitamins				
							Ca	*Fe*	*A*	*Thiamine*	*Riboflavin*	*Niacin*	*Ascorbic Acid*
		gm	*calories*	*gm*	*gm*	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*
Prunes, cooked	3	45	49	tr	tr	13	10	0.8	310	0.01	0.03	0.4	tr
Scrambled eggs	2	128	220	14	16	2	102	2.2	1380	.10	.36	tr	0
Bacon, cooked	2 strips	16	100	5	8	1	2	.5	0	.08	.05	.8	—
Toast, enriched	1½ slices	30	90	3	2	18	29	.9	tr	.08	.08	.9	tr
Butter	2 pats	14	100	tr	12	tr	2	0	460	—	—	—	0
Coffee													
Light cream	1 tablespoon	15	30	tr	3	1	15	tr	130	tr	.02	tr	tr
Total			589	22	41	35	160	4.4	2280	.27	.54	2.0	tr
Recommended Dietary Allowances													
Woman, 18–35 years			2100	58			800	15	5000	.8	1.3	14	70
Per cent of RDA			28	38			20	29	46	34	42	14	0

6. Check each of your calculations to be sure it is correct before entering the result on the final calculation sheet.

7. Record all data so that numbers are legible and digits and decimal points are aligned.

8. Total the amount of each nutrient contained in the entire diet or recipe.

9. Compare the actual totals of the diet with the Recommended Dietary Allowances of the individual for whom the evaluation was made. If there are wide deviations between the two, it is especially important to look for possible errors in calculations, misplacement of decimal points, or mistakes in additions.

10. Calculate for each of the nutrients the percentage of the Recommended Dietary Allowances provided by the diet.

11. Summarize the study by listing ways in which the diet can be improved.

PROBLEMS AND REVIEW

1. What is meant by metabolism? What body processes are included in the general use of this term?

2. What is meant by the Recommended Dietary Allowances? Who has prepared this guide?

3. List the recommended allowances for yourself. If a dietary calculation indicated that you were getting less than these allowances in one or more respects, how should you interpret this?

4. State the characteristics of the reference woman. How do you differ?

5. Examine the labeling on a loaf of bread or a package of cereal. Calculate in milligrams the amounts of iron, thiamine, riboflavin, and niacin contained in 1 ounce of the product. What percentage of the Recommended Dietary Allowances for an adult male is provided?

6. List five reasons why two oranges may differ in ascorbic acid content.

7. Two students had hamburger for lunch, each raw hamburger weighing 4 ounces. One student received more calories from her hamburger than did the other. Explain.

8. What is meant by: bioassay; microbiologic assay?

9. Examine the information provided in the sample calculation in Table 4–4. In terms of the Recommended Dietary Allowances:

   a. How would you rate eggs?
   b. For which nutrients would special plans need to be made during the remaining meals of the day?
   c. How does this breakfast rate: good, fair, poor? Explain your answer fully.

PROBLEMS IN THE USE OF FOOD TABLES

10. Examine the tables in the Appendix to become familiar with the information which is available.

11. Using Table A–1, list the five fresh fruits which are the most outstanding sources of vitamin A. In your community, which of these, if any, are not practical for dietary planning?

12. Using Table A–1, calculate the nutritive value of 35 gm nonfat dry milk; 60 gm green beans.

13. Determine from Table A–1 whether whole-wheat bread is superior to enriched white bread.

14. How many eggs must you eat to provide the same amount of calcium as 1 cup of milk? What can you conclude concerning the calcium content of eggs?

15. Which is the least expensive source of ascorbic acid, canned tomato juice or frozen orange juice?

16. Keep a careful record of your food intake for a week. See page 50 for directions.

a. Score your week's diet according to the Daily Food Guide. What food group should you emphasize each day to improve your diet?
b. Select the day most nearly typical of your daily pattern and calculate the nutritive values, using Table A–1. Compare your intake with your recommended allowances.

Keep your evaluation and refer to it from time to time throughout your study of nutrition.

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See also **General References—Tables of Food Composition,** Appendix.

UNIT

The Nutrients: Their Characteristics, Functions, Metabolism, Food Sources, Daily Allowances

Chapter

5 PROTEINS AND AMINO ACIDS

6 CARBOHYDRATES

7 FATS AND FATLIKE SUBSTANCES

8 ENERGY METABOLISM

9 MINERAL ELEMENTS

10 THE FAT-SOLUBLE VITAMINS

11 THE WATER-SOLUBLE VITAMINS: ASCORBIC ACID

12 THE WATER-SOLUBLE VITAMINS: THE VITAMIN-B COMPLEX

13 WATER

Chapter 5

PROTEINS AND AMINO ACIDS

Importance of protein. In 1838 a Dutch chemist, Mulder, described certain organic material which is "unquestionably the most important of all known substances in the organic kingdom. Without it no life appears possible on our planet. Through its means the chief phenomena of life are produced."* Berzelius, a contemporary of Mulder suggested that this complex nitrogen-bearing substance be called *protein* from the Greek word meaning to "take the first place."[1] "Proteins" is now retained as a group name to designate the principal nitrogenous constituents of the protoplasm of all plant and animal tissues; they are necessary for tissue synthesis and in the regulation of certain body functions.

Today, as in Mulder's day, proteins still occupy first place. Protein nutrition of young children is the major nutritional problem of the world.[2] Literally millions of people in parts of Africa, South America, Central America, the West Indies, Europe, and most of Asia are dependent upon the development of more adequate protein resources before they can realize satisfactory nutrition and health. In the United States there is an abundance of protein of good quality, but even here some people do not get enough—usually because of ignorance concerning good food selection.

Chemistry and characteristics. Proteins are extremely complex organic compounds containing the elements carbon, hydrogen, oxygen, nitrogen, and, with few exceptions, sulfur. Most proteins also contain phosphorus, and some specialized proteins contain iron, iodine, copper, and other inorganic elements.

The presence of nitrogen distinguishes protein from carbohydrate and fat. Protein contains an average of 16 per cent nitrogen. The molecular weight of protein varies from 13,000 or less to many millions. These large molecules form *colloidal* solutions which do not readily pass through membranes.

* Mulder, G. J.: *The Chemistry of Animal and Vegetable Physiology.* Quoted in L. B. Mendel, *Nutrition: The Chemistry of Life,* Yale University Press, New Haven, 1923, p. 16.

AMINO ACIDS. The units from which proteins are built are amino acids. Each of the amino acids contains a carboxyl (COOH) or acidic group and an amino (NH_2) or basic group, the latter being on the carbon next to the carboxyl group. By varying the grouping which is attached to the carbon containing the amino group, many different amino acids are possible; for example:

$CH_2(NH_2)\cdot COOH$	Glycine
$CH_3\cdot CH\ (NH_2)\cdot COOH$	Alanine
$CH_2(NH_2)\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH(NH_2)\cdot COOH$	Lysine

Twenty-two different amino acids are widely distributed in proteins (p. 62), while small amounts of four or five additional amino acids have been isolated from one or more proteins.

SPECIFICITY. Proteins are the substances that determine the differences that exist between various species of plants and animals, and between the numerous types of cells and tissues within each organism. Since enzymes are protein in nature, it can also be said that proteins govern the production of numerous nonnitrogenous molecules and the metabolic processes of the organism as a whole.

Every living organism has its unique assortment of proteins that determines its structure and function. That the proteins obtained from plants and animals are quite different both in amount and in quality is well known to every student. That the proteins from one plant species to another or one animal species to another are also different can be appreciated. Perhaps you have wondered why you can bake a light loaf of bread from wheat flour, but that cornmeal gives a heavy breadstuff. The difference lies in the nature of the proteins found in these two cereal flours; wheat proteins yield an elastic quality to the dough, while corn proteins do not possess this elastic quality. Moreover, if you feed wheat proteins to a rat, the animal will maintain its weight, but if you feed corn protein to a rat, the animal is unable to maintain its weight and will eventually die.

One might think that specific proteins such as hemoglobin, insulin, and so forth, would be alike in all species. That this is not so has been shown by an analysis of some proteins for the amino acid composition and arrangement. The insulins from cattle, sheep, pigs, and other animals have been shown to be slightly different in the arrangement of their amino acids. As a result, in some individuals with diabetes mellitus insulin of one species is more useful in treatment than insulin from other species.

The proteins that make up the skin, bones, hair, muscles, and nails in the body are obviously quite different from each other. Likewise, the proteins of liver cells, of hemoglobin, of blood albumin and globulin all differ from one another. If you consider the thousands of enzymes that are responsible for specific actions in the body, the very large number of different proteins in the human body becomes apparent. How is this amazing array of proteins manufactured?

SYNTHESIS. Proteins consist of long chains of amino acids joined to each other primarily by the peptide linkage; that is, the amino (NH_2) group of one amino acid is linked to the carboxyl (COOH) group of another amino acid by the removal of water. Proteins are built up from a pool of amino acids. For a given protein all the amino acids necessary for its structure must be simultaneously present or no synthesis will take place.

The biological specificity of a protein depends upon the number and arrangements of amino acids in the protein molecule. The specific protein that will be synthesized is governed by the *genetic code,* or amino acid code, which exists within the nucleus of each cell. The synthesis of the protein occurs in the cytoplasm of the cell. Each cell is thus capable of synthesizing all the proteins for its own functions but not those of a different type of cell.

Within the nucleus of the cell are found molecules of deoxyribonucleic acid (DNA) which are the patterns or templates for each protein. Just as a specific mold is used in a factory to produce a given size or shape of cup, screw, or other item, so there are specific molds or patterns for every single protein. The highly complex molecules of DNA include molecules of ribose (a 5-carbon sugar), phosphate groupings, and sequences of nitrogenous bases (adenine, cytosine, guanine, and thymine). The arrangement of the four bases in the DNA molecule determines the specific protein that will be synthesized; thus, DNA determines the hereditary traits for the species.

The linkage of the amino acids in a protein takes place on particles of ribonucleic acid (RNA) within the cytoplasm of the cells. A specific enzyme for each amino acid speeds up the reaction. Some molecules of RNA "carry the message" (messenger RNA) from DNA for the arrangement and sequence of the amino acids, while others "transfer" (transfer RNA) the amino acids to the exact spot on the particles in order to bring about the peptide linkage. A complete description of the mechanisms as they are presently understood is beyond the scope of this text, but the student who is interested in some further details will find a lucid description in a recent article by Jukes.[3]

CLASSIFICATION. Proteins are usually grouped in three classes:

1. Simple proteins such as zein of corn, albumins in egg white, gliadin of wheat consist of amino acids only. An almost infinite number of proteins is possible because the number of amino acids present in the protein may vary, the 20 or so amino acids may be arranged in different sequences in different proteins, and the amount of each amino acid together with their proportions one to another may vary from protein to protein.

2. Conjugated proteins contain protein and some nonprotein molecule. A complex iron grouping combines with protein to form hemoglobin; different groupings containing phosphoric acid result in phosphoproteins; lipids combine with protein to form lipoproteins; and vitamins such as thiamine, pantothenic acid, and many others combine with proteins to form enzymes.

3. Derived proteins result from a partial breakdown of a native protein. Proteoses, peptones, and polypeptides which result from the action of the digestive enzymes on protein are examples of this class.

Proteins constitute th
anc nds. They are majo.
teet nd hair; and blood ce
cell , except bile and urin
for a to supply the mate
tinuo ell proteins throughout life.

In uctural components of body tissue
teins h nctions in the regulation of bo
Hemog in which is the chief constituent of th
blood c in carrying oxygen to the tissues. Plasma
proteins portance in the regulation of osmotic pressure
and in th water balance. Blood proteins have a role of maintaining the y alkaline reaction of the blood. The body's resistance to disease ed in part by antibodies which are protein in nature.

Enzymes are specific catalysts for metabolic processes in the body are protein nature. (See Chapter 3.) Governing the body reactions are hormones which also are protein substances—insulin, epinephrine, the thyroid hormone, and adrenocorticotropic hormone (ACTH) to name but a few. Some amino acids have specific functions: tryptophan serves as a precursor for niacin, one of the B-complex vitamins, and methionine can provide methyl groups for the synthesis of choline, another B-complex vitamin.

Proteins yield 4 calories per gram when broken down in the body. This energy is derived from the metabolism of excess food protein, or it results from the breakdown of body tissues. Because protein foods are the most expensive items of the diet, they are not an economical source of energy; moreover, the process of deamination and the excretion of the waste product urea result in additional work for the liver and kidney.

Digestion and absorption. Digestion is necessary in order to degrade the proteins to amino acids so that absorption can take place and so that the biologic specificity of the protein can be destroyed. Since saliva contains no proteolytic enzyme, the first digestive action takes place in the stomach. The hydrochloric acid in the stomach changes the inactive enzyme *pepsinogen* to the active form *pepsin*, denatures the protein so that it is more readily acted upon, and provides a suitable reaction for the optimum activity of pepsin. Pepsin acts upon specific peptide linkages to begin the digestion of protein.

Pancreatic juice contains two inactive proteolytic enzymes, *trypsinogen* and *chymotrypsinogen*. In the small intestine trypsinogen is activated to *trypsin* by *enterokinase*, an enzyme produced in the intestinal wall. Chymotrypsinogen is activated by trypsin to *chymotrypsin*. These active enzymes continue to split proteins by attacking certain peptide linkages. The final breakdown of eins is effected by a group of enzymes called *peptidases* which are secreted intestinal mucosa.

e end products of digestion, the amino acids, are absorbed from the tinal wall into the portal circulation in a gradual and continuous manner. orption takes place through some active transport mechanism and not only

varies for each amino acid and may
es. Vitamin B_6 is also believed to play a
the cells.
protein in the typical mixed diet eaten in the
y digested. The proteins of some foods such as eggs,
re completely digested than are others, especially those
A high amount of fiber such as that in the diet of vegetarians
centage of protein digested.
eins require a somewhat longer time for digestion than do carbohy-
es, and thus their presence in a meal provides a feeling of satiety.

Metabolism. The absorbed amino acids are carried by the portal circulation to the liver or they may circulate directly to the tissues (see Figure 5–1). At any given moment the metabolic pool of amino acids includes all amino acids available for protein synthesis including those originating from the diet and those which have been released by the breakdown of tissue proteins.

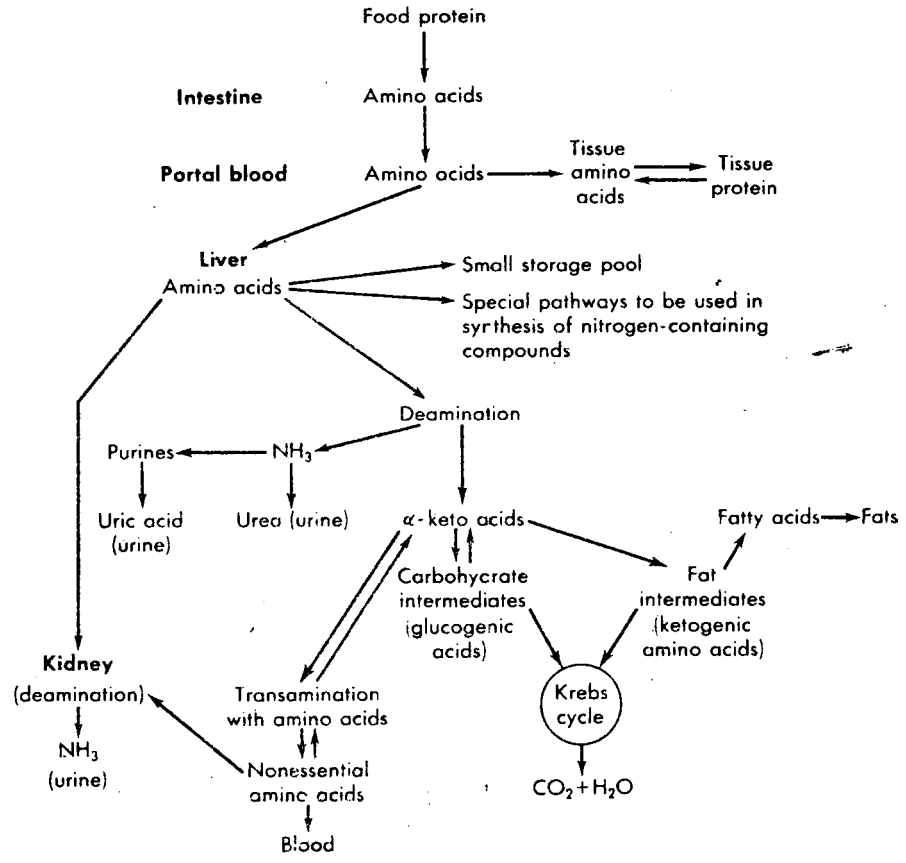


FIG. 5–1. The metabolism of protein.

NITROGEN BALANCE. One way to measure the extent of protein metabolism is to determine the nitrogen content of food, urine, and feces, since 1 gm nitrogen represents 6.25 gm protein. The difference between the nitrogen intake and the nitrogen value of the feces represents the nitrogen that has actually been absorbed and therefore is available for use by the body. The nitrogen content of the urine varies directly with the amount of the amino acids that are being broken down.

Normally adults synthesize proteins at a rate equivalent to their breakdown; that is, they maintain *nitrogen equilibrium*. The synthesis of proteins exceeds their catabolism (positive nitrogen balance) when new tissues are being added to the body: growth throughout childhood; pregnancy; the muscular development during athletic training; the recovery phase of illness. The diet must contain an adequate amount of calories from carbohydrates and fat, because the energy requirement will take priority over tissue synthesis when there is a calorie deficit. Tissue building is favored by the activities of the growth hormones of the pituitary, insulin, testosterone, and thyroxine secretion in normal amounts.

When the excretion of nitrogen is greater than the intake, a state of *negative nitrogen balance* exists, as in the following circumstances: (1) inadequate quantity of protein to meet synthetic needs; (2) inadequate quality of protein to supply essential amino acids; (3) inadequate caloric intake so that dietary protein is used to supply energy needs; (4) accelerated catabolism without increase in dietary intake. Protein breakdown is greatly accelerated following severe injury, burns, surgery, or illness with a high fever. The adrenocortical hormones and an excessive production of thyroxine increase the breakdown of proteins.

BODY PROTEIN RESERVES. The body does not store protein in the sense that it stores fat. This condition should not be confused with the positive nitrogen balance which prevails during growth; in this situation there is an increase in cell structure and it does not involve the addition (or storage) of nitrogen to cells already in good nutrition. However, the body does have "labile" reserves which can be mobilized in emergency. Although the exact nature of these reserves is not fully known, it appears that some tissues rapidly release some proteins—on loan as it were—to be used where the need is more urgent.

CATABOLISM OF AMINO ACIDS. The first step in the catabolism of amino acids is their *deamination* in the liver, that is the amino group is removed and is subsequently synthesized into urea which is excreted as the main nitrogenous product of the urine. After the amino group has been removed, the nonnitrogenous part of the amino acid molecule meets one of several fates:

1. Certain amino acids will yield glucose, which can be used immediately for energy or stored as glycogen or fat. Lusk has found that under severe conditions 58 per cent of the amino acids could be so converted.

2. Other amino acids are converted to fat for immediate use as energy, or for storage as adipose tissue.

3. The nitrogen-free molecule may recombine with free amino groups to build new amino acids.)

NITROGEN EXCRETION. The end products of protein metabolism, chiefly urea, are excreted by the kidneys, skin, and intestines. The principal route of excretion is by the kidneys, and the amount of nitrogen in the urine directly reflects the rate of amino acid catabolism. When the protein intake is high, the amino acids in excess of tissue needs are deaminated, thus leading to a high urea excretion. Conversely, when the protein intake is low, the urea excretion will be reduced.

The losses of nitrogen in the perspiration and through desquamation of skin are ordinarily low. When people live and work at high environmental temperatures so that sweating is profuse, the losses through the skin have been found in men to be as high as 3.75 gm nitrogen (equivalent to 23 gm protein) in 24 hours.[4]

The nitrogen content of the feces originates from (1) undigested dietary protein, (2) desquamation of mucosal cells, (3) degraded enzymes in the digestive juices, and (4) bacteria. In the healthy individual the fecal nitrogen excretion approximates 1.0 gm daily, but there may be considerable variation.

Protein quality. No two food proteins are identical in their quality; that is, in the efficiency with which they can be used in the body. The quality is dependent upon the kinds and amounts of the amino acids present in the foods in relation to body needs.

ESSENTIAL AMINO ACIDS. The importance of the amino acid composition of proteins was shown by Osborne and Mendel in 1915, who observed that rats failed to grow or even survive if some amino acids were omitted from the diet, but that the elimination of other amino acids had no such harmful effects. Later work by others, especially by Dr. William C. Rose,[5] established that this was also true for human beings. Thus, amino acids came to be classified as *essential* and *nonessential*. Strictly speaking, all the amino acids are essential units for the synthesis of the protein molecule. However, the body can manufacture many amino acids if it has an adequate nitrogen source, but it cannot produce certain others in adequate amounts to meet body needs. Those amino acids which cannot be synthesized in sufficient amounts by the body and which must be provided in the diet are essential. The human adult requires eight essential amino acids, while growing children require nine or perhaps ten. Arginine is classified as semiessential since growth is retarded if it is not available. The presence of cystine and tyrosine in the diet will reduce the requirement for methionine and phenylalanine, respectively; hence, they are also classed as semiessential. The student should learn to recognize the names of the essential amino acids since they are being referred to more and more frequently in writings on protein nutrition.

Essential: isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine
histidine also essential for children

Semiessential: arginine, cystine, tyrosine
Nonessential: alanine, aspartic acid, glutamic acid, glycine, hydroxyproline, norleucine, proline, serine

COMPLETE AND INCOMPLETE PROTEINS. Depending upon their ability to maintain life and promote growth, proteins have long been classified as *complete, partially complete,* and *totally incomplete.* A complete protein contains the essential amino acids in sufficient quantities for maintenance and a normal rate of growth. Such proteins are sometimes referred to as having a *high biologic value.* Egg, milk, and meat (including poultry and fish) proteins are all complete but not necessarily identical in quality. Wheat germ and dried yeast have a biologic value approaching that of animal sources.

Partially incomplete proteins will maintain life, but they lack sufficient amounts of some of the amino acids necessary for growth. Gliadin, which is one of a number of proteins found in wheat, is a notable example of proteins of this class. Adults under no physiologic stress can maintain satisfactory nutrition for indefinite periods when consuming sufficient amounts of protein from certain cereals or legumes.

Totally incomplete proteins are incapable of replacing or building new tissue, and hence cannot support life, let alone promote growth. Zein, one of the proteins found in corn, and gelatin are classic examples of proteins which are incapable of even permitting life to continue.

Supplementary value of proteins. Four essential amino acids are in short supply in plant foods: lysine, methionine, threonine, and tryptophan. Just because plant foods, when fed alone, do not provide the necessary quota of essential amino acids is no reason to condemn them as protein sources. Three possibilities exist for making effective use of their protein: (1) they may be fed simultaneously with small amounts of complete protein foods; (2) the correct mixtures of several plant foods may yield all of the necessary amino acids in suitable amounts; and (3) synthetic amino acids may be added to the food to make up the deficiency.

The use of plant protein to stretch the supply of expensive animal proteins is well known. When plant proteins are fed together with a small amount of animal proteins, the quality of the mixture is likely to be as effective as if only animal protein had been fed. Therefore, a good rule in meal planning is to include some animal protein at each meal, rather than concentrating all of it in one meal. Some widely used combinations which effectively supplement one another are: cereal and milk; macaroni and cheese; eggs and toast; egg, cheese, or meat sandwiches. Bread, so important in low-cost diets, is considerably improved in its biologic value when it is made with nonfat dry milk.

To supplement plant proteins with complete proteins is not practical for most of the world's population since milk, eggs, and flesh foods are indeed scarce. Legumes, whole grains, nuts, and vegetables provided a satisfactory combination of amino acids for a group of pure vegetarians studied by Hardinge *et al.*[6] When a variety of plant foods is used, one food tends to make

up for the deficiencies of another. To illustrate, corn and dry beans are not very satisfactory for protein quality when eaten separately, but in combination the biologic value is considerably improved. One of the tremendously important areas of nutrition research today is directed toward the development of mixtures of plant proteins whereby the limiting amino acid of one food is provided by another. INCAPARINA was the first such mixture to be used successfully in infant and child feeding.[7] The proteins of this mixture approach the biologic value of milk.

Some investigators have suggested that synthetic amino acids can be added to cereals and legumes to supply the limiting amino acids. (See Figure 5–2.) If they can be supplied cheaply enough, and if the correct proportions can be determined, this may ultimately be one way to improve the quality of plant foods. However, certain experiments on animals have shown that the addition of a limiting amino acid to a low-protein diet increases the requirement for the second most limiting amino acid, resulting in a further decrease of growth and in liver damage.[8] Consequently, much more information must be acquired on the problems of amino acid imbalance before widespread supplementation of foods with amino acids is attempted.

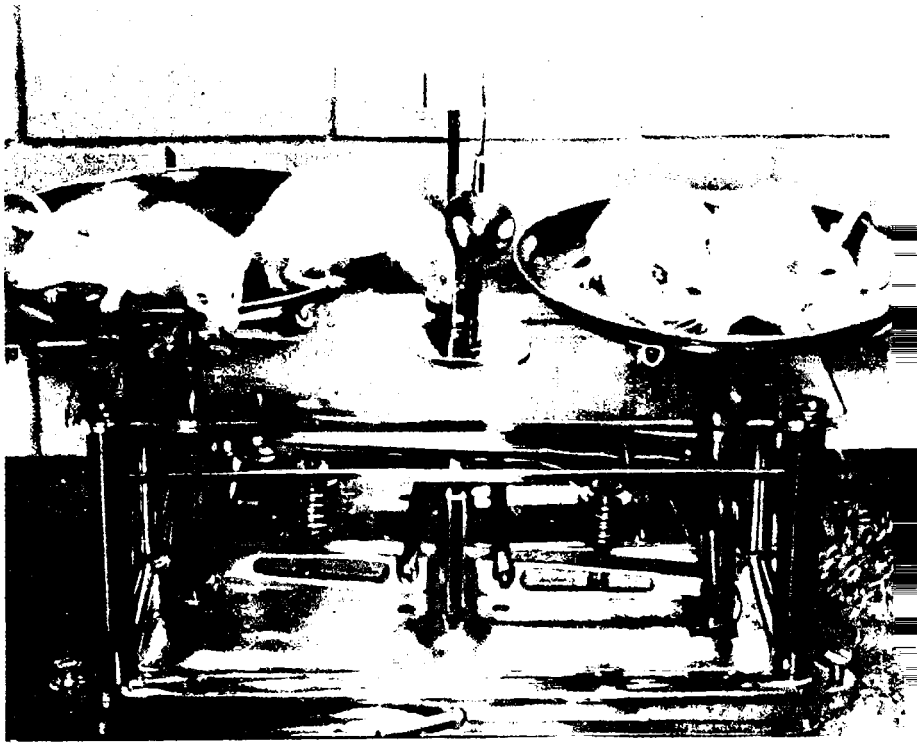


FIG. 5–2. Effect of protein quality. These rats of the same age were fed a bread diet. The two rats on the right received bread to which lysine, the limiting amino acid in grains, had been added. This improvement of the protein quality led to the greater gain. (*Courtesy, E. I. DuPont de Nemours and Company, Inc.*)

One may question the advisability or the need for amino acid supplementation of foods in the United States since the "average" diet exceeds by a wide margin the minimum requirements for amino acids (see Table 5–1). Lysine, the amino acid being currently added to specialty breads and some cereals, is abundantly supplied. Because of their higher cost these fortified foods fail to help persons on a restricted budget who might be in most need of them.

Table 5–1. Minimum Essential Amino Acid Requirements Compared with Amino Acids in the United States per Capita Food Supply*

	Minimal Requirements			U.S. per Capita
	Infants	*Men*	*Women*	Food Supply 1953†
Essential Amino Acid	*mg per kg*	*gm per day*	*gm per day*	*gm*
Histidine	32			
Isoleucine	90	0.70	0.45	5.2
Leucine	120	1.10	.62	8.0
Lysine	90	.80	.50	6.1
Methionine				
In absence of cystine		1.10		
In presence of 15 mg cystine per kg	85			
In presence of 50 mg cystine per kg	65			
In presence of 200 mg cystine			.35	
In presence of 810 mg cystine		.20		
Phenylalanine				4.6
In absence of tyrosine		1.10		
In presence of 175 mg tyrosine per kg	90			
In presence of 1100 mg tyrosine		.30		
In presence of 900 mg tyrosine			.22	
Threonine	60	.50	.30	3.9
Tryptophan	30	.25	.16	1.2
Valine	93	.80	.65	5.5

* Table arranged from data summarized by: Williams, H. H.: "Amino Acid Requirements," *J. Am. Dietet. A.*, 35: 929, 1959.

† Phipard, E. F.: "Protein and Amino Acids in Diets," *Nutrition Committee News*, U.S. Department of Agriculture, Washington, D.C., May, 1959.

Daily protein needs. Many factors enter into the level of protein which is desirable for the individual, including (1) body size; (2) the quality of protein fed; (3) the adequacy of the caloric intake; (4) the previous state of nutrition; (5) the efficiency of digestion; and (6) the special physiologic needs as during growth, pregnancy, or recovery from illness.

The nitrogen-balance technique has been most widely used to determine amino acid and protein requirements. By this method the minimum protein requirement is that level of protein intake at which nitrogen equilibrium is just barely maintained on a diet adequate in essential nutrients and in calories.

ESSENTIAL AMINO ACID REQUIREMENTS. Dr. Rose[9,10] has determined the quantitative requirements of the essential amino acids for healthy young men by feeding a controlled diet which included a mixture of pure amino acids flavored with lemon juice and sugar, and wafers made of cornstarch, sucrose centrifuged butterfat, corn oil, and vitamins. Similar studies have been reported for young women and for infants.[11,12] The minimum requirements on the basis of these studies are summarized in Table 5–1; they suffice only when the diet provides enough nitrogen for the synthesis of the nonessential amino acids so that the essential amino acids will not be used for this purpose. On a weight basis, it will be noted that the infant requirements are several times as high—a fact one would expect in view of the high rate of tissue synthesis during infancy.

REFERENCE PROTEIN. The protein requirement was described a number of years ago by a nutrition committee of the Food and Agriculture Organization in terms of a reference pattern of amino acids. This pattern was based upon the kinds and amounts of amino acids required by healthy human beings to meet obligatory nitrogen losses in urine, feces, and skin. The *reference protein* was one which would produce one gram of tissue for each gram consumed; thus, it would have a biologic value of 100. Other individual foods or diets could thus be compared with this reference protein to measure their biologic values. After a series of investigations, it was found that the amino acid patterns in human milk and whole eggs corresponded most closely to the pattern required by humans. Therefore, in 1965 the joint FAO/WHO committee recommended that these proteins be used as a reference pattern.[2]

RECOMMENDED DIETARY ALLOWANCES. Because foods vary in their protein quality and because individuals may vary somewhat in their actual needs, it is wise to allow a margin of safety in the diet. An allowance of 1 gm per kilogram (about ½ gm per pound) of desirable body weight, or 70 and 58 gm for the reference man and woman respectively, has long been accepted.[13] It is good nutritional practice to select at least one third of the adult protein intake from complete protein foods.

Contrary to popular beliefs, exercise does not increase the protein requirement. However, since the caloric requirement increases with activity, most people are likely to select foods for calories which also contain some protein, so that the protein intake is increased.

During pregnancy and lactation the protein allowance for the woman should be increased by 20 gm and 40 gm over the basic level, respectively. The greatest amount of protein per unit of body weight is needed during childhood. Between the ages of 1 and 12 years the allowances gradually decrease from about 2 gm to 1.7 gm per kilogram body weight. An allowance of 58 to 62 gm protein is recommended for adolescent girls, and 75 to 85 gm for boys. One half to two thirds of the protein during childhood should be selected from complete protein sources.

On a caloric basis, the protein allowances range from 10 to 15 per cent of

he caloric requirement, the higher percentage being more satisfactory for children.

MINIMUM PROTEIN REQUIREMENT. The minimum protein requirement would be that amount of protein which just covers the obligatory losses of nitrogen in the urine, feces, and skin. Because protein supplies throughout the world are not fully adequate, it is of the greatest importance to know what minimum levels are safe. Moreover, in certain disease conditions a temporary restriction of protein at minimum levels is desirable.

A number of studies under carefully controlled conditions have shown that the minimum protein for nitrogen equilibrium ranges from approximately 25 to 40 gm depending upon the quality of protein fed. The Food and Nutrition Board has indicated the minimum requirements of the adult to be 0.46 to 0.55 gm per kilogram when the biologic value of the protein is 100. For representative diets the biologic value is closer to 70, so that a practical daily allowance ranges from 0.65 to 0.8 gm per kilogram.

Food sources. It is now possible to compute the amino acid composition of a diet by using tables compiled by Orr and Watt[14] (see Table A–5 in the Appendix) and to compare the values with the amino acid requirements. Such evaluations are of immense worth to the investigator who is studying effective food combinations. For practical purposes the student will continue to rely on the broad classifications of complete and incomplete proteins.

On the basis of the household survey conducted in 1955, the protein content of household supplies averaged 103 gm per person, with two thirds of this amount coming from animal sources. Three of the Four Food Groups are significant for their contribution of protein. The average protein values of common foods together with a rating of their quality are presented in Table 5–2. Nonfat dry milk and meat are especially high in protein concentration, but the amounts of liquid milk and of breads and cereals consumed result in important additions to the daily total. The protein contributions of the basic diet plan may be seen in Figure 5–3.

Effect of processing on protein quality. The use of dry heat, when prolonged, results in a linkage of some amino acids which is not easily broken down by the digestive enzymes. Lysine, for example, combines with carbohydrates so that in the process of digestion it may not be released for absorption at the time the other amino acids are being absorbed; thus, it becomes limiting to the effectiveness of the protein eaten. In bread the brown crust contains less available lysine than does the white crumb; dry bread contains less than fresh; and toasting results in some loss. Breakfast cereals processed at high temperatures are likewise subject to such lysine losses. While these losses are not serious in the American diet which provides such abundant supplies of lysine, they could be serious when cereal foods constitute the mainstay of the diet.

Heating improves the nutritive value of some proteins. Egg white, soy beans, and navy beans are more efficiently used when cooked because mild heating

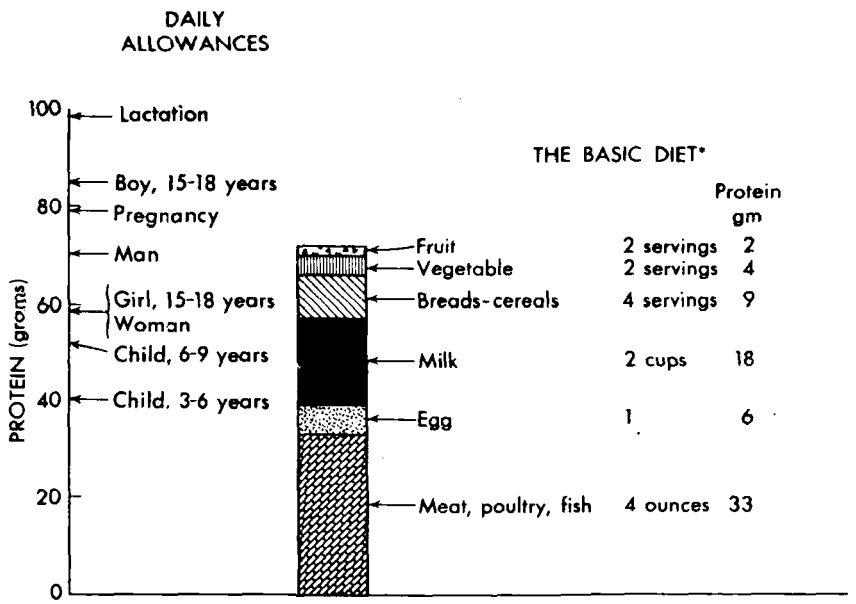


FIG. 5–3. The Four Food Groups of the Basic Diet meet the recommended allowances for protein for the man and the woman. The addition of 1 to 2 cups of milk and 1 ounce of meat, or their equivalent, will fulfill increased needs. Note that the milk and meat groups provide a high proportion of complete protein. See Table 14–2 for complete calculation.

inactivates an enzyme in these foods which inhibits the action of trypsin. Marked heating of soybean protein decreases the availability of the protein.

Protein deficiency. Because the protein intake in the United States is high, and because the quality is exceptionally good, one would not expect to see many individuals exhibiting the clinical symptoms of severe deficiency. A reduced protein intake over an extended period of time leads eventually to depletion of the labile tissue reserves and then to the lowering of blood protein levels. The speed with which the deficiency develops depends upon the quality and quantity of the protein intake, the caloric intake, the age of the individual and other factors. According to Youmans,[15] edema (known as "nutritional edema" as distinct from edema of circulatory origin) is the first clinical sign; this is dependent upon posture and becomes more marked in the legs at the end of the day. As the condition becomes more severe, edema becomes more generalized.

Protein deficiency is sometimes seen among pregnant women from low-economic groups ignorant of the essentials of a good diet. Miscarriage, premature birth, and anemia are frequent in these women. Other vulnerable groups are the elderly who have too little income to secure food, insufficient understanding of the importance of diet, lack of incentive to eat, or poor health; and the chronically ill who have poor appetites but increased protein requirements. While symptoms of protein deficiency may not be detectable, the stress of an

ıble 5–2. Average Protein Content of Foods in Four Food Groups*

Food	Average Serving	Protein gm	Protein Quality Limiting Amino Acids
lk group			
lk, whole or skim	1 cup	9	Complete
nfat dry milk	⅞ ounce (3–5 tablespoons)	9	Complete
ttage cheese	2 ounces	10	Complete
ıerican cheese	1 ounce	7	Complete
ı cream	⅛ quart	3	Complete
eat group			
ıat, fish, poultry	3 ounces, cooked	15–25	Complete; higher protein for lean cuts
g	1 whole	6	Complete
ied beans or peas	½ cup cooked	7–8	Incomplete; methionine
anut butter	1 tablespoon	4	Incomplete; several amino acids borderline
ıgetable-fruit group			
ıgetables	½ cup	1–3	Incomplete
ıits	½ cup	1–2	Incomplete
ead-cereals group			
eakfast cereals, wheat	½ cup cooked		
	¾ cup dry	2–3	Incomplete; lysine
ead, wheat	1 slice	2–3	Incomplete; lysine
acaroni, noodles, spaghetti	½ cup cooked	2	Incomplete; lysine
ːe	½ cup cooked	2	Incomplete; lysine and threonine
ɔrn meal and cereals	½ cup cooked	2	Incomplete; lysine and tryptophan

* These values represent approximate group averages. For specific food items, consult Table A–1, in e Appendix.

ıfection or surgery on such an individual may result in delayed convalescence r poor wound healing.

Kwashiorkor, a global problem in malnutrition. A major public health roblem in some sixty underdeveloped countries or territories of the world is washiorkor (see Figure 5–4).[7] Whether the disease is observed in Africa, eylon, Indonesia, Jamaica, Central America, Brazil, Spain, Greece, or elsewhere, one striking fact stands out, namely that the protein intake is severely restricted with animal protein being scarcely ever eaten.

Kwashiorkor occurs most commonly in the infant after weaning when the diet which replaces the mother's milk is markedly deficient in protein but high in carbohydrate. The calories may often be adequate as in the "sugar-baby" type of kwashiorkor seen in Jamaica. In other instances the calories may be inadequate but not as severely deficient as the protein thus resulting in some degree of tissue wasting.

Scrimshaw has estimated that perhaps at least 100 cases of protein malnutrition, sometimes called prekwashiorkor, exist for every child with kwashior-

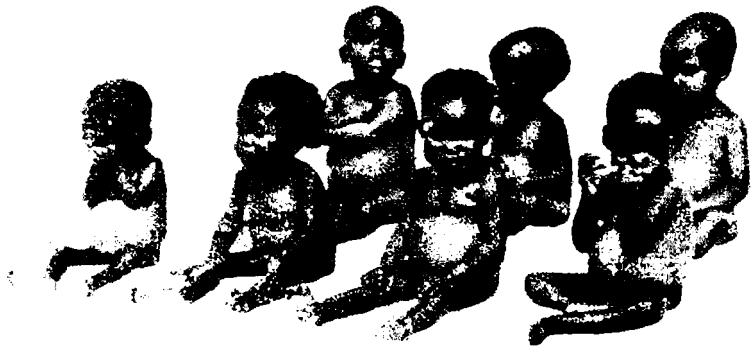


FIG. 5–4. Children suffering from kwashiorkor—Africa. (*Courtesy, M. Autret and tl Food and Agriculture Organization.*)

kor. This manifests itself by retarded growth and development and poor re sistance to infection. When an infection occurs, such children succumb rapidl to the acute symptoms of kwashiorkor. Death rates for children in these area are 10 to 40 times higher than in the United States.

Kwashiorkor has its highest incidence between the ages of 1 and 4 year when the needs for essential amino acids for tissue synthesis are great. Th classic symptoms include growth failure, retarded development, loss of appe tite, mental apathy, edema, diarrhea, pellagrous skin lesions, and color an texture changes of the hair. There may also be manifestations of variou vitamin deficiencies.

Laboratory studies show low blood protein levels, and low vitamin-A an carotene levels. The production of digestive enzymes such as amylase, trypsin and lipase is decreased so that digestion and absorption of food are poor Anemia is not infrequent and may be aggravated by malaria or hookworm infestation. Pathologic studies have shown fatty infiltration of the liver an atrophy of the pancreas.

The treatment of kwashiorkor in most cases has consisted of reconstitute nonfat dry milk. Within a few days striking improvement may be seen, and ir a matter of weeks the child appears well nourished. More recently, vegetable protein mixtures have been used satisfactorily in place of milk in Central America, India, South Africa, and the Congo (see Figure 5–5).

The prevention of kwashiorkor must be directed toward the education of mothers with respect to infant feeding and the provision of protein of high biologic value within economic reach of the population group. Since the supply of nonfat dry milk is inadequate to meet the needs of all preschool children in underdeveloped areas, it is necessary to look to the further development and manufacture of inexpensive plant protein mixtures which supply the kinds and amounts of essential amino acids required by this age group.



FIG. 5–5. Two-year-old child 2 weeks after admission and 10 weeks after treatment with Incaparina. (*Courtesy, Institute of Nutrition of Central America and Panama, and the* Journal of the American Dietetic Association.)

PROBLEMS AND REVIEW

1. Describe the synthesis of tissue proteins. Under what circumstances would synthesis be accelerated?
2. Name four ways in which proteins are used in the regulation of body functions.
3. Explain why proteins are considered to be a wasteful source of energy.
4. *Problem.* Prepare an outline or diagram which shows the steps in the digestion of protein.
5. What is meant by an essential amino acid; complete protein; high biologic value; supplementary value of protein?
6. What is meant by positive nitrogen balance; negative nitrogen balance; nitrogen equilibrium? When does each condition occur?
7. How can you explain the fact that a person on a low-protein high-calorie diet is less likely to go into negative nitrogen balance than one who is on a low-calorie diet of the same protein level?

8. How can you explain the fact that some vegetarians maintain good protein nutrition while others do not?

9. *Problem.* Plan a diet for a woman which provides 60 gm of protein, of which not more than one third is in the form of animal protein. What foods are especially important in such a diet plan?

10. What happens to protein which is eaten in excess of body requirements? Why is it important to provide a margin of safety in planning for the daily protein allowance?

11. What foods would you include in your own diet to ensure an adequate protein intake? How would you modify this plan for a growing child?

12. *Problem.* A diet contains 3000 calories and 150 gm of protein. What percentage of the calories are supplied by protein?

13. *Problem.* One pint of milk supplies 17 gm of protein. What amounts of these foods would be required to replace the protein of the milk: buttermilk; nonfat dry milk; evaporated milk; ice cream; Cheddar cheese; eggs; halibut: beef liver; sirloin steak; peanut butter; oatmeal? How does the quality of protein in the various foods listed above compare?

14. *Problem.* On the basis of current market prices, calculate the cost for the amounts of foods which were needed to replace the protein of 1 pint milk (Problem 13). What conclusions can you draw from this calculation?

15. A friend asks you whether she should buy lysine-enriched bread in preference to the usual enriched loaf of bread. How would you reply?

16. What are the effects of insufficient protein in the diet?

17. Describe kwashiorkor with respect to its incidence, symptoms, treatment, and prevention.

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Chapter 6

CARBOHYDRATES

All living organisms ultimately derive their energy from the sun. In a highly complex manner, chlorophyll, the coloring matter in leaves, utilizes the energy of the sun to synthesize carbohydrate from the carbon dioxide of the air and the water of the soil. This process of photosynthesis is probably the most important reaction for the continuance of life, for the energy thus stored in the plant is used in turn by other species. Animal foods which are used so abundantly by people in the United States represent the conversion of carbohydrate and other nutrients of the plant world by the animal into protein and fat.

Man can utilize certain but not all of the carbohydrates produced by plants. Carbohydrates, notably from cereal grains, represent the primary source of energy for the world's population. In the United States man obtains slightly less than half of his energy needs from the carbohydrates, but in other parts of the world far greater proportions of the caloric requirement are met by carbohydrate. As the income decreases and as the available land for producing food becomes more limited in terms of the population, the cereal foods become increasingly important for providing the caloric requirement. When properly chosen, these foods also constitute significant sources of protein and of some of the B-complex vitamins.

Composition. Carbohydrates are simple sugars or substances that can be reduced to simple sugars by hydrolysis. Such breakdown of complex carbohydrates is accomplished by digestive enzymes or by heating with dilute acids.

Carbohydrates are composed of carbon, hydrogen, and oxygen, the last two being in the proportion to form water—hence the term "carbohydrate." The general formula is $C_nH_{2n}O_n$.

Classification and characteristics. The carbohydrates of significance in nutrition may be classed in the following three groups:

I. MONOSACCHARIDES, SIMPLE SUGARS, OR HEXOSES, $C_6H_{12}O_6$, are more or less sweet, water soluble, diffusible, crystallizable, and not affected by digestive enzymes.

A. *Glucose,* sometimes called dextrose, grape sugar, or corn sugar, is found in sweet fruits such as grapes, in vegetables such as sweet corn, and in certain roots. It is prepared commercially in its crystalline form, or in corn syrup, by the hydrolysis of starch with acids.

Glucose is physiologically the most important sugar of this class. It is the chief end product of hydrolysis of di- and polysaccharides during digestion. It is the form of carbohydrate circulating in the blood and is utilized by the tissues for energy.

B. *Fructose,* also known as levulose or fruit sugar, is the sweetest of all sugars and does not easily crystallize. It occurs especially in honey, ripe fruits, and many vegetables, and also results from the hydrolysis of sucrose.

C. *Galactose* results from the hydrolysis of lactose or milk sugar. It does not occur in the free state in nature.

II. DISACCHARIDES or double sugars, $C_{12}H_{22}O_{11}$, are water soluble, diffusible, crystallizable, and of varying sweetness. They are split to simple sugars by acid hydrolysis or by the digestive enzymes.

A. *Sucrose,* the table sugar with which we are familiar, is found in sugar cane, sugar beets, in the sap of sugar maples, sorghum cane, and in many fruits and vegetables.

B. *Maltose,* or malt sugar, is found in malted products such as cereals and beer as the result of the action of the enzyme diastase on the starch of the cereal grain. It is also an intermediate product in the digestion of starch to glucose.

C. *Lactose,* or milk sugar, is produced only by mammals. The concentration of lactose in milk varies from about 2 to 8 per cent, depending upon the species. It is not very soluble, and is much less sweet than the other single or double sugars.

III. POLYSACCHARIDES, $(C_6H_{10}O_5)_n$, are complex compounds with relatively high molecular weights. They are amorphous rather than crystalline, not sweet, generally insoluble, and are digested in the body with varying degrees of completeness.

A. *Starch* is the form in which plants store carbohydrate, and thus is the primary source of energy in the diet. Cereal grains, seeds, roots, potatoes, green bananas, and other plants contain considerable starch. It is insoluble in cold water, but in boiling water the cell walls of the starch granule are ruptured, the starch absorbs water, and thickening results. The action of heat, enzymes, or acid on starch leads to the production of *dextrins* which are intermediate products in the breakdown of starch. The eventual product of starch hydrolysis is glucose.

B. *Glycogen,* the so-called animal starch, is the form in which the animal body stores carbohydrate. Oysters when freshly opened, and liver immediately after removal from the slaughtered animal are sources of

glycogen; however, this glycogen is rapidly broken down so that the diet ordinarily contains none.

C. *Cellulose* is the most abundant organic compound in the world, comprising at least 50 per cent of the carbon in vegetation. Wood and cotton are chiefly cellulose, but the skins of fruits, the coverings of seeds, and the structural parts of edible plants are the only forms of cellulose and hemicellulose with which we are concerned in the study of nutrition. Ruminants are able to utilize cellulose for energy because of enzymes in the rumen, but for man cellulose is a nondigestible dietary constituent. It is insoluble in hot or cold water. *Pectins* are indigestible carbohydrates occurring in ripe fruits; they have the ability to absorb water and to form gels, a property utilized in making fruit jellies.

Functions. Carbohydrates supply potential energy, contribute structural elements, and participate in some regulatory functions. The chief function of carbohydrates is to serve as the principal source of energy for the body. On the average, each gram of carbohydrate yields 4 calories. Some of the dietary carbohydrate will be used in the form of glucose to meet immediate tissue energy needs, a small amount will be stored as glycogen in the liver and muscles, and some will be stored as adipose tissue for later conversion to energy. Glucose is the sole form of energy for the brain and nervous tissue and must be available, moment by moment, for the functioning of these tissues. Any failure to supply glucose or the oxygen for its oxidation is rapidly damaging to the brain.

The storage form of carbohydrate in the body is glycogen. At any given time about 100 gm glycogen would be stored in the liver and 200 gm in the muscle, thus providing sufficient energy to meet not more than one half of the day's energy need.

Dietary carbohydrate has a protein-sparing action. The body will use carbohydrate preferentially as a source of energy when it is adequately supplied in the diet, thus sparing the protein for synthetic purposes. On the other hand, a low-calorie intake because of insufficient carbohydrate and fat will cause protein from dietary and tissue sources to be used for energy, since meeting the energy needs of the body takes priority over other functions.

A certain amount of carbohydrate is necessary in the diet so that the oxidation of fats can proceed normally. When carbohydrate is severely restricted, fats will be metabolized faster than the body is able to take care of the intermediate products. The piling up of these incompletely oxidized products leads to acidosis or ketosis. Carbohydrate must be almost entirely lacking in the diet for such acidosis to occur under normal conditions, but in uncontrolled diabetes mellitus it is common.

CARBOHYDRATE IN BODY COMPOUNDS. Structurally, carbohydrates account for only a very small part of the weight of the body. Yet, they are vitally important constituents of such tissue components as the nucleic acids, [illegible]lac-

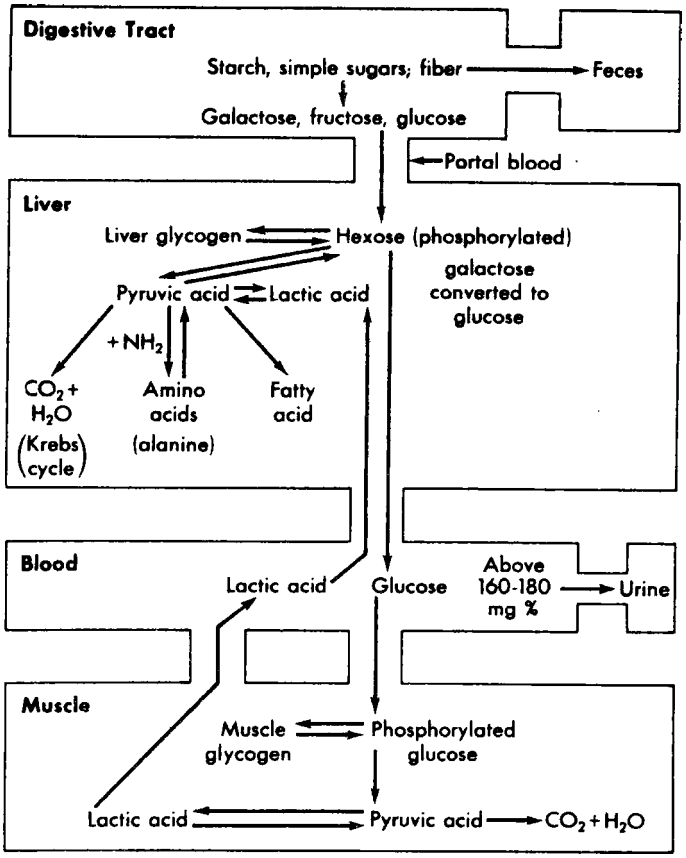


FIG. 6–1. Pathways of carbohydrate metabolism.

in the liver and then proceed to the formation of glycogen. Insulin, a hormone secreted by the islands of Langerhans in the pancreas, is essential for this conversion. When the blood sugar level drops, the glycogen in the liver will be broken down to glucose in order to maintain the relatively constant concentration in the circulation. Three hormones have been shown to possess the ability to facilitate the breakdown of glycogen to glucose, namely, (1) epinephrine, secreted by the adrenal gland, (2) thyroxine, secreted by the thyroid gland, and (3) glucagon, a hormone produced by the alpha cells in the pancreas.

The rate of synthesis of glycogen and its breakdown is obviously dependent upon the speed with which the tissues remove glucose from the circulation, and this, in turn, is governed by the rate of energy metabolism of the body. The uptake of glucose is facilitated by insulin. Skeletal, smooth, and cardiac muscles as well as other tissues convert some glucose to glycogen, thus maintaining their own stores. Subsequently the glycogen is degraded again to glucose which, in turn, can be split into two molecules of lactic or pyruvic acids. During the formation of these molecules the energy is supplied for muscle con-

traction. Part of the lactic acid formed may reenter the blood circulation and carried to the liver for conversion to glycogen once again.

Glucose is not oxidized in a single explosive reaction to yield energy and the end products, carbon dioxide and water. Rather, numerous intermediate steps catalyzed by an enzyme at each stage, permit the gradual release of energy. The hydrogen atoms are picked up and transferred to oxygen with which they combine to form water, while the remaining fragments are disposed of as carbon dioxide.

Muscle contraction involves exceedingly complex chemical reactions, the discussion of which is beyond the scope of this text. Energy for the work of the muscle is obtained from adenosine triphosphate (ATP). In this compound two phosphate groupings are held to the rest of the molecule by "high-energy" bonds. On demand, ATP gives up one of its phosphate groupings to yield the burst of energy for muscle contraction. The energy required to reconvert ADP to ATP is supplied by the splitting of glucose to the pyruvic and lactic acid molecules.

The carboxyl group of pyruvic acid may be removed by means of an enzyme of which thiamine, a B-complex vitamin, is a component. The acetic acid, in turn, is oxidized to provide energy, carbon dioxide, and water; or the acetate unit may be used for the synthesis of fats and cholesterol (see p. 93). Pyruvic acid could also serve as a nucleus for building the nonesssential amino acid alanine, through the addition of an amino group from another source.

So far it has been assumed that the source of glucose for metabolism was derived solely from the simple sugars absorbed from the intestinal tract. The body also realizes glucose from two additional sources, namely fats and certain amino acids. The glycerol resulting from the hydrolysis of fats is metabolized as carbohydrate; about 10 per cent of the dietary fat is so used. Certain amino acids, following their deamination, are also utilized as glucose; roughly half of the protein in the diet is a potential source of glucose in the body. Thus, a diet consisting solely of meat would yield appreciable amounts of glucose for glycogen formation in the body.

During starvation, body fat and protein may be broken down to meet the energy needs—the glucose again being realized from the same proportions of fat and amino acids as if they were of dietary origin. This concept of glucose formation from proteins and fats is essential to the understanding of the role of these three major nutrients in various therapeutic regimens, such as weight loss, weight gain, diabetes mellitus.

Normally, only trace amounts of sugar are present in the urine. However, when the glucose level of the blood exceeds approximately 160 to 180 mg per 100 ml, the so-called renal threshold for glucose, glucose is excreted in the urine. Urinary sugar may be found in a number of situations, including diabetes mellitus.

Daily allowances. The Food and Nutrition Board makes no exact recommendation for carbohydrate but has suggested 500 calories from carbohydrate

as a minimum dietary level.[1] The low-carbohydrate diet of the Eskimos and the high-carbohydrate diets of many Oriental peoples indicate that man can be healthy with wide variations in carbohydrate intake. That this wide variation is compatible with good health is apparent when one realizes how readily protein, fat, and carbohydrate are interchangeable in providing the energy needs of the body.

A liberal use of carbohydrate foods is advantageous because (1) they are easily digested and almost completely absorbed for efficient use in producing energy, (2) they are protein-sparing in action, (3) when selected from enriched and whole-grain sources, or potatoes, the B-complex vitamin and iron intakes are appreciably increased, (4) they are widely distributed and economical, and (5) they enhance the palatability of the diet. For maximum protein-sparing action, some carbohydrate foods should accompany protein at each meal.

CHANGES IN CARBOHYDRATE CONSUMPTION. In the United States about 45 to 50 per cent of the available calories are derived from carbohydrate.[2] The sources of carbohydrate available per capita in the national food supply at the retail level are shown for three five-year periods in Figure 6–2. The total amount of carbohydrate available for consumption is currently 100 gm less than it was about 50 years ago. The moderate increase in the consumption of sugars and sweets by no means offsets the marked reduction in the quantities of flours and cereals that were available. These changes in carbohydrate supply reflect a more generous economy, the influence of a more sedentary way of life, and certainly the effects of technology and the marketing system.

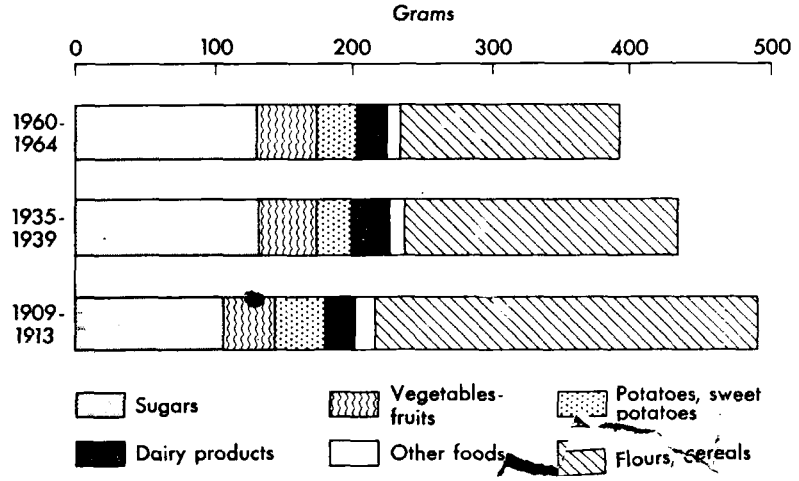


FIG. 6–2. Comparison of sources of carbohydrate in three time periods. Note that sugars contribute a greater proportion of total carbohydrate in the 60's than early in the century; the carbohydrate from flours and cereals is just half of that 50 years ago. (*Data from* Nutritive Values of Food Available for Consumption 1909–64, *U.S. Department of Agriculture, Jan. 1966, pp. 4, 6.*)

The changes in the sources of carbohydrate have resulted in a much greater proportion of simple to complex carbohydrates. Of the total carbohydrate in the 1909–13 food supply, 21.5 per cent was provided by sugars and sweets and 56.1 per cent by the flour-cereal products. In 1960–64, 35.7 per cent was furnished by sugars and sweets and 37 per cent by flour-cereal products. Some investigators[3–6] have presented evidence that the shift from the complex carbohydrates to the simpler forms may bring about an elevation of blood lipids, including serum triglycerides and serum cholesterol Other research workers have pointed out that these changes are not of the same order of magnitude as those seen with alterations in the amount and nature of fat. (See Chapter 7.)

ENRICHMENT. Refined cereals and breads are deficient in B-complex vitamins, especially thiamine, and iron. More than 80 per cent of all refined cereals and breads which are produced in this country are now enriched with thiamine, riboflavin, niacin, and iron. The inclusion of four or more servings of enriched or whole-grain breads and cereals, as suggested in the Daily Food Guide, provides substantial amounts of the B vitamins and iron.

FIBER. Although it is generally conceded that some fiber is essential in the diet for normal laxation, the exact amounts required cannot be stated. Cowgill[7] recommended 100 mg of fiber per kilogram, or about 5 to 6 gm per day for the adult, as a sufficient allowance. For most persons, the average mixed diet including each day a raw vegetable and some fresh fruit with skins in addition to cooked fruits and vegetables will provide sufficient fiber. Others need to increase their intake of fiber by including some whole-grain cereals or bread. A recent study[8] including pure vegetarians, lacto-ovo-vegetarians, and nonvegetarians showed that the fiber intake could vary widely over a period of years without adverse effects on the digestive tract; the vegetarians had fiber intakes four times as high as the nonvegetarians, while the latter equaled or exceeded Cowgill's recommended allowance.

Sugars in the diet. Gram for gram all sugars provide the same number of calories. In order of sweetness the carbohydrates rank as follows: fructose, 173; sucrose, 100; glucose, 74; maltose and galactose, 33; and lactose, 16. Sucrose is the only sugar widely used in food preparation. Sugar is an important ingredient in practically all baked goods and desserts, many of which contribute essential nutrients in the milk, eggs, and enriched flour used in their preparation. Frozen and canned fruits are more acceptable when preserved with some sugar. Few people completely shun an occasional piece of candy. Sugar is a very inexpensive source of calories. When a high-calorie diet is required, one of the ways often used to increase the calorie intake is to add one or another sugar to the food or beverage, thus keeping the bulk of the diet to a minimum. When the fat intake is severely restricted, the use of sugars and starches must be increased to maintain caloric equilibrium.

When good food habits are developed in childhood, sugars and sweets will have a legitimate place in the diet. The sweet will not become a "good food"

(in taste) which is "bad" for one; nor will it be used as a reward or a bribe. Undoubtedly, many Americans would benefit by some shift of carbohydrate intake to the enriched and whole-grain flour and cereal products.

PROBLEMS RELATED TO THE USE OF SUGARS. The role of sugars in the incidence of dental caries is by no means sharply defined. Certainly, the occurrence of tooth decay cannot be explained solely on the basis of excessive intake of sugars. However, if the consumption of sweets by the child leads to reduced intake of other foods, dental decay may result from failure to provide the essential nutrients for tooth development. Experimental work has also established that the contact of carbohydrate with the teeth provides a favorable medium for rapid growth of bacteria; candies which are sticky and adhere to the teeth are more likely to be harmful. Obviously, brushing the teeth after the eating of candy or other sweets, or rinsing the mouth with water, at the very least, is a helpful measure.

An excessive intake of concentrated sweets by some may lead to irritation of the gastrointestinal mucosa and may, in certain disorders, favor excessive fermentation and gas production. The person of any age who indulges in sweets to the point of reducing the intake of necessary protein, mineral, and vitamin-rich foods below recommended levels cannot expect to maintain optimal nu-

Table 6–2. Carbohydrate Content of Some Typical Foods

Food	Per Serving Portion			Per 100 Grams of Food
	Measure	Weight gm	Carbohydrate gm	gm
Bread, all kinds	1 slice	23	12	48–56
Cereals, breakfast, dry	1 ounce	30	22	60–85
Crackers, all kinds	2 graham	14	10	60–80
Flour, all kinds				71–80
Macaroni, noodles, rice, spaghetti	½ cup cooked	70	16	73–75 (dry basis)
Cake, plain and iced	1/16 layer	100	59	49–62
Sugar, all kinds	1 teaspoon	4	4	100
Syrups, molasses, honey	1 tablespoon	20	15	55–75
Jams, jellies	1 tablespoon	20	14	70
Candy	1 ounce (caramel)	30	22	47–97
Beverages, carbonated	8 ounces	240	21–28	8–12
Fruits, fresh, unsweetened	1 exchange*		10	4–23
Fruits, dried	4 prunes	32	18	67–75
Potatoes, white	1 medium boiled	122	18	17 (raw)
Sweet potatoes	1 medium baked	110	36	26 (raw)
Vegetables	½ cup (peas)	80	10	4–20
Legumes	½ cup cooked	130	30	60–62 (dry)
Nuts	1 ounce (peanuts)	30	7	11–24
Milk, cow's	1 cup	244	12	5

* See Fruit Exchange List, Table A–4, for amounts of fruit to provide 10 gm carbohydrate.

tritional status; in fact, marked diversion from the recommended dietary levels could contribute to nutrient deficiencies and also to overweight.

Certain misguided persons and unscrupulous promoters recommend the use of raw sugar, crude sugar, black strap molasses, and similar products in the place of cane or beet sugar. While the impurities in these products may contribute some mineral elements to the diet, the amount is insignificant and cannot be justified in terms of the considerable added cost usually involved.

Sources of carbohydrate. Pure sugars are 100 per cent carbohydrate, while syrups, jellies, and jams contain 65 to 80 per cent. On a dry-weight basis, flours, cereals, and crackers contain in excess of 65 per cent carbohydrate. Together these groups furnish about three fourths of the carbohydrate in the national food supply. Many fruits and vegetables are appreciable sources of carbohydrate, but the amounts eaten are not comparable with those for the above groups. Among fruits and vegetables relatively high in carbohydrate are dried fruits, dried legumes, potatoes, sweet potatoes, corn, Lima beans, and bananas. Milk is the only animal food contributing to the daily carbohydrate intake.

Table 6–2 summarizes the carbohydrate content of some typical foods.

PROBLEMS AND REVIEW

1. What is the ultimate source of all carbohydrate? What are the important differences between the three classes of carbohydrates?
2. Almost half of the calories in the daily diet are derived from carbohydrate. Under what circumstances would you expect to find a higher intake of carbohydrate?
3. The chief function of carbohydrate is to supply energy. Describe in detail the steps which are necessary before the starch of a slice of bread can be utilized to supply this energy.
4. What is the form of carbohydrate circulating in the blood? What is its normal concentration?
5. If carbohydrate is eaten in excess of the body's daily requirement for energy, what happens to it?
6. Cellulose is an indigestible carbohydrate. Of what practical importance is it in the diet?
7. *Problem.* Calculate the carbohydrate content of:

60 gm of bread
120 gm of potato
150 gm of orange

8. *Problem.* Calculate the carbohydrate and caloric content of your diet for one day. What percentage of your calories were derived from carbohydrate? What percentage of your calories were derived from cereal foods and breadstuffs; cakes, pies, and other pastries; sugars, candy, carbonated beverages?
9. What reasons can you give for reducing the intake of sugars and sweets? What legitimate role do they have in the diet?

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Chapter 7

FATS AND FATLIKE SUBSTANCES

Fats and fatlike substances are almost as widely distributed in nature as are the carbohydrates, and as a concentrated source of energy they supply roughly two fifths of the calories in the American diet.

Composition. Fats, like carbohydrates, are organic compounds composed of carbon, hydrogen, and oxygen; some fatlike substances may also contain a few molecules of other elements. They differ from carbohydrates in that they contain much less oxygen and much greater proportions of carbon and hydrogen.

Classification. The term *lipid* includes true fats and also other fatlike substances which are related by reason of physical and chemical properties. Four types of lipids are of importance in nutrition:

1. *Neutral fats* or true fats are organic esters of 1 molecule glycerol, $C_3H_5(OH)_3$, and 3 molecules fatty acids. These fats constitute 98 to 99 per cent of food and body fats.

2. *Phospholipids* are organic esters of fatty acids but also include phosphoric acid and usually a nitrogenous base. *Lecithin,* the most widely distributed of these compounds, and *cephalin* are found in all cell protoplasm—brain, nerve, liver, kidney, heart, egg yolk, and so on.

3. *Derived fats* include free fatty acids and glycerides from which one or two of the fatty acids have been removed by hydrolysis (mono- and diglycerides).

4. *Sterols* are organic compounds containing a multiple ring structure. They are not chemically related to fats. From a nutritional point of view, cholesterol and ergosterol are the most important members of this group. Cholesterol is the only sterol occurring as such in the animal body. Ergosterol and cholesterol are important as precursors of vitamin D.

Fatty acids. Many fatty acids are found in food and body fats. Butter, for example, contains at least 60 different fatty acids.[1] Some of the fatty acids contain as few as 4 carbon atoms (butyric acid) and some as many as 24 carbon atoms all hooked to each other in chainlike fashion. The fatty acids in foods are straight carbon chains with an even number of carbon atoms.

Fatty acids are "saturated" or "unsaturated." Those that are saturated have no double bonds between the carbon atoms; that is, they contain as much hydrogen as the carbon atoms are capable of holding. The most commonly occurring saturated fatty acids are myristic, palmitic, and stearic acids. Unsaturated fatty acids are those in which one or more double bonds occur between the carbon atoms so that they are capable of holding more hydrogen atoms. Oleic acid ($C_{18}H_{34}O_2$) which is a *monounsaturated* fatty acid is the most common of all food and tissue acids. It differs from stearic acid ($C_{18}H_{36}O_2$) only in that it contains one double bond—that is, two less hydrogen atoms. Two *polyunsaturated* fatty acids, linoleic acid ($C_{18}H_{32}O_2$) and linolenic acid ($C_{18}H_{30}O_2$), also contain the same number of carbon atoms as stearic acid but two and three double bonds respectively. Some fish oils with long chains of fatty acids are highly unsaturated, containing 4, 5, and 6 double bonds.

Characteristics of fats. The nature of a fat—its hardness, melting point, and flavor—is determined by the length of the carbon chain and the saturation of the carbons in that chain. Short-chain fatty acids of 12 carbons or less are liquid, while longer-chain saturated fatty acids are solid. Long-chain fatty acids with one or more double bonds are liquid.

The fat of each species is distinctive. Herbivora have harder fats than carnivora, and land animals have harder fats than fish. Beef, lamb, and milk fats (butter) are more saturated than are pork, poultry, and fish fats. See Table 7–1 for comparative amounts of saturated fatty acids. The fat produced by the pig or chicken can be modified by the nature of the fat in the animal's diet, but the fat produced by cattle cannot be so changed.

The concentration of oleic acid is high in all the animal fats except fish fats, such as menhaden. Butter and beef are low in their content of linoleic acid, while lard, chicken fat, and fat of egg yolk are moderate sources.

Of the vegetable fats, coconut oil is unique in that it is composed almost entirely of short-chain saturated fatty acids, thus conferring the liquid property. The remaining vegetable fats listed in Table 7–1 predominate in unsaturated fatty acids. Corn, cottonseed, and soybean oils are very rich in linoleic acid, while peanut and olive oil are rich in oleic acid and correspondingly low in linoleic acid.

Fats are insoluble in water, although they dissolve readily in ether, chloroform, and other organic solvents. They are capable of forming emulsions with liquids, a property utilized, for example, in the preparation of mayonnaise. Emulsification is a prerequisite for the digestion, absorption, and transportation of fats.

Hydrogenation refers to the process whereby liquid fats are changed to solid fats by introducing hydrogen into some, but not all, of the double bonds of the carbon chains. The process is widely used in the manufacture of margarines and vegetable shortenings. Some of the fatty acid chains are changed from their natural configuration, known as the *cis* form, to another form known as the *trans* form. The latter gives a higher melting point to the fat,

Table 7–1. Typical Major Fatty Acid Analyses of Some Fats of Animal and Plant Origin*†

	Saturated								Unsaturated					
		Capric	*Lauric*	*Myristic*	*Palmitic*	*Stearic*	*Arachidic*	*Behemic*	*Palmit-oleic*	*Oleic*	*Linoleic*	*Linolenic*	*Arachi-donic*	*Other Polyenoic Acids*
	4–8	10.0	12.0	14.0	16.0	18.0	20.0	22.0	16.1	18.1	18.2	18.3	20.4	
Animal														
Lard				1.5	27.0	13.5			3.0	43.5	10.5	0.5		
Chicken			2.0	7.0	25.0	6.0			8.0	36.0	14.0			
Egg					25.0	10.0				50.0	10.0	2.0	3.0	
Beef				3.0	29.0	21.0	0.5		3.0	41.0	2.0	0.5	0.5	
Butter	5.5	3.0	3.5	12.0	28.0	13.0			3.0	28.5	1.0			
Human Milk		1.5	7.0	8.5	21.0	7.0	1.0		2.5	36.0	7.0	1.0	0.5	
Menhaden				9.0	19.0	5.5			16.0					48.5
Vegetable														
Corn					12.5	2.5	0.5			29.0	55.0	0.5		
Peanut					11.5	3.0	1.5	2.5		53.0	26.0			
Cottonseed				1.0	26.0	3.0			1.0	17.5	51.5			
Soybean					11.5	4.0				24.5	53.0	7.0		
Olive					13.0	2.5			1.0	74.0	9.0	0.5		
Coconut	7.0	6.0	49.5	19.5	8.5	2.0				6.0	1.5			

* Food and Nutrition Board: *Dietary Fat and Human Health.* Pub. 1147, National Academy of Sciences, National Research Council, Washington, D.C., 1966, p. 6.

† Composition is given in weight percentages of the component fatty acids (rounded to nearest 0.5) as determined by gas chromatography. The number of carbon atoms: number of double bonds are indicated under the common name of the fatty acid. These data were derived from a variety of sources. They are representative determinations rather than averages, and considerable variation is to be expected in individual samples from other sources.

but both forms are well utilized by the body. Hydrogenation reduces the linoleic acid content of the fat, depending upon the extent to which double bonds are saturated with hydrogen.

Saponification refers to the formation of a soap of fatty acid and a cation. In the alkaline medium of the small intestine, a free fatty acid may combine with calcium to form an insoluble compound which is excreted in the feces. This may be of some nutritional significance in diseases characterized by poor absorption of fat— sprue, for example.

Excessive heating of fats leads to breakdown of the glycerol, producing a pungent compound (acrolein) which is especially irritating to the gastrointestinal mucosa. If unsaturated fats are exposed to high heat for long periods of time, oxidation occurs. When fed as a large proportion of the diet to experimental animals these oxidized fats have led to some toxic effects. On the other hand, the oxidation of fats that occurs under ordinary conditions of home or commercial frying has been found to be insufficient to produce any adverse effects.

With exposure to air, unsaturated fats become rancid and unpalatable. Antioxidants are usually incorporated into food fats to counteract this tendency.

Functions. Lipids are distributed in all body cells and tissues. The body is provided with a complex system of enzymes and hormones for their digestion and metabolism, attesting to the fact that fats are essential and normal components of body functioning.

Fats are the most concentrated source of energy, and in America they provide 40 per cent, more or less, of the body's energy needs. Since each gram of fat burned in the body will yield 9 calories, it is evident that fats are more than twice as concentrated a form of energy as carbohydrates and proteins. An individual with a relatively high caloric requirement would find it necessary to consume a somewhat bulky diet if he depended upon carbohydrates to provide substantially all his energy needs.

The high density and low solubility of fats make them an ideal form in which to store energy for the body's needs. In fact, carbohydrates and amino acids that are not promptly utilized by the tissues are rapidly synthesized into fats and stored as adipose tissue. The conversion is a continuous process in the normal individual. It is not restricted to the accumulation of adipose tissue in the person who has an excessive intake of calories.

In addition to providing energy, fats serve as (1) padding around the organs, holding them in place and absorbing the shocks to which they might otherwise be subjected; (2) protection for the nerves; (3) insulators for the body, thus avoiding rapid changes of body temperature by excessive heat loss from its surface; (4) sparers of body proteins, since a sufficient amount of carbohydrates and fats furnishes the energy needed to carry on the work of the body; (5) carriers of the fat-soluble vitamins; (6) lubricants of the gastrointestinal tract; and (7) depressors of gastric secretion, thus delaying the emptying of the stomach and retarding the appearance of hunger.

Fats contribute importantly to the palatability of the diet. The distinctive flavors of many fruits and vegetables depend upon minute quantities of certain volatile oils, many of which are lost when these foods are cooked. The culinary achievements of the home would not be possible without a variety of fats as basic ingredients. Butter and margarine enhance the acceptability of bread as well as add flavor to many cooked foods.

PHOSPHOLIPIDS. Brain and nervous tissue are especially rich in phospholipids, but all cells contain minute amounts of these lipids. Unlike neutral fats, they have a strong affinity for water, and thus they facilitate the passage of fats in and out of the cells. They probably play a role in the absorption of fats from the intestine and the transport of fats from the liver. They constitute an important fraction of the blood lipids.

ESSENTIAL FATTY ACIDS. The omission of highly unsaturated fatty acids—linoleic and arachidonic—from the diet of animals leads to failure in growth and reproduction, dermatitis, and faulty utilization and deposition of fats. Hansen[2] observed that the inclusion of these acids in the diets of infants with eczema led not only to improvement of the skin but also to greater gains in weight (see Figure 7–1). The essential fatty acids make up an important part of the esters of cholesterol in the blood. They may be involved in transport mechanisms and the permeability of the cell.

Only linoleic acid is truly a dietary essential, since the body is able to convert linoleic acid to arachidonic acid. Linolenic acid can replace some of the linoleic acid of the diet but is unable to prevent all the symptoms observed in animals. Therefore, linolenic acid is not considered as one of the essential fatty acids.

Digestion and absorption. There is no digestion of fat in the mouth and very little in the stomach. The stomach, however, is important because its churning action reduces the size of the particles and because it acts as a reservoir so that fats do not reach the intestine too rapidly. Finely divided fats such as cream and egg yolk may be broken up by gastric lipase, but the action is not important.

When fat enters the duodenum a hormone, *cholecystokinin,* is produced in the intestinal wall and carried by the blood stream to the gallbladder so as to cause its contraction. Bile, secreted by the liver and stored in the gallbladder is forced by this contraction into the common duct and thence into the small intestine. Bile stimulates the motility of the gastrointestinal tract, emulsifies the fats to provide a great increase in their surface area, and helps to provide the alkaline reaction necessary for the action of the lipase. Pancreatic lipase, also known as steapsin, is a powerful enzyme which hydrolyzes the minute fat droplets to fatty acids and glycerol. Hydrolysis is a graduated process in which one fatty acid is probably split off at the time, leaving di- and monoglycerides.

Being effective wetting agents, bile and phospholipids provide the means whereby the insoluble fats are held in solution for their absorption. Free fatty



A B

FIG. 7–1. Child, 2½ years, showing (*A*) eczema present since 2 months of age; (*B*) condition 1 month after fresh lard was added to the diet. (*Courtesy, Dr. A. E. Hansen, Galveston, Texas.*)

acids and monoglycerides are the principal forms entering the mucosa where triglycerides are again synthesized. These are taken by the lymph circulation to the thoracic duct in the form of *chylomicrons* and finally enter the blood circulation. In addition to these resynthesized fats, the products entering the lymph circulation also include small amounts of free fatty acids, mono- and diglycerides, phospholipids, cholesterol esters, and possibly some fats which have not been hydrolyzed at all. The water-soluble short-chain fatty acids and glycerol are carried directly to the liver by the portal circulation.

Digestibility of fats. As a rule, 93 to 98 per cent of the commonly used fats are digested and absorbed. An important requirement for the digestion and absorption of fats is that they must be liquid at body temperature. The fats containing short-chain fatty acids and unsaturated fatty acids have lower melting points than those composed of the long-chain and saturated fatty acids. Butter, for example, with a melting point of 75° F, is more completely absorbed than a hard fat such as beef fat which melts at 95° to 105° F. The occurrence in foods of triglycerides containing only the saturated fatty acids is small. Adults apparently metabolize all food fats quite well, but infants and aged persons show a selective absorption of shorter-chain fatty acids when the diet contains mixed fats.

That fats remain in the stomach longer than other nutrients is usually advantageous, for it prevents the early return of hunger and increases the

satiety value of small meals. Glucose absorption proceeds gradually for several hours and excessive gastrointestinal motility is avoided.

Fried foods are digested more slowly because food particles coated with fat must be broken up before they can be acted upon by the enzymes. When the frying temperature is too low, foods may absorb an excess of fat, and when the temperature is too high, the decomposition products of glycerol may be formed. In either case digestive upsets may occur, but foods fried at the proper temperatures do not cause such digestive difficulties.

Mineral oils, which are not true fats, are not absorbed from the intestine. The presence of mineral oil in the gastrointestinal tract interferes with the absorption of the fat-soluble vitamins, and there is no justification for the use of this oil with foods as in salad dressing; as a medication, mineral oil should be used with caution and never at mealtime.

Transport of lipids. In the fasting state the total blood lipids may vary from 400 to 1000 mg per 100 ml.[1] Of these, about 45 per cent of the fatty acids are in phospholipids, 35 per cent in glycerides, 15 per cent in cholesterol esters, and 5 per cent as free fatty acids. Many of the unsaturated fatty acids are carried in the cholesterol esters and in the phospholipids.

Since fats are insoluble in water, proteins provide the mechanism for their transport in the aqueous medium of the blood. Small amounts of free fatty acids are attached to albumin, but they leave the albumin with great rapidity to enter the tissue cells so that the total transport of fat in this form in a given day is extremely high. At any given time, most of the lipids in the blood are held by two main groups of lipoproteins: α-lipoproteins, or high-density lipoproteins, and several classes of β-lipoproteins, or low-density lipoproteins. Little change takes place with increasing age in the α-lipoproteins, but the various classes of β-lipoproteins increase greatly during the third, fourth, and fifth decades of life. This increase has been associated with the high incidence of coronary disease in Americans. The blood cholesterol values are often measured to determine these changes.

Numerous investigations have shown that the following dietary changes, singly or in combination, may reduce the concentrations of serum cholesterol and of one or more other lipid fractions: very low-fat diet; high proportion of polyunsaturated fat to saturated fat in a diet of usual total fat content; low-cholesterol diet; low proportion of sugars to complex carbohydrates; reduction and maintenance of weight. It is hypothesized that the reduction in blood cholesterol may reduce the incidence of atherosclerosis and the consequent coronary disease.

Following a meal rich in fat, larger particles of very low density (chylomicrons) give a milky appearance to blood serum. This change is accompanied by a more rapid clotting time of the blood. These particles are rapidly removed by the tissues where they are hydrolyzed by lipoprotein lipase. The blood serum is thus "cleared,' and the blood coagulation time once again returns to normal.

Metabolism. Fats undergo a variety of changes within the tissues. The atty acids may be modified by (1) shortening the carbon chain by stepwise emoval of two-carbon units; (2) lengthening the chain by the addition of two- :arbon units; and (3) addition or removal of double bonds. The tissues are inable to introduce a second double bond into linoleic acid; hence, it must be)rovided by the diet. On the other hand, the linoleic acid molecule may be nodified by introducing a two-carbon unit and by adding two double bonds, hus resulting in arachidonic acid. Vitamin B_6 is probably necessary for the onversion of linoleic acid to arachidonic acid.

The liver is the chief organ for fat metabolism. It is the primary site for the ynthesis of lipoproteins and phospholipids. For these syntheses, certain *ipotropic* factors are essential. These include the amino acid methionine /hich yields methyl groups for the synthesis of choline, vitamin B_{12}, betaine, nd inositol. When these factors are missing, fatty deposits accumulate in the iver.

Contrary to popular belief, adipose tissue is continually participating in ietabolism by manufacturing, storing, or releasing fats. Adipose cells ynthesize fatty acids from the two-carbon units which have originated from arbohydrates, fats, or proteins. (See Figure 7–2.) If calorie equilibrium is

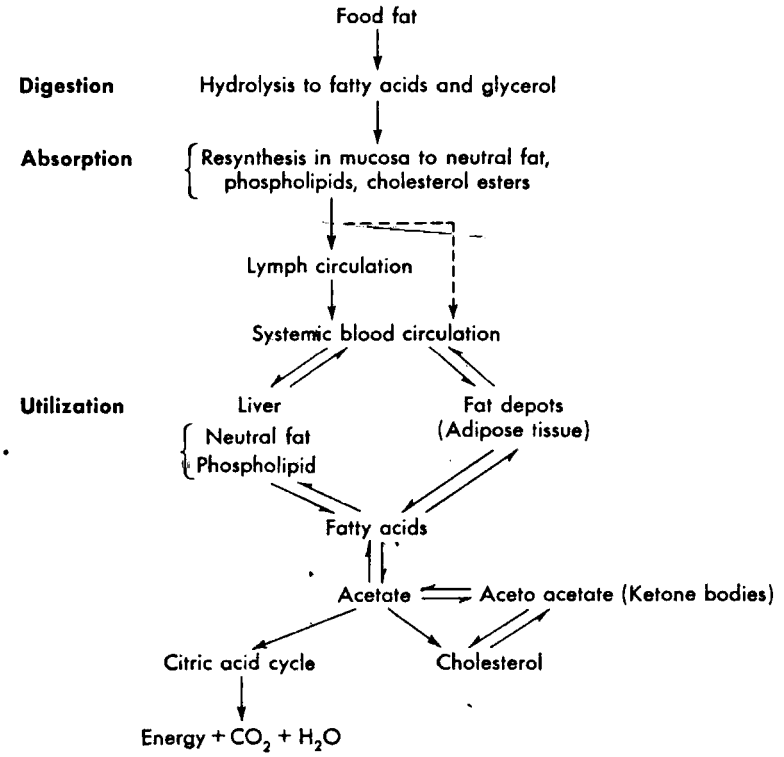


FIG. 7–2. The metabolism of fat in the body.

being maintained, synthesis and breakdown of fat tissues will be equal, but i excess calories are ingested, the adipose tissue will increase regardless of th source of the calories.

Adipose tissue releases fatty acids continuously for their oxidation b practically all cells of the body. In the breakdown of fatty acids by the tissue two-carbon fragments (acetate) are removed at the time. Coenzyme A, complex molecule containing pantothenic acid, a B-complex vitamin, i essential for this breakdown. The acetate is further oxidized through the citri acid cycle to yield energy, carbon dioxide, and water. The glycerol fractio of fats is utilized as carbohydrate; about 10 per cent of the fat molecule i thus a source of available glucose.

The rate of oxidation of fat is inversely proportional to that of carbohydrate When carbohydrate oxidation is severely curtailed, the rate of breakdown o fats may be so great that intermediate products cannot be utilized rapidl enough, and therefore they accumulate in the blood. These products know as ketone or acetone bodies include acetone, acetoacetic acid, and β-hydroxy butyric acid. They are fairly strong acids and will lower the pH of the bloo (acidosis). The conditions under which these intermediate compounds ac cumulate include (1) long periods of fasting; (2) rapid weight loss whil consuming a very low-carbohydrate, low-calorie diet; and (3) uncontrolle diabetes.

Daily allowances. From a physiologic point of view, wide variations of fa intake are compatible with good health. People of the Orient consume fa accounting for only 10 per cent of their calorie intake, while in the Unite States fat represents more than 40 per cent of the intake. Some investigator today, based upon their research, advocate drastic changes in the dietary fa as a preventive measure against coronary disease, while others hold that th evidence for such changes is by no means conclusive. The Food and Nutritio Board has taken a moderate position on this question by recommending "moderate reduction" in the total fat intake with some substitution of poly unsaturated fats for the more saturated fats.[1,3] They urge that Americans be more alert to the disadvantages of consuming large amounts of the many rich foods so abundantly available. Moreover, dietary changes should be based upon keeping the total calorie level appropriate for desirable weight and upon the selection of foods to meet all nutrient needs.

Food sources. On the basis of the food supply available for consumption, about 44 per cent of the calories are provided by fat. Three fifths of the fat comes from "invisible" sources including meat, poultry, fish, dairy products (excluding butter), eggs, and baked foods; two fifths of the fat is "visible" and includes butter, margarine, lard, bacon, oils, salad dressings, and hydrogenated shortenings.

In the 1964 food supply the principal contributors to fat in the national diet were in percentages: meat, 32; poultry and fish, 3; fats and oils, including butter, 40; dairy products other than butter, 14. All fruits, vegetables, legumes,

flour and cereal products, and cocoa products made up the remaining 11 per cent.[4]

About 4 per cent of the calories available for consumption are furnished by linoleic acid, with the rest of the fat calories being derived about equally from saturated fatty acids and oleic acid.[5] The principal sources of linoleic acid in the American diet are corn, cottonseed, and soy oils, all of which may be used in salad dressings, for frying, and for some baked products. Some margarines now being marketed are prepared from vegetable oils with a minimum of hydrogenation and are consequently much higher in linoleic acid content than are regular margarines.[6] Smaller but significant amounts of linoleic acid are furnished by fish, poultry, and pork.

Oils, lard, hydrogenated shortenings, butter, margarine, and salad dressings are the most concentrated sources of fat. Hence, a small amount will contribute importantly to the calorie level of the diet. Meats, poultry, and fish vary widely in their fat content, and the fat and calories actually ingested will depend on whether or not fat drippings are used or discarded, and whether visible fat is eaten or trimmed off as waste. Lean cuts of pork, beef, lamb, and veal do not differ greatly in their fat content.

All of the fat in the egg is in the yolk. About one third of this fat is in the form of phospholipids. Whole milk, cream, ice cream, and whole milk cheeses furnish appreciable amounts of fat. Fruits, vegetables, legumes, and flours and cereals are low in fat content. On the other hand, nuts may contribute a considerable amount of fat if they are eaten to any great extent.

The fat content of the basic diet pattern is shown in Table 7–2. Typical additions to this basic diet provide for wide variations in total fat intake and in kind of fat.

Table 7–2. Fat Content of Basic Diet

	Measure	Total Fat	Fatty Acids		
			Saturated	Oleic	Linoleic
		gm	gm	gm	gm
Milk	2 cups	18	10	6	tr
Egg	1	6	2	3	tr
Meat, fish, poultry, lean	4 ounces	10	4	5	1
Vegetables-fruits	4 servings	tr	tr	tr	tr
Bread	3 slices	3	tr	1	tr
Total Fat in Basic Diet		37	16	15	1
Typical Additions of Fat to Basic Diet					
Butter	3 teaspoons	11	6	4	tr
French dressing	1 tablespoon	6	1	1	3
Corn oil in cooked foods	1 tablespoon	14	1	4	7
Cherry pie	1 piece	15	4	10	1
Total Fat		83	28	34	12

CHOLESTEROL

Functions. Cholesterol is found in all animal tissues, being more abundan in brain and nervous tissue, the adrenal cortex, and the liver. Although the wide distribution and relatively high concentrations in actively functioning tissues of the body indicate fundamental roles, the mechanisms are poorly understood at the present time. Cholesterol and its degradation products are important constituents of bile. It serves as a precursor for vitamin D, and the exposure of the skin to sunlight results in the conversion of cholestero to the active vitamin. Structurally, cholesterol is also related to the sex hormones and the adrenocortical hormones, and possibly it serves as a starting point for the formation of some of these substances.

Dietary sources and synthesis. The body obtains its cholesterol from di etary sources and from synthesis within the body. The exogenous or dietary sources include egg yolk—the richest source, liver, kidney, brains, sweetbreads and fish roe with smaller amounts from the fat of whole milk, cheese, cream ice cream and meat. Individuals who eat no eggs or organ meats may inges as little as 200 to 300 mg per day; if they also use skim milk and no butter, the intake is further reduced to less than 100 mg daily. Those who eat one or more eggs a day and who use organ meats at regular intervals may have an intake of 1000 mg or more. A table of cholesterol values may be consulted in the Appendix (see Table A–7).

By far the most important source of cholesterol to the body is that synthesized chiefly by the liver, although the adrenal cortex, skin, and intestinal wall also possess this ability. The manufacture of cholesterol proceeds at a rapid rate with acetic acid serving as the direct precursor. It will be remembered that the two-carbon acetate grouping is available to the body from fats, carbohydrates, and amino acids which are being metabolized. The rate of synthesis keeps pace with body need; more or less will be produced depending upon the dietary intake in relation to need.

Metabolism. Cholesterol is readily absorbed into the lymphatic circulation and is carried to the liver. This organ not only synthesizes cholesterol as needed, it also regulates the level in the blood by removing the excess. Cholesterol is oxidized in the liver to bile acids or may be disposed of without change in the bile which is excreted into the small intestine.

The concentration of cholesterol is quite variable in the blood serum, values of 80 to 300 mg per 100 ml being cited for apparently healthy individuals in various parts of the world. About two thirds of this is in ester formation chiefly with unsaturated fatty acids. Being insoluble in an aqueous medium, cholesterol, like fats, is carried in the blood in combination with protein as lipoprotein.

Cholesterol metabolism is regulated by a number of hormones, including those of the thyroid, estrogens, pancreas, adrenal, and pituitary. Subnormal

activity of the thyroid gland results in a high serum cholesterol level, while in hyperthyroidism the cholesterol levels are low. Blood cholesterol levels are increased in uncontrolled diabetes mellitus, nephrosis, and xanthomatosis. Gallstones are composed chiefly of cholesterol.

In experimental animals numerous dietary factors have been shown to affect blood cholesterol levels, namely, protein, lipotropic factors (choline, methionine), vitamin B_{12}, biotin, and pantothenic acid. The dietary level of cholesterol, the quantity and nature of the dietary fat and of carbohydrate may be of some importance. For example, under certain conditions, a high fat intake in which there is a significant proportion of saturated fatty acids has led to an increase in serum cholesterol levels, while a high fat intake in which the fats were in the form of unsaturated oils, actually led to a decrease of the serum cholesterol.

PROBLEMS AND REVIEW

1. True fats contain carbon, hydrogen, and oxygen. How do they differ from carbohydrate?
2. Palmitic, oleic, and stearic acids are the fatty acids most frequently found in foods. Which of these limits the digestibility of fats? Why is this so?
3. An unsaturated fatty acid does not contain enough hydrogen to combine with all the free carbon atoms. How does this affect the hardness of a fat? Give several examples of unsaturated fatty acids.
4. What is a hydrogenated fat? Give some examples. How does it compare in nutritive value with the fat from which it was made?
5. Phospholipids, like proteins, are essential constituents of all cells. How do they differ from natural fats? Why are they so important? What are some good food sources?
6. What is meant by an essential fatty acid? Name two. In what way may, essential fatty acid deficiency manifest itself?
7. Name eight functions of fat in the body.
8. What effect will the inclusion of fatty foods such as fried potatoes and pork chops have on the digestion of the meal as a whole?
9. *Problem.* Prepare an outline which shows the digestion, absorption, and metabolism of fats.
10. What amounts of fat are desirable in the daily diet? Name six plant and six animal sources of fats.
11. List some possible results of an excessive intake of fats; of a very low fat intake.
12. *Problem.* Calculate the fat content of:

125 gm white bread
30 gm white bread with 5 gm butter
200 gm milk

13. *Problem.* Calculate your own fat intake for one day. Which of the foods you ate are good sources of linoleic acid? What percentage of the total calories in your diet was derived from fat?
14. What is cholesterol? What are some of the possible roles of cholesterol in the body?
15. How does the body obtain its supply of cholesterol?
16. A patient tells you he has not been eating eggs and butter and has been drinking no milk because he read in a magazine that cholesterol was harmful. How would you meet this situation?

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Chapter 8

ENERGY METABOLISM

The energy derived from food is used to perform the involuntary and voluntary work of the body, to maintain body temperature, and to synthesize new body constituents. In the United States, a caloric intake in excess of the body's energy requirement is so frequent that obesity has become a major health problem. In some parts of the world, however, there is never quite enough food to provide adequately for the energy needs of all of the people so that a high incidence of undernutrition results. A deficit of energy foods leads rapidly to low morale and diminished ability to do work. When plans are made for the rehabilitation of starving populations, it is not surprising, then, that the first emphasis is placed on providing an adequate source of calories.

Energy metabolism. The physicist defines energy as the capacity for doing work. The sun is the original source of all energy. Plants, through the action of chlorophyll with sunlight, store energy in the form of carbohydrate, which in turn becomes available to animals and man. Potential energy is found in the foods we eat, just as potential energy is found in coal and in many other forms of fuel.

The *law of conservation of energy,* which is a fundamental law in physics, states that energy can be neither created nor destroyed. The workings of the human body are no exception to this law. If we could keep a careful record which included the intake of food, the excretion of materials through the skin, kidney, lungs, and bowels, the heat produced in the body, and the work performed, we would find that an accurate balance exists between the energy intake and output.

No matter how slight movement may be, some fuel is required by the body. The body is frequently likened to an engine. However, when an engine stops, its use of fuel likewise stops; but with the body, as long as life goes on, there is always a need for fuel. The pulsations of the heart, the rhythmic breathing, the work of the glands in the body, and the maintenance of muscle tone are accomplished by the oxidation of foodstuffs. The maintenance of a

constant body temperature is vital. The voluntary activities of daily living impose additional fuel needs. The digestion, absorption, and assimilation of food eaten to satisfy the energy needs of these several activities require further caloric allowances.

FUEL VALUES OF FOODS

Methods of measurement. The energy exchanges of the body and the potential energy values of foods are expressed in terms of the calorie which is a heat unit. By definition, 1 *calorie* is the amount of heat required to raise the temperature of 1 kg of water 1° C. This is the large Calorie, or kilocalorie, and is 1000 times as large as the small calorie which is the unit used in physics. In nutrition literature the kilocalorie is used exclusively, and this fact is generally understood whether the word is written with a capital "C" or a small "c."

The fuel value of foods may be readily determined in the laboratory by means of an apparatus known as a bomb calorimeter, illustrated in Figure 8–1. A weighed sample of food is placed in a heavy steel container called a "bomb." After charging the bomb with oxygen, the sample is ignited and the heat is dissipated into a known volume of water surrounding the bomb. By noting the change in the temperature of the water, one can calculate the energy value of the food by applying the definition for a calorie.

Physiologic fuel factors. The caloric values of foods burned in the bomb calorimeter are somewhat higher than those realized in the body. First of all certain small losses occur in digestion for all three nutrients. For the typical mixed American diet, 98 per cent of the carbohydrate, 95 per cent of the fat, and 92 per cent of the protein are digested and absorbed. The carbohydrates and fats which are absorbed are entirely oxidized in the body as they are in the bomb calorimeter. In the case of proteins, however, the end products of metabolism are partly eliminated as urea and other organic nitrogen compounds which are combustible. In other words, the body loses part of the potential energy value of protein so that the net value is less than that measured by the calorimeter.

The "physiologic fuel factors" proposed by Atwater are based upon the corrections for losses of unabsorbed nutrients in the feces and for the caloric equivalent of the nitrogenous products in the urine. These factors are

1 gm of pure protein will yield 4 calories
1 gm of pure fat will yield 9 calories
1 gm of pure carbohydrate will yield 4 calories.

Specific fuel factors. Each food has a specific coefficient of digestibility, and thus the fuel value likewise would be specific for each given food. For example, the coefficient of digestibility for the protein in milk, eggs, and meat is 97 per cent, but for the protein of whole ground corn meal it is only 60

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FIG. 8–2. The energy expenditure for various kinds of activity may be measured by means of a portable respirometer. (*Courtesy, U.S. Department of Agriculture.*)

rapidly increases the rate of oxidation. If the subject has had any activity in the morning, he should be permitted to relax for at least one half to one hour prior to the test.

3. Free from emotional upsets or fear of the test itself. An increased pulse rate may suggest such effects.

4. In a comfortable room environment. Shivering rapidly increases the amount of oxidation in the tissues.

5. Afebrile. For each degree F rise in body temperature above normal, the metabolism is increased about 7 per cent. Thus, an individual with a temperature of 102.6° F will show an increase in the metabolic rate by 28 per cent.

Under the above conditions an individual is considered to have a normal metabolic rate if his metabolism comes within 10 to 15 per cent of the recognized standards.

Factors influencing the basal metabolic rate. The adult basal metabolic rate is approximately 1 calorie per kilogram body weight per hour or 1350 to 1700 calories daily for women and men, respectively. For most people, the basal metabolism accounts for the largest proportion of the total energy requirement. The rate of basal metabolism is affected by size, shape, and weight of an individual, body composition, age, rate of growth, the activity of the endocrine glands, and the state of nutrition.

SIZE, SHAPE, AND WEIGHT. Heat is continuously lost through the skin by radiation. Since the heat loss is proportional to the skin surface, the basal heat production is directly proportional to the surface area. A tall, thin person has a greater surface area than an individual of the same weight who is short and fat and the former therefore will have a higher basal metabolism.

BODY COMPOSITION. The rate of heat production is dependent upon the amount of active protoplasmic tissue. Again, a tall, thin person with little deposits of fat tissue is expected to have a higher rate of basal metabolism than the short, stout individual of the same weight who has larger amounts of inactive adipose tissue. Athletes show about 5 per cent higher basal metabolism than nonathletic individuals. The metabolic rate of women is 6 to 10 per cent lower than that of men, generally ascribed to the fact that men have more highly developed muscles and less inactive adipose tissue than women.

AGE. The basal metabolism during rapid growth is at a high level. The younger the individual, the higher his basal metabolism per unit of body weight, since much energy is stored for growth. The period at which the basal metabolism reaches its highest level is between the ages of 1 and 2 years. A gradual decline occurs from 2 to 5 years with a more rapid decline (except for a slight rise at adolescence) until adult age is reached. After 25 years, there is a gradual decline in the metabolic rate with each decade.

INFLUENCE OF THE ENDOCRINE GLANDS. The thyroid gland in particular exerts a marked influence on the energy requirements. If the thyroid gland is overactive (hyperthyroidism), the metabolism will sometimes be speeded up as much as 100 per cent; if the activity of the gland is decreased (hypothyroidism), the metabolism may be reduced by 30 to 40 per cent.

Instead of measuring the basal metabolism to determine thyroid function, clinical laboratories often determine the *protein-bound iodine* in the blood. This test is based upon the fact that the level of protein-bound iodine circulating in the blood is proportionate to the degree of thyroid activity. If the thyroid is hypoactive, the level of protein-bound iodine is depressed. A close correlation has been found to exist between the basal metabolism and the level of protein-bound iodine.

Other endocrine secretions may have a more transitory effect on the basal metabolism. An increased excretion of epinephrine during excitement or fear temporarily raises the metabolic rate. Disturbances of the pituitary gland may also modify the metabolic rate. Just prior to the onset of the menstrual period the metabolism is increased slightly, but it is a little lower than normal during

the period. These slight changes are of no overall significance in determining the energy requirement.

EFFECT OF STATE OF NUTRITION. An individual who has been chronically undernourished is likely to have a lower basal metabolic rate. Analyses of metabolism in "naturally occurring" starvation and of experimental starvation "indicate that the oxidative rate of the active tissues deviates little, if at all, from the metabolic rate of the active mass under normal conditions. The observed decrease in basal metabolism is almost completely accounted for by the decrease in mass of active tissues." *

Depending upon the circumstances, undernourished children may have an increase or a decrease of the basal metabolic rate. Underweight school children sometimes show an increased rate because of the high percentage of active lean tissues as compared with very little inactive adipose tissue. When undernutrition is severe, the destruction of body tissues is likely to lower the rate.

EFFECT OF PREGNANCY. During the last trimester of pregnancy the basal metabolism increases from 15 to 25 per cent. This increase can be accounted for almost entirely by the increase in weight of the woman and the high rate of metabolism of the fetus.

Factors influencing the total energy requirement. Superimposed upon the energy expenditure for maintaining the involuntary activities of the body are such factors as voluntary muscular activity, the effect of food, and the maintenance of the body temperature.

EFFECT OF MUSCULAR ACTIVITY. Next to the basal metabolism, activity accounts for the largest energy expenditure; in fact, for some persons who are vigorously active, the energy needs for activity may exceed those for the basal metabolism. Sedentary work, which includes office work, bookkeeping, typing, teaching, and so forth, calls for less energy than more active and strenuous occupations such as nursing, homemaking, or gardening. A still greater amount of energy is required by those individuals who do hard manual labor such as ditch digging, shifting freight, and lumbering. The energy expenditure for many activities has been measured in adults and children,[2,3] and the data serve as a guide in setting standards for various groups of people. A few examples are given below of the number of calories expended in 1 hour by a woman weighing 120 pounds. These figures include the basal allowance.

	CALORIES PER HOUR
Awake lying still (basal rate)	56
Sitting quietly	72
Typing rapidly	102
Dishwashing	104
Sweeping the floor	122
Walking slowly (2.6 miles per hour)	145
Walking moderately fast (3.75 miles per hour)	217
Swimming	362

* Review: "The Metabolic Rate in Semistarvation," *Nutrition Rev.*, 6:311, 1948.

If an exact record of activity for a given 24-hour period were kept, it would be possible with data such as the above to estimate the daily caloric requirement of an adult. However, such calculations are time consuming and give, at best, only rough approximations since individuals vary widely in the efficiency of their work and in their muscle tone.

The figures above illustrate the value of exercise in weight control, for it is quite evident that the student who sits quietly watching television, for example, is expending only half as many calories as one who is walking leisurely, and only one fifth as many calories as one who swims for an hour.

Not infrequently the question is raised as to the reason for the differing caloric needs of two people of the same build and body weight who are doing the same kind of work. The energy needs will be greater for the person who wastes many motions in the performance of a piece of work, who works under greater muscle tension, or who finds it difficult to relax completely even when at rest.

EFFECT OF MENTAL EFFORT. Nervous tissue accounts for about 2 per cent of the body weight and the energy expenditure of the body is not appreciably increased even with intense mental effort such as that expended in writing examinations. Some students may become tense and restless in the solving of problems, but the increased energy expenditure in such a situation is not primarily the result of mental work.

EFFECT OF FOOD. A certain amount of work is expended in the digestion of food, its absorption, its transfer to the tissues, and its utilization. The increased heat production as the result of the ingestion of food is known as the *specific dynamic action*. Protein when eaten alone has been shown to increase the metabolic rate by 30 per cent, while carbohydrates and fats will produce much smaller increases in metabolism. On the basis of the mixed diets usually eaten, the specific dynamic action is approximately 6 per cent of the energy requirement.[4]

MAINTENANCE OF BODY TEMPERATURE. Under normal conditions the temperature of the body is controlled by the amount of blood brought to the skin. When the surrounding temperature is low, most of the heat is lost by radiation and conduction; but when the environmental temperature is high, the body heat is lost chiefly through evaporation. It is a well-known fact that more heat is lost by evaporation when the air is dry than when it is humid.

During cold weather, man avoids excessive heat losses from his body by the use of suitable clothing and the heating of his home or place of work. Moreover, body heat is conserved if there is a layer of adipose tissue under the skin. The subcutaneous fat serves to keep heat in the body rather than allowing it to be dissipated through the skin—an advantage in cold weather, but a disadvantage in warm weather.

When the body is subjected to extreme cold, the body temperature is maintained by an increase in involuntary and often by voluntary activity. The

blood vessels constrict so that there is less blood reaching the skin surface; the muscles become tense; and shivering follows. These involuntary activities result in a considerable increase in the metabolic rate. As anyone knows who has been exposed to a cold winter day, one is not likely to stand still. In addition, then, to the increased energy expenditure occasioned by the involuntary activities, the individual increases his voluntary activity.

EFFECT OF GROWTH. The building of new tissue represents a storage of energy in one form or another; for example, every gram of protein in body tissue represents about 4 calories. When growth is rapid, as during the first year of life, the energy allowance must be high. In fact, the caloric need is greater per unit of body weight at this time than at any other time in life. In pregnancy, likewise, the energy needs are increased to cover the building of new tissue. These needs are discussed in more detail in Chapters 22, 23, and 24.

CALORIC ALLOWANCES

Daily allowances. The Recommended Dietary Allowances[5] for calories take into account sex, body size, age, climate, and activity. They are based on the maintenance of optimum body weight or a suitable rate of growth and must be adjusted upward or downward to meet individual needs. The allowances are a rough guide in dietary planning for groups; they may vary widely for any given individual. The bases for these allowances are described in the following paragraphs.

REFERENCE STANDARD. The recommended allowances are stated in terms of the reference man and woman. The man and woman are in good health, 25 years of age, live in an environment with a mean annual temperature of 20° C (68° F), and weigh 70 kg (154 lb) and 58 kg (128 lb), respectively. They lead a moderately active, healthy life and are engaged in occupations that could be described neither as sedentary nor as hard physical labor. The allowances for the American man and woman have been adjusted downward from the recommendations made by the Committee on Calorie Requirements of the Food and Agriculture Organization of the United Nations.

ADJUSTMENT FOR BODY SIZE. Caloric allowances should be based on the desirable weight for height and health (see Tables A–14 and A–15). Table 8–1 gives the allowances for individuals whose weight differs from that of the reference man and woman.

ADJUSTMENT FOR AGE. The allowances are stated for the average needs of individuals; thus, the allowance at 25 years includes the period from 18 to 35 years, and so on. Between 35 and 55 years the caloric allowances are reduced 5 per cent for each decade; from 55 to 75 years they are decreased 8 per cent for each decade, and from 75 years and beyond a further decrease of 10 per cent is made. These corrections have been applied to individuals of 45 and 65 years in Table 8–1.

Table 8–1. Caloric Allowances for Individuals of Various Body Weights and Age*

(At mean environmental temperature of 20° C and assuming *moderate physical activity*)

Desirable Weight		Caloric Allowances for Men			Caloric Allowances for Women		
Kilograms	*Pounds*	*25 years*	*45 years*	*65 years*	*25 years*	*45 years*	*65 years*
40	88				1600	1450	1200
45	99				1750	1600	1300
50	110	2300	2050	1750	1900	1700	1450
55	121	2450	2200	1850	2000	1800	1550
58†	128				2100	1900	1600
60	132	2600	2350	1950	2150	1950	1650
65	143	2750	2500	2100	2300	2050	1750
70**	154	2900	2600	2200	2400	2200	1850
75	165	3050	2750	2300			
80	176	3200	2900	2450			
85	187	3350	3050	2550			

* Food and Nutrition Board: *Recommended Dietary Allowances.* Pub. 1146. National Academy of Sciences, National Research Council, Washington, D.C., 1964, p. 5.

† Reference woman weighs 58 kg.

** Reference man weighs 70 kg.

ADJUSTMENT FOR CLIMATE. In summer and winter most Americans live in an environmental temperature of about 20° C. In winter they wear warm clothing, live and work in well-heated buildings, and travel by heated means of transportation. Likewise, in summer many of them live and work in air-conditioned buildings. Therefore, adjustments for temperature are not usually necessary.

A small increase in calories may be necessary in winter for the person carrying a weight of heavy clothing. When a person is inadequately clothed, the calorie expenditure may increase considerably.

Men doing a given work at high temperature (above 37.8° C) require a slight increase in calories because of increase in metabolic rate and extra energy expenditure to maintain normal body temperature. Most individuals tend to reduce activity in hot weather and thus reduce their caloric need.

ADJUSTMENTS FOR ACTIVITY. Today the average work week is 35 to 40 hours; sleep may account for 50 to 60 hours; eating and travel to and from work may consume 20 hours, more or less; and leisure time may amount to 50 or 60 hours in a given week. The leisure activities may range from reading, watching television, movies, or stamp collecting, on the one hand, to such vigorous activities as tennis, gardening, golf, and swimming, on the other hand. Obviously, to set up a caloric allowance in terms of one's activity at work alone is to ignore a large part of one's day.

The recommended allowances are set up in terms of the general average of the population, but individuals will differ widely. Only rarely will these allowances need to be increased by more than 25 per cent for the healthy adult. For many Americans who are sedentary in their occupations and who are also inactive in their leisure, the allowances are too high.

The best guide to the adequacy of the caloric allowances lies in the maintenance of desirable weight. Individuals should be encouraged to weigh themselves at regular intervals. Thus, the insidious and undesirable increases in body weight over desirable levels may be checked by appropriate reduction in the intake of energy-rich foods. Likewise, suitable rates of growth may be maintained. The dangers of excessive weight gain, or of underweight, are discussed in Chapter 32.

Selecting foods for energy. The inclusion of minimum amounts of each of the Four Food Groups provides energy at approximately basal levels for the adult (see Figure 8–3). To complete the caloric requirement, any foods desired may be selected. More foods from the bread-cereals group will not only increase the caloric intake at low cost, but will enhance the protein, iron, and B-complex vitamin level of the diet. The selection of additional foods from the other three groups will increase the caloric level of the diet in varying degree and provide further nutritional benefits in protein, minerals, and vitamins.

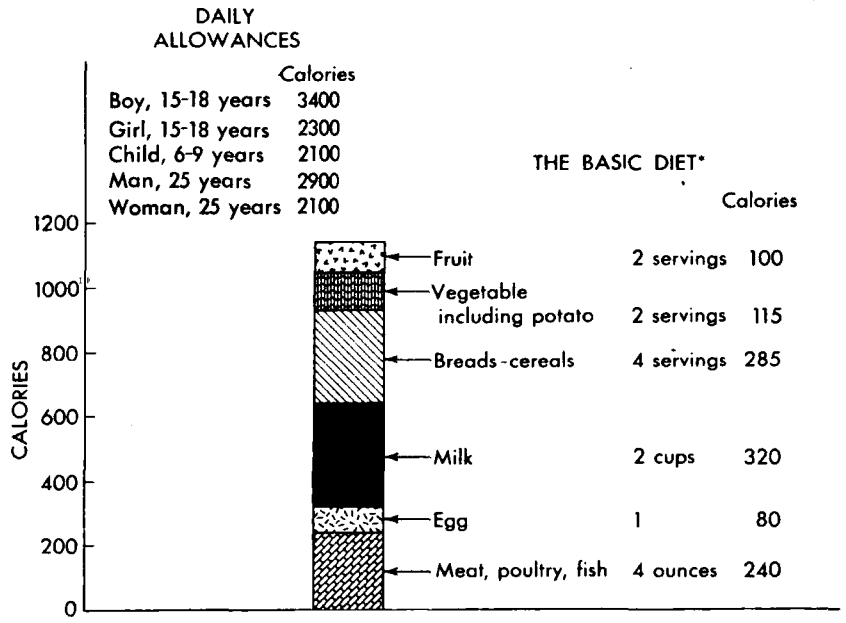


FIG. 8–3. The Basic Diet provides just over half of the energy requirement of the teen-age girl and the woman of 25 years. See Table 14–2 for complete calculation.

Fats and sugars are concentrated sources of energy and may be used to rapidly increase the caloric level of the diet. They have a legitimate place in the diet, but it must be borne in mind that fats (except butter and fortified margarine) and sugars do not contain protein, minerals, and vitamins. When they constitute a large proportion of the total calories in the diet, there is danger that other nutrient needs will not be met. Too many Americans select diets in which fats and sugars provide one third or more of the calories. This is an important area for nutrition education.

PROBLEMS AND REVIEW

1. Define or explain what is meant by calorie; basal metabolism; bomb calorimeter; respiratory calorimeter.
2. *Problem.* On the basis of protein, fat, and carbohydrate composition, calculate the energy value of

240 gm milk
160 gm orange
20 gm dry oatmeal

3. *Problem.* Calculate the number of grams required of each of the following foods to furnish 100 calories: butter, milk, cheese, egg, potato, apple, banana, orange, sugar, bread, and lean beef.
4. The use of Atwater's physiologic fuel values is not desirable for calculating the caloric value of a diet composed chiefly of cereal foods. Why?
5. The basal metabolism is the rate of oxidation occurring in the body at rest. What are the standard conditions for performing the test? What factors might make the basal metabolism of two adult individuals of the same age vary? How does age itself affect basal metabolism?
6. *Problem.* Each liter of oxygen consumed by an individual on a mixed diet is equal to about 4.8 calories. What is the basal caloric need per 24 hours of a nurse who consumed 2 liters oxygen during a 10-minute test?
7. Explain how the following factors affect the total energy requirement of an individual: muscular activity; food; climate; clothing; growth; muscle tension; endocrine secretions. Which usually has the greatest effect?
8. *Problem.* Calculate the caloric value of your own meals for one day. How does this compare with your estimated requirement?
9. *Problem.* What proportion of your own caloric requirement is provided by the basic diet (Table 14–2)? What is the most economical way in which you can complete your requirement of energy using this basic diet?
10. Why would you expect the caloric requirement of many poor people to be higher during cold weather than that of people in better economic circumstances?
11. What is the best indication of adequate caloric intake?

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Chapter 9

MINERAL ELEMENTS

Mineral composition of the body. About 4 per cent of the body weight is made up of the elements usually designated as minerals. These may be defined as those elements which remain largely as ash when plant or animal tissues are burned. Calcium and phosphorus account for three fourths of the mineral elements in the body, and five other elements account for most of the rest. Many of the elements are present in such minute amounts that they are generally referred to as *trace elements* or *micronutrients*. Some of the trace elements are essential to body functions, while others may be present as contaminants. As research is extended, it may be that some of the latter are also found to have an essential function. Table 9–1 summarizes the mineral composition of the body, including approximate concentrations of many of them.

General functions. Mineral elements are present in organic compounds such as phosphoproteins, phospholipids, hemoglobin, and thyroxine; as inorganic compounds such as sodium chloride and calcium phosphate; and as free ions. They enter into the structure of every cell of the body. Hard skeletal structures contain the greater proportions of some elements such as calcium, phosphorus, and magnesium, while soft tissues contain relatively higher proportions of potassium.

Mineral elements enter into numerous regulatory activities of the body. The contraction of muscles, the normal response of nerves to stimulation, the control of water balance, the maintenance of acid-base equilibrium, and the metabolism of foodstuffs are but a few of the numerous functions.

The amount of an element present gives no clue to its importance in body functions. It will be shown, for example, that a few milligrams of an element such as iodine can make a critical difference in the health of an individual.

Mineral elements are interrelated to each other and to the organic compounds in their functioning. Thus, sodium, potassium, calcium, phosphorus, and chlorine are all essential constituents of body fluids; the response of the muscle fiber, for example, depends upon not one but all of these elements being present in the correct concentrations. Likewise, calcium, magnesium,

Table 9–1. Mineral Composition of the Body

	Amount in the Body*		Micronutrients (no estimates of amounts)	
	Per Cent	Per 70 Kilograms Gm		
Major Elements			**Essential for Body Functions**	
Calcium	1.5–2.2	1050–1540	Cobalt	
Phosphorus	0.8–1.2	560–840	Fluorine	
Potassium	0.35	245	Zinc	
Sulfur	0.25	175	**Probably Essential**	
Sodium	0.15	105		
Chlorine	0.15	105	Chromium	
Magnesium	0.05	35	Molybdenum	
			Selenium	
Micronutrients			**No Known Function**	
Iron	0.004	2.8	Aluminum	Cadmium
Manganese	0.0003	0.21	Arsenic	Lead
Copper	0.00015	0.105	Barium	Nickel
Iodine	0.00004	0.024	Boron	Silicon
			Bromine	Strontium
				Vanadium

* Calculations are on the basis of elementary composition of the body as stated by H. C. Sherman in *Chemistry of Food and Nutrition*, 8th ed. The Macmillan Company, New York, 1952, p. 227.

phosphorus, and others are bone constituents; a deficiency of one element will obviously affect the functioning of the others. Iron, copper, and cobalt function in an interrelated manner together with protein, vitamin B_{12}, and other nutrients for the synthesis of hemoglobin and the red blood cells.

The problem of optimum mineral intake. For the normal adult a state of equilibrium is usually desirable with respect to the minerals; that is, the intake should equal the amount which is excreted. A continual exchange of mineral elements occurs in the body, as may be ascertained by the use of radioactive tracers. For example, bone is not an inert substance in any sense of the word but is exceedingly active in its uptake and release of mineral constituents. Other tissues are in an equally dynamic state of equilibrium. The determination of the levels which best maintain the state of equilibrium is highly complex because the body has the ability to adapt to varying levels of intake. The results of many earlier balance studies on calcium, for example, have been seriously questioned because the balance periods were too short to take such adaptation into account.

The minerals are eliminated by various routes; namely, the kidney, the bowel, and the skin. Some are excreted by all three routes, while others may be lost primarily from the kidney or the intestine. About one fourth of the solid

material of urine consists of minerals, and approximately one tenth of the solid material of feces is mineral matter.

During growth, pregnancy, and lactation it is necessary that the intake of certain minerals be sufficient to allow for the building of new tissue, or in other words, that a state of positive balance exist.

Many minerals are essential for good nutrition; but if calcium, iron, and iodine are provided in adequate amounts, there is scant likelihood that dietary deficiency of other minerals will occur. Special consideration will then be given to these three minerals with a brief discussion of the other equally important but seldom deficient minerals.

In the selection of foods one should keep four points in mind: (1) the richness of the mineral in the food; (2) how much of the particular food is to be used; (3) whether the food has lost some of its minerals through refinement or cooking processes; and (4) whether the food contains the mineral in an available form.

CALCIUM

Functions. Calcium is by far the most abundant mineral element in the body, about 99 per cent of it occurring in the bones and teeth. Bone consists of an organic matrix of insoluble protein, chiefly collagen, into which are embedded the various mineral compounds. Most of the calcium is in the form of a complex salt called hydroxyapatite, $Ca_{10}(PO_4)_6(OH)_2$, with smaller amounts being associated with carbonate and citrate.

Bones are also a storehouse of calcium, the ends of the bones in the well-nourished individual being especially rich in needlelike crystals of calcium salts, called *trabeculae*. The surfaces of these crystals give an exceedingly great area from which rapid interchange with the blood circulation takes place. The blood concentration is maintained at constant levels to provide for the regulatory functions of calcium.

Only 1 per cent of the body calcium is found in the blood, other body fluids, and soft tissues. Its presence in proper proportions with sodium, potassium, and magnesium is necessary in the fluids which bathe the tissues and which are responsible for contraction of muscle fibers; the rhythm of the heartbeat is dependent upon this fluid medium. Calcium is one of several factors in blood coagulation, in the normal response to nervous stimuli, in cell permeability, and in the activation of some enzymes.

Sherman has shown that a generous intake of calcium leads to greater vitality and size of experimental animals, and that this improvement results in a longer prime of life. It is reasonable to suppose that such benefits will accrue to human beings as well if the calcium intake is optimum.

Metabolism. Calcium is absorbed only from the small intestine, most of the absorption occurring in the upper part of the intestine (see Figure 9–1).

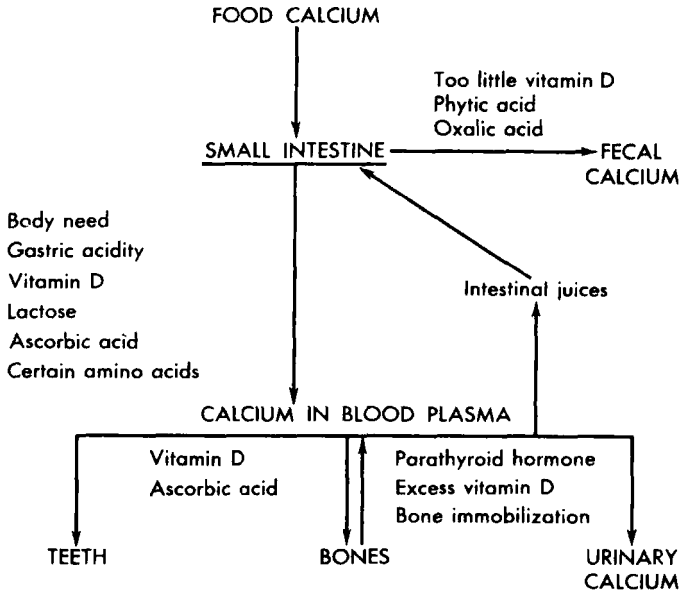


FIG. 9–1. Utilization of calcium.

The amount of calcium absorption is most directly influenced by the body need. During growth and in pregnancy and lactation the amount of calcium absorbed is much greater than it is in periods of maintenance. The body has an adaptive mechanism for the regulation of calcium absorption. An individual who has been receiving a high-calcium diet will show a negative calcium balance when he is given a low-calcium diet, but in time he will return to a state of equilibrium at the lower level. If the body need is great and the dietary level is low, the percentage of absorption will be greater than that observed in those who have less body need. Probably 30 to 40 per cent of the dietary calcium is absorbed on the average, but this level is increased during periods of rapid growth.

Calcium salts are more soluble in acid solution, and thus the acid reaction of the gastric juice favorably influences absorption. Vitamin D is concerned with the optimum absorption of calcium. Likewise, lactose, certain amino acids, and ascorbic acid favor the absorption of calcium, at least in experimental animals. Greenwald and his associates[1] found no beneficial effect by adding lactose to high-calcium intakes of two osteoporotic women and one postsurgical hypoparathyroid man.

On the other hand, oxalic acid, phytic acid, an excessive intake of fat, poor digestion of fat, and excessive fiber may interfere with the absorption of calcium. Oxalic acid is an organic acid occurring in such foods as spinach, beet greens, chard, cocoa, and rhubarb. It combines with calcium to form an insoluble salt which cannot be absorbed. While spinach, for example, contains an appreciable amount of calcium, the combination with oxalic acid renders the calcium unavailable. However, the inclusion of spinach in the diet does not

adversely affect the calcium utilization of other foods.[2] Cocoa, in the amounts used by humans, has no adverse effect on calcium utilization.

Phytic acid occurs especially in the bran layer of cereal grains. Like oxalic acid, it combines with calcium to form an insoluble salt. The relatively small consumption of whole-grain cereals together with the liberal intake of calcium and vitamin D in the United States makes this factor of limited importance.

Calcium may combine with fats to form insoluble calcium soaps. When fats are poorly absorbed as in sprue, for example, the amount of calcium absorbed may be so small that bone changes are sometimes observed in the patient.

Calcium is transported throughout the body by means of the blood circulation. The parathyroid hormone maintains a constant blood calcium concentration of 9 to 11 mg per 100 ml, of which about 60 per cent is ionized and the remainder is bound to protein. When the blood calcium level is reduced, calcium is mobilized from the bone; when the blood level is increased some absorption occurs into the bone and some excretion occurs into the urine. Vitamin D is essential for the anchorage of calcium in the bone and also for the release of labile calcium from the bones.

The daily losses of calcium in the urine average 175 mg in the adult, but individuals vary widely. In addition, about 20 mg calcium is excreted in the sweat, with considerably increased amounts during heavy perspiration. Fecal calcium includes (1) approximately 125 mg derived from the digestive juices and (2) unabsorbed dietary calcium. The total endogenous losses are about 320 mg daily.

Daily allowances. The Food and Nutrition Board[3] has set the calcium allowance for the adult at 0.8 gm. This assumes that 40 per cent of the dietary calcium will be absorbed, thus fully covering the 320 mg lost in urine, feces, and sweat each day.

During periods of growth, in pregnancy, and in lactation additional calcium is needed. For the first 9 years 0.8 gm calcium is recommended. Children 9 to 12 years should have 1.1 gm, and boys and girls from 12 to 18 years 1.3 gm. During pregnancy and lactation, the calcium allowance has been set at 1.3 gm.

The recommendations of the FAO/WHO Expert Committee[4] for calcium are somewhat lower than the levels cited above. This committee has recommended 400 to 500 mg calcium as a "practical allowance" for adults.

Food sources of calcium. The calcium content of some typical foods is shown in Table 9–2, while the calcium contribution of the basic diet pattern is charted in Figure 9–2. Milk is the outstanding source of calcium in the diet; without it, a satisfactory intake of calcium is extremely difficult. Whole or skimmed, homogenized or nonhomogenized, plain or chocolate-flavored, sweet or sour milks are equally good. For the adult 2 to 3 cups milk daily and for the child 3 to 4 cups daily will ensure adequate calcium intake. Cheddar cheese is an excellent source of calcium. Cottage cheese and ice cream are good sources but will not adequately substitute for milk. The dairy products, excluding butter, account for three fourths of the calcium in the American dietary.

Table 9–2. Calcium Content of Some Typical Foods

	Household Measure	Calcium mg	Per Cent of Adult Daily Allowance*
Milk, fresh	1 cup	288	36
Milk, nonfat dry	3 tablespoons	288	36
Cheese, American process	1 ounce	219	27
Salmon, pink, canned	3 ounces	167†	21
Collards, cooked	½ cup	145	18
Turnip greens, cooked	½ cup	133	17
Clams or oysters	½ cup	113	14
Mustard greens, cooked	½ cup	97	12
Shrimp	3 ounces	98	12
Ice cream	⅛ quart	87	11
Cottage cheese, uncreamed	3 ounces	78	10
Kale, cooked	½ cup	74	9
Broccoli, cooked	½ cup	66	8
Molasses, light	1 tablespoon	33	4
Egg, whole	1 medium	27	3
Cabbage, raw, shredded	½ cup	25	3
Carrots, cooked	½ cup	24	3
Bread, 4 per cent nonfat dry milk	1 slice	19	2

* Recommended Dietary Allowance of calcium for the adult is 800 mg.
† Includes bones packed with salmon.

All of the foods other than dairy products when considered together contribute not more than 0.2 to 0.3 gm calcium daily. Certain green leafy vegetables such as mustard greens, turnip greens, kale, and collards are important sources of calcium when they are eaten frequently. Canned salmon with the bones, clams, oysters, and shrimp are likewise good sources, but they are not eaten with frequency. Meats and cereal grains are poor sources. The use of nonfat dry milk in bread enhances the calcium value of the diet. Calcium is also an optional enrichment ingredient in flours and breads.

Various calcium salts such as calcium gluconate, lactate, carbonate, and sulfate are sometimes prescribed by a physician to supplement the dietary intake, especially when milk cannot be taken for one reason or another. Calcium in organic compounds and in inorganic salts is well utilized, but it must be remembered that the substitution of salts for milk as a source of calcium deprives the diet of important amounts of riboflavin, protein, and other milk nutrients.

Effect of calcium deficiency. Suboptimal intakes of calcium may result in retarded calcification of bones and teeth in the young. Acute deficiency of calcium is not usually seen unless there is a concurrent lack of phosphorus and vitamin D. Such deficiency leads to stunted growth and rickets, as evidenced by bowing of the legs, enlargement of the ankles and wrists, and a hollow chest (see p. 149).

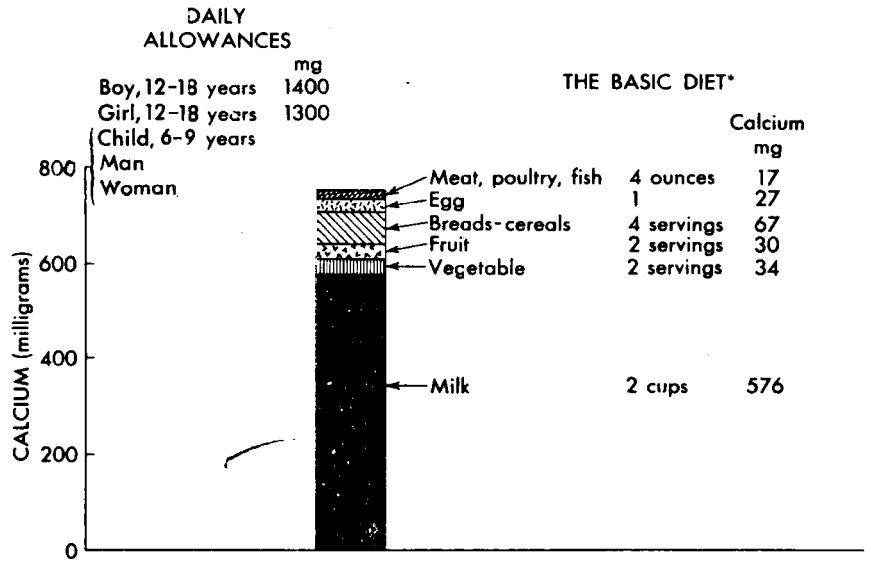


FIG. 9–2. The milk group provides almost three fourths of the calcium allowance of the adult. The addition of 1 to 2 cups of milk ensures sufficient calcium during growth, in pregnancy, and in lactation. See Table 14–2 for complete calculation.

It is a misconception that adults are not subject to calcium deficiency. The gradual drainage from the bones to replace calcium ions which are lost from the body daily may not be detected by x-rays until 10 to 40 per cent of the calcium has been removed. Calcium deficiency leads to thin, fragile bones which break easily, and which heal with difficulty. Osteomalacia and osteoporosis may result from deficiencies of calcium and vitamin D. See page 151 for a more detailed discussion of osteomalacia.

Hypercalcemia. In recent years several reports have been published concerning the milk-alkali syndrome.[5] This condition is characterized by an excess of calcium in the blood and the soft tissues, by vomiting, gastrointestinal bleeding, and high blood pressure. It occurs occasionally in patients who have peptic ulcers and who have used excessive alkali therapy in conjunction with large amounts of milk over a period of years. It does not occur in the absence of alkali therapy even though large amounts of milk are taken, nor does it occur when nonabsorbable antacids are used in ulcer therapy.

Hypercalcemia may also occur in young children who are given an excess of vitamin D. Gastrointestinal upsets are noted, and growth is retarded. The condition is corrected by the removal of vitamin D.

PHOSPHORUS

Phosphorus ranks next to calcium in the total amount of mineral present in the body and constitutes about one fourth of all body minerals. Approximately

80 per cent of the phosphorus is combined in bone structures with calcium, while the remainder is in the soft tissues and fluids of the body.

Phosphorus probably has more functions than any other mineral element. It is an essential constituent of (1) the mineral salts in bones and teeth, (2) the buffers in the blood for the regulation of acid-base balance, (3) the phospholipids that regulate the transport of fatty acids, (4) adenosine triphosphate which supplies the energy for muscle contraction, and (5) enzymes that participate in the metabolism of carbohydrates and fats.

A diet consisting of natural foods and containing enough protein and calcium will also contain enough phosphorus. The adult requires about 1.2 gm phosphorus, while the infant, the child, and the pregnant or lactating woman should receive equal amounts of calcium and phosphorus. Thus, the pregnant woman whose calcium allowance is 1.5 gm should also receive 1.5 gm phosphorus.

Phosphorus occurs in combination with protein as phosphoproteins in the casein of milk, and as nucleoproteins in egg yolk; as phospholipids; and as phosphoric esters of carbohydrate. Excellent food sources are milk, cheese, egg yolk, meat, fish, and fowl. While whole-grain cereals are high in phosphorus, much of the phytin phosphorus is not utilized if the vitamin-D level of the diet is inadequate.[6] Vegetables and fruits are rather low in their phosphorus content. (See also Table A–6.)

IRON

The amount of iron in the adult body is about 3 to 5 gm. About 70 per cent is in the circulating hemoglobin, 4 per cent in the myoglobin of the muscle, and 25 per cent in the stores held in the liver, bone marrow, spleen, and kidneys. The remaining 1 per cent is accounted for by the plasma iron and by various oxidative enzymes.

Functions. Iron is essential for the oxidative processes in the body and as such is found in every cell. Hemoglobin is a complex substance composed of the protein, globin, and an organic iron compound, heme. Hemoglobin combines with oxygen in the lungs to form oxyhemoglobin and is carried to the tissues by the blood circulation. The oxygen is released from the hemoglobin in the tissues. On its return to the lungs hemoglobin serves as a carrier for some of the carbon dioxide, but most of the carbon dioxide is removed by means of the bicarbonate ion.

Myoglobin is an iron-protein complex in the muscle which stores some oxygen. Several oxidative enzymes such as catalase and cytochrome oxidase contain iron as an integral part of the molecule. Other enzymes are activated in the presence of iron.

Metabolism. Since iron is more soluble in the acid medium, most of the absorption takes place from the duodenum and upper jejunum. Ferrous iron is more readily absorbed than ferric iron. Reducing agents such as ascorbic

acid and vitamin E aid in changing the ferric iron to the ferrous state. The hydrochloric acid in the stomach also aids in this change. (See Figure 9–3.)

The mechanism by which iron is absorbed into the circulation is not fully understood, but it has been established that the rate of absorption is governed by body need. Less than 10 per cent of dietary iron is absorbed by the healthy adult, but infants, growing children, and pregnant women absorb iron at somewhat higher rates to provide for the increased body needs. Moore[7] found that absorption of iron by anemic individuals ranged from 45 to 64 per cent.

Iron in the circulating plasma is in the form of a protein-iron complex called *siderophilin,* and originates from three sources: (1) iron released from the continuous breakdown of hemoglobin in the red blood cells, (2) iron stores of the body, and (3) absorbed dietary iron. The level of the plasma iron is a

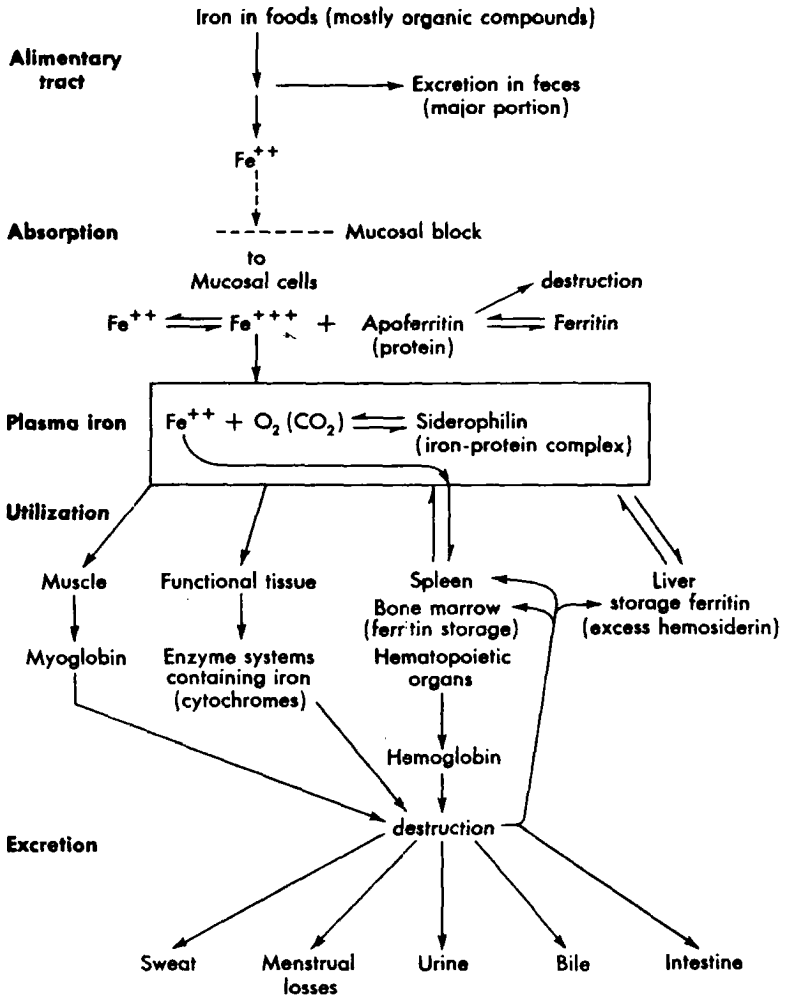


FIG. 9–3. Utilization of iron by the body.

reliable index to the state of iron nutrition, but the determination of hemoglobin levels is more widely used in clinical laboratories.

Iron is withdrawn from the plasma into the bone marrow for the synthesis of hemoglobin. Minute traces of copper are necessary for the construction of hemoglobin, although copper itself is not a part of the molecule. The body exercises amazing economy in the use of iron. When the red blood cell has fulfilled its life cycle of perhaps 100 days, more or less, the worn-out cell is broken down by the liver or spleen so that the iron may be saved for new hemoglobin. It has been estimated that 27 to 28 mg iron may be thus released daily and used over again.[8]

Iron is excreted daily in the urine, sweat, hair, and desquamation of skin. The daily loss of iron in male adults and in postmenopausal women averages 1.0 mg. Menstrual losses vary widely, with the average daily loss being 1.0 mg. Thus, the premenopausal woman loses about 2 mg iron per day.

The fecal iron represents unabsorbed dietary iron, which is, on the average, 90 per cent of the intake. A small amount of fecal iron would also be derived from the breaking down of mucosal cells, but there is very little iron excreted into the intestines from the blood circulation.

Daily allowances. Dietary iron is required for (1) replacement of the daily losses in all individuals; (2) an expanding blood volume and increasing amounts of hemoglobin in growing children; (3) replacement of varying losses through menstruation; (4) development of the fetus and to avoid anemia in pregnant and lactating women; and (5) a reserve of iron which is available when blood loss occurs from any cause whatsoever.

The recommended allowance for men and for postmenopausal women is 10 mg daily, and for women between the ages of 18 and 55 years, 15 mg. The diet of children should contain 8 to 12 mg during the first 9 years and thereafter 15 mg throughout the adolescent period. During the second and third trimesters of pregnancy and during lactation the allowance for women should be increased to 20 mg.

Food sources of iron. Of all nutrients, the iron allowance is most difficult to provide in the diet. From Figure 9–4 it becomes evident that the Four Food Groups provide a satisfactory level for the adult male, but that this dietary guide does not ensure sufficient iron for women and teen-agers. Three of the four groups contribute significant and approximately equal amounts of iron. Milk, cheese, and ice cream are poor sources of iron, a fact which explains why iron-rich foods are introduced early into the infant's diet.

To furnish sufficient iron in the diet of women and teen-agers requires care in the selection of foods that make up the calories for the day. Usually, boys obtain an adequate intake because of their relatively high caloric requirement and the associated consumption of enriched breads, meat, and other such foods. Women, with their lower caloric requirement, can ill afford to include a substantial amount of calories from the "empty calorie" foods such as sweets and fats. Their choice should be directed to more of the iron-rich foods of the Four Food Groups.

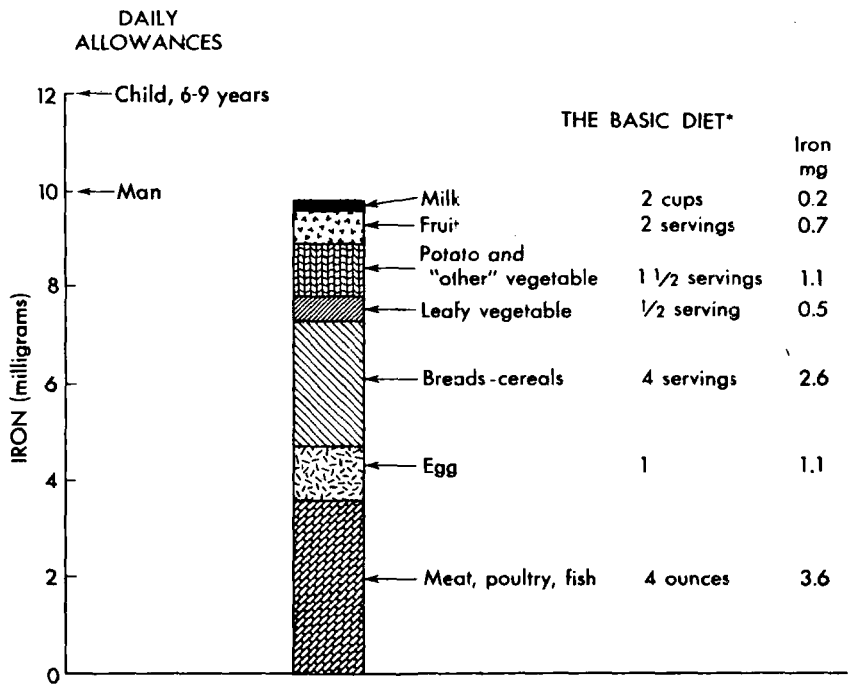


FIG. 9–4. The Four Food Groups of the Basic Diet fulfill the iron allowance for the man. To meet the recommended allowances, the teen-age girl and young woman must choose most of the daily foods from the Four Food Groups with added emphasis on enriched cereals and breads, meats, and dark-green, leafy vegetables. See Table 14–2 for complete calculation.

All varieties of liver are excellent sources of blood-regenerating factors. Other organ meats, lean meats, shellfish, and egg yolk are good sources. Certain fruits such as peaches, apricots, prunes, grapes, and raisins are good sources if they are eaten fairly often. Green leafy vegetables, whole-grain and enriched cereals and breads, legumes, and dark molasses are also significant sources. The widespread enrichment of cereals and flours has been a decided factor in the improvement of the iron intake in recent years.

Effect of deficiency. An inadequate intake of iron will lead eventually to hypochromic anemia, but the incidence of this type of anemia in the United States is not known. In iron-deficiency anemia the hemoglobin content of the red blood cells is reduced and the cells appear pale when seen through a microscope; hence, the designation "hypochromic." The reduced hemoglobin level means that less oxygen can be carried per unit of time to the tissues. Consequently the oxidative processes are more limited, and weariness and shortness of breath are associated symptoms.

Infants, adolescent girls, and pregnant women are especially prone to anemia if the dietary intake is inadequate over prolonged periods of time. Iron-defi-

ciency anemia may also occur even though the diet is normally adequate if excessive blood loss occurs or if there is faulty absorption of iron because of gastric anacidity, intestinal disease, or diarrhea. The iron loss by blood donors is appreciable and may also lead to anemia unless appropriate measures are taken to replace the iron through a liberal diet. (See also Chapter 44.)

IODINE

Endemic goiter, the iodine-deficiency disease, occurs infrequently in the United States because of the widespread use of iodized salt, but the World Health Organization has estimated that as many as 200 million people in other parts of the world may be affected. The deficiency occurs in those areas where the iodine content of the soil is so low that insufficient iodine is obtained through food. Among the areas with iodine-poor soils are the Great Lakes, the Pacific Northwest, Switzerland, Central American countries, mountainous areas of South America, New Zealand, and the Himalayas.

Occurrence and function of iodine. Most of the iodine in the adult body, variously estimated from 25 to 50 mg, is found in the thyroid gland. The concentration in thyroid tissue is about 2500 times as great as that in any other tissues, all of which contain minute traces.

The only known function of iodine is as a constituent of the thyroglobulin, a protein complex of several iodine-containing compounds, including thyroxine. The thyroid hormone regulates the rate of oxidation within the cells. The basal metabolism test is often used to determine thyroid function since this test measures the oxygen consumption under standard conditions (see Chapter 8). Protein-bound iodine in the blood plasma is a more specific measure of the thyroid activity inasmuch as the plasma level increases or decreases proportionately.

Iodine absorbed from the gastrointestinal tract is rapidly withdrawn from the circulation by the thyroid gland and incorporated into the amino acid tyrosine to form thyroxine and related compounds. When thyroxine is used by the tissues, iodine is released into the circulation. About one third of the released iodine is again incorporated into thyroxine, while the remainder is excreted in the urine. If the intake of iodine is inadequate, the stores in the thyroid gland are gradually depleted. The thyroid gland enlarges in an attempt to produce the necessary thyroxine.

Requirement. On the basis of daily urinary losses the Food and Nutrition Board[3] recommends a daily allowance of 100 to 150 mcg iodine for the adult. This is believed to provide a margin of safety, but the needs are proportionately higher in growing children and pregnant women.

Sources. Vought and London[9] in a recent study of the iodine content of foods used in a metabolic study at the National Institutes of Health reported the following median values for food groups:

	MCG PER 100 GM FOOD
Seafood	54
Vegetables	28
Meat products	17.5
Eggs	14.5
Dairy products	13.9
Breads and cereals	10.5
Fruits	1.8

Wide variations occur in the food content of iodine depending upon the soils where they are grown.

People living in coastal areas who eat saltwater fish and shellfish regularly as well as locally grown foods may ingest enough iodine for their needs. However, the wide distribution of foods from one part of the country to another makes it difficult to rely upon food sources.

Iodized salt is the method of choice for supplying sufficient iodine intake because salt is an almost universally used dietary item, the addition of iodine does not affect flavor, and it is inexpensive. The concentration of iodine used in the United States is 1 part of sodium or potassium iodide per 10,000 parts (0.01 per cent) of salt. Since the usually daily intake of salt is 5 to 15 gm, the iodine intake would be 380 to 1140 mcg. Amounts in excess of 1000 mcg daily have not been shown to be harmful.[10]

Much of the salt sold in markets in the United States is not iodized. The Food and Nutrition Board has recommended that legislation be enacted to make the iodization of salt mandatory.

Effects of deficiency. Iodine is the only nutrient for which a deficiency in the soil is known to have an adverse effect on human nutrition. The public health consequences of a lack of iodine in the food supply are endemic goiter, cretinism, increased incidence of thyrotoxicosis and of thyroid cancer.[11] Simple, or endemic, goiter is an enlargement of the thyroid gland, but with no other abnormal physical findings. The basal metabolism remains normal. The deficiency is more prevalent in females than in males and is more frequent during adolescence and in pregnancy.

The studies of Marine and Kimball[12] on schoolgirls in Akron, Ohio, showed the importance of sufficient iodine intake in a striking manner. Over a period of 2½ years they found 495 cases of goiter among 2305 girls who received no supplementary iodine, but only 5 cases among 2190 girls who received sodium iodide.

The most urgent reason for stressing iodine as a preventive measure is not the goiter itself but the cretinism which is its ultimate sequel in areas severely deficient in iodine. Cretinism occurs in the infant when the pregnant woman is so severely depleted that she cannot supply iodine for the development of the fetus. Cretinism is characterized by a low basal metabolism, muscular flabbiness and weakness, dryness of the skin, arrest of skeletal development, and severe mental retardation. Desiccated thyroid given early enough to the

infant results in marked improvement of physical development; mental retardation may be less severe, but any damage which has occurred to the central nervous system cannot be reversed. Endemic cretinism is rare or nonexistent in the United States today.[13]

Goitrogens. Certain substances in foods are known to interfere with the use of thyroxine and will produce goiters, at least in experimental animals, even though the iodine intake would normally be adequate. Such goitrogens are present in rutabagas,[14] peanuts—especially in the red skin,[15] and seeds of the *Brassica* family (cabbage, Brussels sprouts, cauliflower). The substances are inactivated by cooking, and there is currently no evidence that goiters in endemic regions are caused by them.

FLUORINE

Fluorine is a normal constituent of the body found primarily in the bones and teeth. Small amounts of fluorine bring about striking reductions in tooth decay, probably because the tooth enamel is made more resistant to the action of acids produced in the mouth by bacteria.

Mottling of teeth (chronic dental fluorosis) had long been observed in some Texas and Colorado communities and was associated with high concentrations of fluorine in the drinking water. Some mottling occurs if the drinking water contains fluorine somewhat in excess of 1.5 parts per million (1.5 ppm). Instead of a lustrous appearance, the enamel of the teeth becomes dull and unglazed with some pitting. When the fluorine concentration of the water is greater than 2.5 ppm, the incidence increases, and the mottled areas of the teeth may become stained a dark brown.

For some time it had been noted that the mottled teeth were strikingly free of decay. For example, in a study reported from Galesburg, Illinois, there were only 236 decayed, missing, and filled teeth per 100 children, while in Michigan City, Indiana, there were 1,037 decayed, missing, and filled teeth per 100 children.[16] The level of fluorine in the drinking water in Galesburg was approximately twice as high as that in Michigan City.

Carefully controlled studies in some cities for more than ten years have established that fluoridation of the water supplies at a level of 1 ppm may be expected to reduce the incidence of dental caries by approximately 50 per cent. Several thousand communities have now initiated water fluoridation as an effective public health measure. The teeth of young children are benefited more than those of older children. Whether the measure is of value for adults is less certain

Foods as well as water contain varying amounts of fluorine, vegetables and fish being particularly important. The daily diet will contain about 0.5 mg, while 6 glasses of water containing 1 ppm will contribute 1.2 mg. The amounts in water and from the diet are r

duce any toxic manifestations. Up to 3 mg fluorine is excreted daily by the kidneys and sweat glands.

OTHER TRACE ELEMENTS

A number of trace elements are essential for the functioning of numerous enzymes. In some instances the trace elements are integral components of metalloenzymes and cannot be removed without inactivating the enzymes. In others, the mineral elements are held in loose combination with the enzymes (metal enzyme complex) but are not a constituent of the enzyme molecule; the trace elements thus exert catalytic activity. (See Figure 9–5.)



udies with Japanese quail show effects (*right*) of diet withou
l Drug Administration.)

Deficiencies of iron, iodine, and fluorine have been discussed. Dietary deficiencies of the other trace elements in human beings are virtually unknown since any reasonably good diet provides intakes in excess of body needs. One possible exception is the anemia which appears occasionally in infants fed an exclusive milk diet for many months and requires copper as well as iron for its correction.

Toxicities for some of the trace elements have been described in animals but rarely for humans except by accidental contamination such as lead poisoning, an occupational hazard. There is no basis for the belief held by some that aluminum cooking vessels may be harmful.[17]

An outline of the nutritional roles of manganese, copper, cobalt, zinc, and molybdenum is presented in Table 9–3. No functions have yet been ascribed to aluminum, arsenic, boron, lead, nickel, or silicon.

SODIUM, CHLORIDE, POTASSIUM, MAGNESIUM, AND SULFUR

Sodium. Practically all the sodium of the body is found in the extracellular fluid; that is, in the blood plasma and in the fluid which bathes the tissues. It does not cross the cell membrane to any great extent. Sodium functions in the regulation of acid-base equilibrium, the maintenance of osmotic pressure and of water balance, muscle contraction, and nervous irritability.

Sodium is very readily absorbed from the small intestine, but the body content is kept within narrow limits since the kidney excretes any excess chiefly as sodium chloride or sodium phosphate. When the sodium intake is restricted, the kidney conserves body sodium by excreting very little. The amount of sodium excreted by the kidney is controlled by the adrenal cortical hormone. A deficiency of this hormone, as in Addison's disease, leads to an excessive loss of sodium in the urine; on the other hand, excessive therapy with the hormone may lead to sodium retention and accompanying edema. Estrogenic hormones also promote sodium retention, and this fact helps to explain the retention of water by some women before menstruation begins and during pregnancy.

Sodium is also lost from the body in the feces and from the skin, the latter loss being very considerable when one is perspiring profusely. Thus, additional intakes of sodium chloride may be necessary during hot weather until one becomes accustomed to the weather conditions.

The daily diet contains 2 to 6 gm or more of sodium, which is a liberal allowance under normal conditions. In fact, the requirement is probably considerably less except during acclimatization to extremely hot weather. Table salt is the chief source of sodium, but many foods are also high in sodium. Among these are milk, cheese, meat, eggs, and some vegetables. (See Table A–6.)

A relatively high intake of sodium has not been proven to be harmful to the healthy person, since the body readily rids itself of any excess. On the basis of studies on experimental animals it has been suggested that a prolonged high-salt intake may be correlated with hypertension.[18] In cardiac failure and nephritis sodium may be retained in the body with the result that water is also held in the tissues.

Sodium deficiency is seen when there has been severe diarrhea or vomiting, when the intake has been unduly restricted during hot weather, and in adrenal cortical insufficiency. It is characterized by nausea, abdominal and leg cramps, exhaustion, and disturbances of the acid-base balance.

Chlorine. Unlike sodium, the chloride ion readily crosses cell membranes and is found both within the cells and in the extracellular fluid. It occurs in the inorganic form as sodium chloride in extracellular fluid and as potassium chloride within the cell. It is one of the important acid elements for the regulation of acid-base balance, and it helps to maintain the osmotic pressure relationships in the body. Chlorine is a constituent of the acid in the stomach.

Like sodium, chlorine is readily absorbed and is excreted in relation to the intake. Much of the chlorine of the daily diet comes from table salt, the chlorine intake being approximately 3 to 9 gm from all sources including natural foods. Dietary deficiency is unlikely, but in prolonged vomiting chloride loss may become serious and replacement is necessary.

Potassium. Unlike sodium, potassium occurs primarily within the cell, muscle and red blood cells containing most of it. Potassium is essential, together with other mineral elements, in the contraction of muscle, regular heart rhythm, the conduction of the nerve impulse, and the maintenance of fluid balance. The daily intake of potassium ranges from 1.5 to 6.0 gm. Potassium is widely distributed in foods, meats containing especially liberal amounts (see Table A–6.)

The Food and Nutrition Board has indicated that the minimal need for potassium is about 0.8 to 1.3 mg daily.[3] Dietary deficiency of potassium does not occur because of the generous distribution in foods.

Potassium deficiency does occur when there has been prolonged failure to eat and in pathologic conditions such as severe diarrhea, kwashiorkor, diabetic acidosis, excessive therapy with adrenocorticotropic hormone, tumors of the adrenal gland, and extensive tissue destruction as in severe burns. The deficiency is characterized by muscle weakness, loss of gastrointestinal tone leading to abdominal distention, nervous irritability, apathy, drowsiness, mental confusion, and weakness and failure of the cardiac muscle.

Potassium levels of the blood may increase to dangerous levels in adrenal cortical deficiency (Addison's disease) and in renal failure. In these conditions the elevated blood potassium adversely affects the action of the heart.

Magnesium. About 70 per cent of the body magnesium is found in the bones in the form of phosphates and carbonates, but there are 100 to 200 times as much calcium as magnesium in bones. Muscles, on the other hand, contain

about three times as much magnesium as calcium. Together with sodium, potassium, and calcium, magnesium functions in the regulation of cardiac, skeletal, muscle, and nervous tissues. Magnesium is required by the enzymes which bring about energy transformation of the phosphate bond.

According to balance studies the magnesium need each day by the adult is about 200 to 300 mg. This amount is supplied by the average diet and no dietary deficiency in humans has been observed. Cereal grains, nuts, legumes, meat, and milk are among the better sources of magnesium. (See also Table A–6.)

Magnesium deficiency in humans has been observed in chronic alcoholism with hepatic cirrhosis, in severe renal disease, and following the extended administration of parenteral fluids without magnesium. The symptoms are similar to tetany when the blood calcium level is reduced; however, the calcium levels in the magnesium-deficient patient are normal and the magnesium levels of the serum are low. Muscle tremors, convulsions, and delirium are outstanding symptoms in the severely deficient individual.

Sulfur. All body cells contain sulfur chiefly as a constituent of two amino acids—cystine and methionine. Cystine is important in skin, hair, and nails. Glutathione is an important sulfur-containing compound which functions in the biologic system of oxidation. Sulfur is also found in melanin pigments of skin and hair; in insulin, a hormone; in cartilage; and in numerous other body compounds. A diet adequate in protein will supply sufficient sulfur. Proteins contain roughly 1 per cent sulfur, this amount varying with the amount of sulfur-containing amino acids.

ACID-BASE BALANCE

One of the very important functions of minerals is to aid in the maintenance of the acid-base balance of the body. The acid-base condition is ultimately influenced by the food we eat.

The reaction of foods. Sodium, potassium, calcium, and magnesium are elements which in body fluids are cations; that is, they carry excess positive charges because they have lost electrons. Phosphorus (as phosphate), sulfur (as sulfate), and chlorine (as chloride) are elements which are anions; that is, they carry excess negative charges because they have accepted electrons. If there is an excess of cations remaining in the body on metabolism of a food, that food is said to produce an "alkaline ash" and the excess cations will allow the body to retain more bicarbonate ions, which will produce an alkaline reaction. Vegetables, fruits, milk, and some nuts will yield excess cations and lead to an alkaline state. On the other hand, meat, fish, poultry, eggs, cheese, cereals, and some nuts when metabolized yield an excess of anions that are not removed from the body immediately. These foods are said to produce an "acid ash." The excess anions carrying a negative charge must be balanced

approximately with some cations. This yields an acid reaction because less bicarbonate, which also carries a negative charge, can exist in the body. The excess bicarbonate ions form carbonic acid, increasing the acidity. Fats, sugar, and starches contain no mineral elements and are metabolized quickly to form water and carbon dioxide, which are rapidly removed from the body. These foods, therefore, do not form excess cations or anions which would disturb the neutrality regulation.

Although lemons, oranges, and certain other fruits contain some free organic acids which give them the taste of an acid (sour), they yield an alkaline ash because the body quickly oxidizes the anions of the acid to carbon dioxide and water and leaves excess cations which are removed more slowly from the body. Plums, cranberries, and prunes contain aromatic organic acids that are not metabolized in the body, and therefore they increase the acidity of the body fluids.

The alkalinity or acidity of a food can be stated in terms of the amount of normal acid or alkali to which it is equivalent. Commonly used foods have been classified as yielding an acid ash or an alkaline ash (see Chapter 43).

The regulation of body neutrality. The reaction of the body fluids is expressed by the term pH, which is a notation to indicate changes in the hydrogen concentration in the fluid. In an aqueous solution at room temperature where the concentration of the hydrogen ions (H^+) and hydroxyl ions (OH^-) is equal, the pH is designated as 7 and the solution is said to be neutral. An alkaline reaction is expressed as a pH higher than 7, and an acid reaction by a pH lower than 7. The pH of the blood in health is in the narrow range of 7.3 to 7.5; in other words, the blood is slightly alkaline. If the pH of the blood goes much below 7.3 an acidosis exists, while a pH above 7.5 indicates alkalosis.

The narrow range of pH in the body is maintained by the following mechanisms:

1. The presence of certain mixtures, called buffers, minimizes the change in pH when hydrogen ions are increased in the body fluids. They consist of weak acids in the presence of their sodium or potassium salts. The carbonic acid-bicarbonate (H_2CO_3-HCO_3^-) is one important buffer of the blood in maintaining the neutrality. The ease and speed with which the body can get rid of carbon dioxide obtained from this buffer mixture constitute one of the first lines of defense. The plasma bicarbonate is an indicator of the alkaline reserve of the body. Serious disturbances may occur if the alkaline reserve is depleted to a low level. Proteins, including hemoglobin in the blood, and phosphates also form important buffer mixtures.

2. Besides its buffer action hemoglobin aids in the transport of carbon dioxide in two ways which prevent great changes in reaction. The acid strength of hemoglobin is decreased when oxyhemoglobin loses oxygen whereby an extra amount of carbon dioxide can be transported without any change of reaction (isohydric transport). Hemoglobin can also transport a limited

amount of carbon dioxide by forming a carbamate, which releases most of this carbon dioxide from the hemoglobin complex at the lung as the hemoglobin takes up oxygen.

3. The final adjustment to keep the body fluids within narrow pH limits is made by the kidney. The kidney is able to secrete an acid urine (pH as low as 4.5; average normal pH 6.0) and also can synthesize the ammonium ion with a positive charge which is excreted in place of other cations (sodium and potassium) which can be returned to the blood to carry more carbon dioxide as a bicarbonate ion.

Because the body makes these adjustments in the regulation of body neutrality, the reaction of the diet is of no practical significance in health. Those who become concerned about the relative acidity or alkalinity of foods have often been misled by false advertising claims of the food quack.

PROBLEMS AND REVIEW

1. Give examples of the ways in which minerals function together in the body structure; in regulatory activities.
2. List four functions of calcium; of phosphorus. What factors favor or interfere with the absorption and utilization of calcium?
3. *Problem.* Plan a diet for yourself which contains sufficient calcium without the use of milk or cheese. List the amounts of food and calculate the calcium content.
4. Many adults believe that their needs for calcium are low because their bones and teeth are fully developed. Explain why this reasoning is wrong.
5. While phosphorus is as important in the diet as calcium, there have been no dietary allowances listed by the Food and Nutrition Board. Why is such listing unnecessary?
6. Iron is necessary for the formation of blood and muscle hemoglobin. What factors affect the construction of hemoglobin in the body?
7. Iron is essentially a one-way substance. What does this mean? How does this affect the daily requirement for iron?
8. *Problem.* Calculate your daily intake of iron for two days. List the four outstanding sources for each day.
9. *Problem.* Using the basic diet calculation in Table 14–2, plan three ways by which the iron level can be increased to 15 mg. Show calculations for iron and for calories.
10. Iodine is a necessary constituent of thyroxine which regulates energy metabolism. What happens if iodine intake is inadequate?
11. Give three ways in which iodine intake can be made more adequate. Which is the most reliable?
12. Fluorine appears to be important in the prevention of tooth decay. How can fluorine intake be increased? What are the dangers of excessive fluorine intake?
13. What are the functions of copper, sulfur, sodium, potassium, magnesium, and chlorine in the body? How are these elements provided?
14. Sodium, potassium, calcium, and magnesium are the important basic elements in the diet. In which foods do these elements predominate?
15. Phosphorus, chlorine, and sulfur are the important acidic elements in the diet. In which foods do these elements predominate?
16. Acid-tasting fruits, except for cranberries and plums, are actually basic in reaction. How do you explain this?
17. The reaction of the blood and body tissues is in the narrow range of pH 7.3 to 7.5. How is this reaction maintained in the body? What happens if a diet which is acid in reaction is eaten? How does the urine give a clue to the reaction of a diet?

Table 9–3. Summary of the Minerals

Mineral	Functions in the Body	Metabolism	Food Sources	Daily Allowances
Calcium	Builds bones and teeth Muscle contraction Normal heart rhythm Nerve irritability Activation of some enzymes Most abundant mineral element in the body Role in blood coagulation	*Absorption:* according to body need; aided by vitamin D, ascorbic acid, lactose; oxalic acid and phytic acid interfere *Utilization* regulated by parathyroid hormone and vitamin D *Storage* in bone trabeculae *Excretion:* feces, chiefly *Deficiency:* retarded bone and tooth mineralization; fragile bones; stunted growth; rickets; osteomalacia; osteoporosis	*Best* Milk Hard cheese Greens: turnip, collards, kale, mustard *Good* Ice cream Cottage cheese Broccoli Oysters, shrimp Salmon, clams	Children: 0.8 gm Teenagers: 1.3 to 1.4 gm Adults: 0.8 gm Pregnancy; 1.3 gm Lactation: 1.3 gm
Iron	Constituent of hemoglobin, myoglobin, and oxidative enzymes Present in all body cells	*Absorption:* according to body need, aided by gastric acidity, ascorbic acid *Utilization:* copper is essential; iron from worn-out cells used over again *Storage* in liver, bone marrow, spleen, kidneys *Excretion:* minute amounts in urine, sweat; most of fecal iron is unabsorbed iron from the diet *Deficiency:* reduced hemoglobin level—anemia	*Best* Liver *Good* Meat, egg yolk Enriched bread and cereals Peaches, apricots, prunes, raisins Dark green vegetables Molasses Legumes	Children: 8 to 12 mg Men: 10 mg Women: 15 mg Pregnancy: 20 mg Lactation: 20 mg
Iodine	Constituent of thyroxine which regulates rate of energy exchange	*Storage:* thyroid gland *Excretion:* in urine *Deficiency:* simple goiter with enlarged thyroid; cretinism—very rare in United States	Iodized salt is best protection Sea foods and foods grown in nongoitrous regions	Adults: 0.10 to 0.15 mg

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Chapter 10

THE FAT-SOLUBLE VITAMINS

INTRODUCTION TO THE STUDY OF THE VITAMINS

The story of the vitamins—their discovery, their positive functions in maintaining health, and their usefulness in healing deficiency diseases—is fascinating and deserving of considerable study. Popular interest was early aroused by the discovery of the role of vitamins in preventing such severe deficiency diseases as scurvy, pellagra, beriberi, and others. It is now known that vitamins function primarily in enzyme systems which facilitate the metabolism of amino acids, fats, and carbohydrates. Those who understand the functions of vitamins do not minimize their importance in relation to the utilization of food. However, it is important that no one be misled into believing that vitamins are "cure-alls" for disease.

A brief discussion of the discovery of vitamins has been presented in Chapter 2. The properties of vitamins, their functions in metabolism, their distribution in foods, and the effects of deficiency will be discussed in the sections below.

Definition and nomenclature. The term "vitamine" was first coined by the Polish chemist, Funk, who believed that the water-soluble antiberiberi substance he was describing was a "vital amine." The final "e" was soon dropped, but *vitamins* is the name given to a group of potent organic compounds other than protein, carbohydrate, and fat which occur in minute quantities in foods and which are essential for some specific body functions of maintenance and growth. Many of them cannot be synthesized, at least in adequate amounts, by the body and must be obtained from the diet.

Early classifications listed two groups of vitamins, namely, those that are water soluble and those that are fat soluble. This classification has been generally accepted, but it is arbitrary inasmuch as the vitamins within each group are not similar in their properties, functions, or distribution. Vitamins were first named for their curative properties or were given a convenient letter

designation. Today, chemically descriptive names are now used for many of the vitamins; letter designations are still applied in some instances.

The B complex is a group of vitamins, each having distinct physical and chemical properties and functions. Consequently, one must use specific nomenclature for each member of the complex if there is to be clear differentiation.

Measurement. Before the chemical nature of vitamins was discovered, their potency could be measured only by their ability to promote growth or to cure a deficiency when test doses were fed experimental animals such as rats, guinea pigs, pigeons, and chicks. Such measurement is known as "bioassay" and has been expressed in terms of units. Vitamins A and D are still measured in international units (I.U.). Other vitamins, formerly measured in units, are now measured by chemical assay in milligrams (mg) or micrograms (mcg), 1 milligram being equal to 1000 micrograms or gamma (γ). Still other vitamins are measured by their ability to promote growth of microorganisms; this is known as microbiologic assay.

Selection of foods for vitamin content. In selecting the foods to furnish vitamins in the diet it is well to keep in mind the following points: (1) under normal circumstances it is better to use common food sources than concentrates, because foods furnish other essential factors as well; (2) it is important to determine how often any given food will be used in the dietary; (3) the amount of food which would ordinarily be used must be ascertained; (4) the effects of processing and preparation of foods on the vitamin retention must be clearly understood; and (5) economic factors such as availability and cost must be considered. For example, 100 gm of parsley furnish about 8500 I.U. of vitamin A, whereas 100 gm of milk supply only 140 I.U. of vitamin A. Parsley, as a garnish, will have limited use, while 1 pint of milk a day, essential in an adequate diet, furnishes about 10 per cent of the day's needs for vitamin A. Potatoes cooked in their skins or baked may be a significant source of ascorbic acid; but leftover mashed potatoes cannot be relied upon for this easily destroyed vitamin.

Vitamin supplementation of the diet. Any diet selected on the basis of the Four Food Groups will provide a substantial amount of the necessary vitamins. When further food selections are made at least in part from these food groups to complete the caloric requirement, the recommended allowances for the vitamins are easily met or exceeded. Vitamin pills and other forms of concentrates are, therefore, not necessary in the diets of healthy persons. As a matter of fact, the water-soluble vitamins in excess of body needs will be excreted in the urine. Vitamin A, being fat soluble, is stored in appreciable amounts in the liver, other fat-soluble vitamins are stored to a lesser degree. As a matter of fact, excessive intakes of vitamins A and D have been shown to be toxic.

Vitamin-D supplementation for infants, growing children, and pregnant or lactating women is an important exception to the above statement since the

diet does not supply sufficient amounts of the vitamin if fortified foods are not used.

Physicians may recommend supplementation of the diet when physical or emotional illness prevents the consumption of a fully adequate diet. Sometimes through ignorance or through poor eating habits a serious dietary deficiency of vitamins may pertain, in which instance a supplement is sometimes prescribed. However, such supplementation should never replace efforts toward the correction of the factors leading to the dietary inadequacy.

Undoubtedly, the sale of vitamin supplements far exceeds the need for them. The potency of preparations on the market varies widely, and the number of nutrients contained differs from one product to another. The consumer is unable, as a rule, to interpret the label information in terms of his own requirements. Under consideration by the Food and Drug Administration are regulations which would define the levels of nutrients to be used in such preparations and the appropriate labeling for these products. Such regulations are urgently needed.

VITAMIN A

Vitamin A was the first fat-soluble vitamin to be discovered. It was soon found to be in some way related to chlorophyll, the green coloring matter of plants, and by 1932 carotene, which occurs abundantly in yellow vegetables and in thin, dark-green leaves, had been shown to be the *precursor* of vitamin A.

Chemistry and characteristics. Vitamin A occurs in several forms: as retinol ($C_{20}H_{29}OH$, an alcohol); as retinal (also known as retinene), an aldehyde; and as retinoic acid. It may be esterified and is known as retinyl ester. These several forms may be referred to as vitamin A in most instances.

In its pure form vitamin A is a pale-yellow crystalline compound. It occurs naturally in the animal kingdom and has been synthesized so that it is available commercially. It is soluble in fat but insoluble in water, and it is relatively stable to heat and to acids and alkalies. It is easily oxidized, and rapidly destroyed by ultraviolet irradiation.

The ultimate source of all vitamin A is in the carotenes which are synthesized by plants. Animals in turn, and man as well, convert a considerable proportion of the carotene of the foods they eat into vitamin A. The carotenes are dark-red crystalline compounds and are known as the "provitamins" or precursors of vitamin A. Alpha-, beta-, and gamma-carotene, and possibly cryptoxanthin are of nutritional significance. Each molecule of beta-carotene ($C_{40}H_{56}$) yields 2 molecules of vitamin A, while each molecule of the other three carotenes yields on hydrolysis only 1 molecule of vitamin A.

Measurement. Vitamin A is measured in international units, I defined by the World Health Organization as the vitamin-A activity mcg of pure vitamin-A acetate (0.300 mcg crystalline vitamin-A alco 0.600 mcg pure beta-carotene. The U.S.P. (*United States Pharma* unit is identical to the international unit.

The vitamin-A concentration in foods and in body tissues may mined by chemical methods or by the determination of growth rates given amount of the substance being tested is fed to rats.

Physiology. Foods may supply vitamin A in the form of caroten vitamin A, or as vitamin-A esters. The presence of fat facilitates the tion of carotenes and vitamin A, with bile also being essential, as digestion and absorption of fats. The carotenes are converted to vitam... in the intestinal wall, probably through the activity of an enzyme, caroten Probably some carotene is also converted to vitamin A by the liver. Retiny esters are hydrolyzed to retinol before passing into the intestinal wall, but within the mucosal cells the vitamin is again esterified chiefly with palmitic acid.[1]

Any factors that limit fat absorption are likely to minimize absorption of vitamin A as well. Liquid petrolatum (mineral oil) interferes with the absorption of carotene and therefore should never be taken immediately before or after meals. Carotene is especially subject to oxidation in the intestinal tract, but the presence of vitamin E helps to prevent this destruction.

Like fats, the vitamin-A ester is transported in the lymph circulation to the thoracic duct and then enters the blood circulation to be carried to the liver where it is stored in the ester form. As vitamin A is needed by the tissues it is released from the liver as retinoic acid or retinol to be carried in the blood circulation as lipoproteins.

The body possesses a great capacity for storing vitamin A, about 95 per cent of the storage deposits being held in the liver. Small amounts are also to be found in the kidneys, lungs, and occasionally in the fatty tissues. The reserves in the liver are relatively small at birth but increase gradually with age if the diet has been good.

Functions. The most clearly established function of vitamin A is related to the maintenance of normal vision in dim light. Vitamin-A aldehyde (retinal) combines with a protein, opsin, to form rhodopsin, also known as visual purple. Rhodopsin absorbs light and breaks down to the aldehyde and protein. Although the vitamin-A aldehyde and protein may recombine in the dark, some of the aldehyde is lost so that a fresh supply is necessary. If a continuing supply is not available, rhodopsin cannot be formed rapidly enough for quick adaptation to light.

Vitamin-A acid effects the synthesis of factors which stimulate mucus secretions and which maintain the integrity of the epithelium, especially the membranes which line the eyes, the mouth, and the gastrointestinal, respiratory,

...nary tracts. Membranes maintained in their optimum condition ...ance to bacterial invasion; to that extent vitamin A gives protection infection, but the designation *anti-infective* is unfortunate. Large ...vitamin A will not confer additional protective benefits.

...n A, as are all the vitamins, is required for growth, normal skeletal ...nt, and tooth structure. In experimental animals, vitamin A has ...wn to be essential for spermatogenesis in the male and normal estrus the female. Fetal tissues develop with many malformations if vita... ...ot available.

...allowances. The Recommended Dietary Allowances[2] have been set ...s which provide approximately double the minimal requirements. These ...nces also assume that two thirds of the vitamin will be supplied by the ...es and one third will be available from the preformed vitamin. The ...dult allowance has been set at 5000 I.U., but 3000 I.U. would suffice if ...vailable from the preformed vitamin.[2]

A greater amount of vitamin A is needed per unit of body weight in children than in adults. Infants should receive 1500 I.U. daily, while the allowances for older children increase gradually to 5000 I.U. by the adolescent age. In pregnancy and lactation the allowances are 6000 I.U. and 8000 I.U., respectively.

Food sources. Only animal foods contain vitamin A as such, fish-liver oils being outstanding. These oils are generally not classed with common foods, but milk, butter, fortified margarines, whole-milk cheeses, liver, and egg yolk contain vitamin A. Milk from cows which have been eating green foliage usually contains more vitamin A than that from cows which have been eating dried fodder.

The principal source of vitamin A in the diet is likely to be from the carotenes which are widespread in those plant foods which have high green or yellow colorings. There is a direct correlation between the greenness of a leaf and its carotene content. Dark-green leaves are rich in carotene, but the pale leaves, in lettuce and cabbage for example, are insignificant sources. Abundant sources of carotene are found in foods such as:

Green leafy vegetables—spinach, turnip tops, chard, beet greens
Green stem vegetables—asparagus, broccoli
Yellow vegetables—carrots, sweet potatoes, winter squash, pumpkin
Yellow fruits—apricots, peaches, cantaloupe

The vitamin-A contribution of the Four Food Groups is indicated in Figure 10–1. The meat group contributes only when liver or an organ meat is included every week to 10 days. One egg provides about one tenth of the daily allowance.

Retention of food values. Since vitamin A is stable to the usual cooking temperatures, only slight losses are likely to occur in food preparation. The wilting of vegetables or dehydration of foods results in considerable losses.

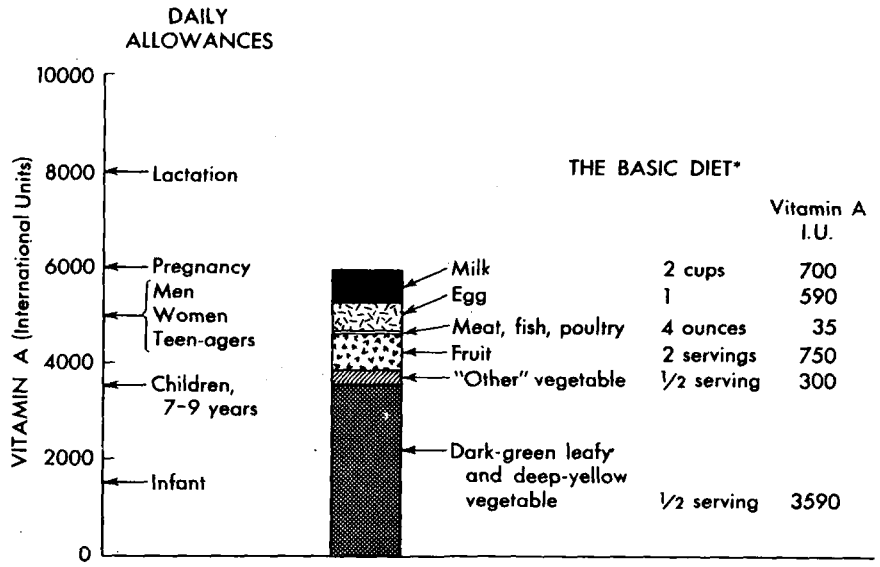


FIG. 10–1. The Four Food Groups of the Basic Diet provide a liberal allowance of vitamin A for all categories of persons. Note the contribution made by dark-green, leafy and deep-yellow vegetables. Breads, cereals, and white potato do not provide vitamin A. (See Table 14–2 for complete calculations.)

Canned and frozen foods retain maximal values for 9 months or longer. Vitamin-A activity is rapidly lost in rancid fats.

Effects of vitamin-A deficiency. In the United States vitamin-A deficiency resulting from faulty diet is not of frequent occurrence. The exact incidence of mild deficiency states is not known since it is difficult to establish a specific etiology for such conditions as night blindness. The severe manifestations of vitamin-A deficiency, xerophthalmia and keratomalacia, are not seen in this country, but are not infrequent, even today, in India and other countries of the Orient where grossly inadequate diets are the rule.

Vitamin-A deficiency may result from faulty absorption and metabolism such as chronic diarrhea as in sprue and colitis, liver disease, abnormal fat metabolism as in pancreatic dysfunction, or incomplete absorption because of the use of liquid petrolatum. Depending upon the reserves in the liver, vitamin A deficiency may not be manifested for weeks or months.

NIGHT BLINDNESS. One of the earliest signs of vitamin-A deficiency is night blindness, or nyctalopia (see Figure 10–2). This is a condition in which the individual is unable to see well in dim light, especially on coming into darkness from a bright light as in entering a darkened theater. Drivers who are easily blinded (glare blindness) by the headlights of other automobiles and who consequently see road markers, pedestrians, etc., with difficulty constitute a special traffic hazard. Nyctalopia occurs when there is insufficient vitamin A to bring about prompt and complete regeneration of visual purple. Dark-adap-

tation tests with a biophotometer, blood carotene and vitamin-A levels, and a substantiating dietary history are useful in establishing a diagnosis of vitamin-A deficiency. Other causes of night blindness must be ruled out. If a therapeutic dose of vitamin A does not bring about relief of night blindness after a few weeks' trial, it may be assumed that the condition is not a vitamin-A deficiency.

EPITHELIAL CHANGES. An inadequate supply of vitamin A may lead to definite changes in the epithelial tissues throughout the body: *keratinization,* or a noticeable shrinking, hardening, and progressive degeneration of the cells occurs, which increases the susceptibility to severe infections of the eye, the nasal passages, the sinuses, middle ear, lungs, and genitourinary tract.

Skin changes in severe vitamin-A deficiency have been described, but it is doubtful that there is such a relationship to skin conditions observed in this country. In severe deficiency the skin becomes rough, dry, and scaly. The keratinized epithelium plugs the sebaceous glands so that goose-pimplelike follicles appear first along the upper forearms and thighs, and then spread along the shoulders, back, abdomen, and buttocks.

EPITHELIAL CHANGES IN THE EYE. The epithelium of the eye may be so profoundly affected during vitamin-A deficiency that the condition finally becomes irreversible. The first mild symptoms of epithelial changes in the eye are sensitivity to bright light (photophobia), itching, burning, and sometimes inflammation of the lids. The eyes and the eyelids become dry and inflamed owing to impairment of the lacrimal glands whose function it is to secrete fluid to keep the surfaces moist and wash away bacteria and other foreign agents. *Xerophthalmia* is the most serious disturbance in the eye and occurs only after deficiency has been severe and prolonged. The cornea becomes dry and then inflamed and edematous. This is later followed by cloudiness and infection which leads to ulceration. The absence of the usual eye secretions provides a favorable medium for infection. The final stages of the disease, *keratomalacia* is a softening of the cornea with permanent blindness resulting.

PREVENTION AND TREATMENT. In the Far East where xerophthalmia is a major cause of blindness, vitamin-A deficiency is often attributed to ignorance since dietary sources of carotene are locally available. The very low fat intake by many of these people reduces the efficiency of absorption.

Vitamin-A deficiency may become manifest in children who are fed skim milk for the treatment of kwashiorkor. As the child responds to the protein in the milk, the liver is rapidly depleted of its small store of vitamin A, thus precipitating the symptoms of deficiency. Therefore, it is important that the treatment for protein malnutrition include vitamin-A supplements.

FIG. 10–2. Night blindness. (*A*) Safe driving at night depends, in part, on the ability of one's eyes to adjust to the glare of lights. (*B*) Properly focused headlights of an approaching automobile do not impede a good view of the road when the eye has an adequate supply of vitamin A. (*C*) The edge of the road and distances far ahead cannot be seen immediately after meeting an automobile when there is insufficient vitamin A available to the eye. (*Courtesy, The Upjohn Company, Kalamazoo, Mich.*)

The recommended allowances for vitamin A fully protect the normal individual against evidences of deficiency. Once deficiency has appeared, therapy consists of (1) correcting the diet so that it once again becomes adequate, (2) removing or curing any condition that interferes with absorption, and (3) prescribing therapeutic doses of vitamin concentrates.

Hypervitaminosis A. Therapeutic doses of vitamin A in excess of 50,000 I.U. daily over prolonged periods may be toxic to adults. Lesser doses will produce symptoms in children. Infants who received 18,500 to 60,000 I.U. daily showed signs of toxicity within 12 weeks.[3] The common symptoms of toxicity are anorexia, hyperirritability, and drying and desquamation of the skin. Loss of hair, bone and joint pain, bone fragility, headaches, and enlargement of the liver and spleen are quite frequent. When vitamin A is discontinued, recovery takes place. Far too frequently excessive dosages are prescribed, and some individuals use supplements with uncalled-for zeal.

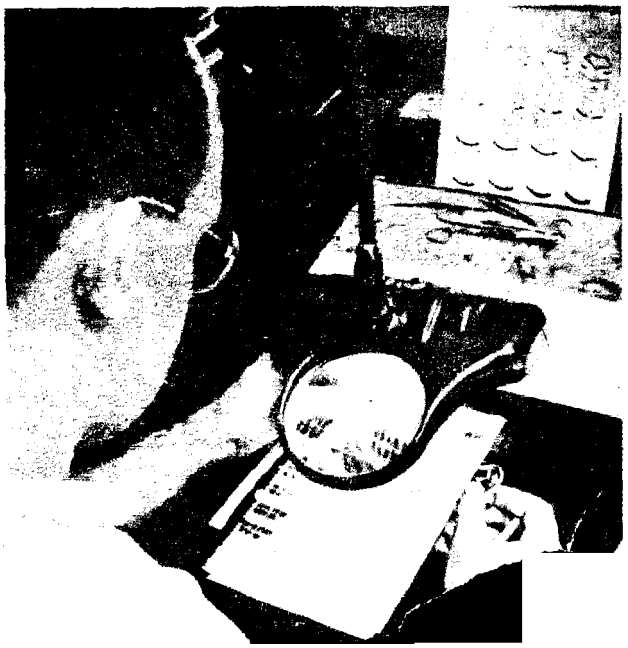
VITAMIN D

Cod-liver oil has been recommended as a remedy for rickets ever since the Middle Ages but does not appear to have been used with any consistency until the present century. During World War I, Hess and Unger noted the effect of cod-liver oil in protecting Negro children in New York City against rickets. Then in 1919 Mellanby found that the skeletal structure of puppies was influenced by some fat-soluble substance in food. McCollum, Steenbock, and Drummond simultaneously reported that cod-liver oil in which vitamin A had been destroyed still retained its antirachitic properties, and hence it was shown that vitamin A was not the antirachitic factor. Steenbock and Hess in 1924 independently found that foods that had been exposed to ultraviolet rays possessed antirachitic properties. Pure vitamin D was isolated in crystalline form in 1930 and was called calciferol ($C_{28}H_{43}OH$).

Chemistry and characteristics. Vitamin D is in reality a group of chemically distinct sterol compounds possessing antirachitic properties, but it is customary to speak of the group as though it were one vitamin. The vitamins are produced by irradiating a precursor or provitamin D with ultraviolet light; in other words, substances like ergosterol are exposed to ultraviolet light to form calciferol. Of the 10 or more forms of this vitamin which are known, only 2 are of nutritional interest: (1) vitamin D_2 (activated ergosterol, calciferol, viosterol)—ergosterol being the chief vitamin-D precursor found in plants; and (2) vitamin D_3 (activated 7-dehydrocholesterol)—the chief form occurring in fish-liver oils. Vitamin D_3 is believed to be the substance developed in the skin on exposure to ultraviolet light from sunshine or from a machine. Pure vitamins D are white, odorless crystals which are soluble in fats and in fat solvents. They are insoluble in water, and they are stable to heat, acids, alkalies, and oxidation.

Measurement. One international unit (I.U.) of vitamin D is the activity of 0.025 mcg of pure crystalline vitamin D. The I.U. and U.S.P. unit are identical.

Rachitic rats are the standard test animals for measuring the potency of vitamin D in materials. Young rats from mothers having a deficient supply of vitamin D are kept on a rachitogenic diet so that no calcification occurs in the ends of the long bones. When a test material is fed, its value as a source of vitamin D is measured by the amount which must be fed for 7 to 10 days to produce a good calcium line (line test) in the ends of the long bones. Standard cod-liver oil is fed to a similar group of animals and is used as a basis of comparison. No satisfactory chemical or microbiologic assay is yet available. (See Figure 10–3.)



Physiology. Vitamin D from the dietary or from concentrates is absorbed from the intestine together with the fats. Bile salts appear to be necessary for absorption. Man can synthesize provitamin D_3 in the body, and activation takes place in the skin on exposure to ultraviolet light. Vitamin D_3 from the skin or vitamin D_2 absorbed from the intestine is stored primarily in the liver, although some is also found in the skin, brain, lungs, spleen, and bones. The body conserves its stores of vitamin D carefully.

Function. Although the exact manner in which vitamin D works is not known, it has been established that it regulates the absorption and anchorage of calcium and phosphorus. Vitamin D presumably renders the intestinal membranes more permeable to calcium salts so that absorption is facilitated.[4] It also regulates the level of the enzyme *alkaline phosphatase* in the serum; this enzyme is believed to be concerned with the deposition of calcium phosphate in the bones and teeth. While optimal intake of vitamin D does not decrease the daily need for calcium, the vitamin does assist in the maximal utilization of the calcium.

Daily allowances. Whenever new skeletal tissue is being built, there is a definite increase in the need for vitamin D. This is especially marked in premature infants, in twins, and in infants who are underdeveloped. For infants, growing and adolescent children, and pregnant and lactating women, 400 I.U. of vitamin D are recommended.[2] This allowance is also believed to be satisfactory for premature infants.

The daily diet furnishes such a very small amount of vitamin D that it must be assumed either that the need for it in adults is low, or that the requirements are met by exposure to sunlight. For persons who work at night, or invalids, elderly persons, and others who may not be exposed to sunlight, an intake of 400 I.U. of vitamin D may be desirable.

Sources. Natural foods are poor sources of vitamin D, although small amounts are present in egg yolk, liver, and fish such as herring, sardines, tuna,

ıay be fortified by adding concentrates of vitamin D.
d much of the fresh whole milk are now
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for growing children

strained out by dust, smoke, fog, clothing, and ordinary window glass—all of which act as barriers to prevent the rays from reaching the skin.

Hypervitaminosis D. The tolerance for vitamin D varies widely. As little as 1800 I.U. over a long period of time may be mildly toxic to children,[5] while massive doses of 100,000 I.U. may be necessary and tolerated by those rare individuals who have refractory rickets. Generally speaking, daily doses ranging from 1000 to 3000 I.U. per kilogram are toxic.[2] The symptoms of toxicity include nausea, diarrhea, weight loss, polyuria, and nocturia. As the toxicity becomes more severe, renal damage and calcification of the soft tissues such as the heart, blood vessels, bronchi, stomach, and tubules of the kidney occur.

Effects of vitamin-D deficiency. A deficiency of vitamin D leads to inadequate absorption of calcium and phosphorus from the intestinal tract and to faulty mineralization of bone and tooth structures. The inability of the soft bones to withstand the stress of weight results in skeletal malformations.

RICKETS. Infantile rickets is rarely seen in the United States because of the widespread use of fortified milk or of fish-liver oils in prophylaxis. When such preventive measures are not taken, rickets is more prevalent in northern regions than in warm, sunny climates. It is more likely to develop in dark, overcrowded sections of large cities where the ultraviolet rays of sunshine, especially in the winter months, cannot penetrate through the fog, smoke, and soot. Poverty and ignorance may account for failure to obtain enough vitamin D from concentrates, fortified milk, or from skin exposure. Dark-skinned children are more susceptible to rickets than those of the white race.

Premature infants are more susceptible to rickets than full-term infants since the growth rate and the calcification of the skeleton impose additional demands for vitamin D.

Fully developed cases of rickets present the following characteristics (see Figure 10–4):

1. Delayed closure of the fontanelles, softening of the skull (craniotabes), and bulging or bossing of the forehead, giving the head a boxlike appearance;
2. Soft, fragile bones leading to widening of the ends of the long bones; bowing of the legs; enlargement of the costochondral junction with rows of knobs or beads forming the *rachitic rosary;* projection of the sternum as in "pigeon breast"; narrowing of the pelvis; spinal curvature;
3. Enlargement of wrist, knee (knock-knees), and angle joints;
4. Poorly developed muscles; lack of muscle tone—pot belly—being the result of weakness of abdominal muscles; weakness, with delayed walking;
5. Restlessness and nervous irritability;
6. High serum phosphatase; lowered inorganic blood phosphorus.

Rickets is treated by giving relatively large amounts of vitamin-D concentrates, the dosage being prescribed by the physician.

TETANY. "Tetany is a syndrome manifested by a sharp flexion of the wrists and ankle joints, muscle twitchings, cramps, and convulsions. It is due

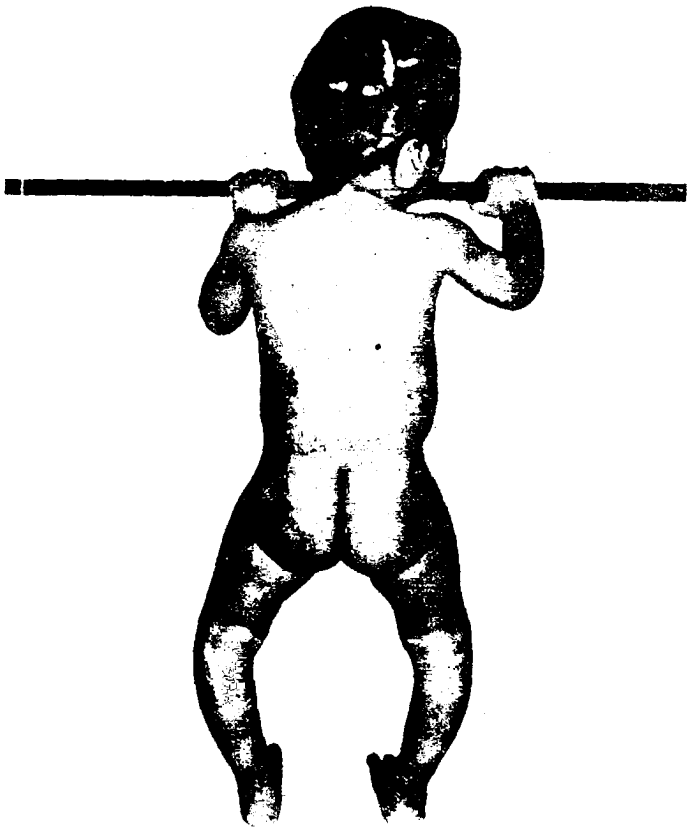


FIG. 10–4. Early skeletal deformities of rickets often persist throughout life. Bowlegs that curve laterally, as shown here, indicate that the weakened bones have bent after the second year, as the result of standing. (*Courtesy, Dr. Rosa Lee Nemir, professor of pediatrics, New York University—Bellevue Medical Center, and* The Vitamin Manual, *published by The Upjohn Company.*)

to abnormal calcium phosphorus metabolism."* Tetany may result from insufficient dietary calcium or vitamin D, from failure of absorption of calcium or vitamin D, or from a disturbance of the parathyroid gland. The physician prescribes calcium salts to control the acute spasms, a diet liberal in calcium, and vitamin-D concentrates.

DENTAL CARIES. A deficiency of vitamin D may lead to delayed dentition and to malformation of the teeth. There may be a predisposition to dental caries. It has been shown that children who have received an abundance of milk, eggs, meat, vegetables, and fruits and who have consistently had liberal intakes of vitamin D have fewer carious lesions than do children on suboptimal

* Sebrell, W. H.: "Preventive Medicine," in *Handbook of Nutrition.* American Medical Association, Chicago, 1943, p. 473.

intakes.[6] Thus, protection against dental caries would seem to depend, at least in part, on adequate intakes and utilization of calcium, phosphorus, and vitamin D. The influence of fluoride has been discussed in Chapter 9 and that of carbohydrate in Chapter 6.

OSTEOMALACIA, frequently referred to as "adult rickets," represents a failure of the process of calcification to keep up with the rest of the metabolic processes. It is caused by simple vitamin-D lack and calcium inadequacy. It occurs in the Orient especially in pregnant or lactating women who subsist on meager cereal diets and who are indoors most of the time.

Osteomalacia may also occur when there is interference with fat absorption and is occasionally seen in this country. A third type of this disease resembles resistant rickets in that the individual has an inherent resistance to vitamin D so that normal metabolism does not take place.[7]

The following changes take place in osteomalacia:

1. A softening of the bones, which may be so severe that the bones of the legs, spine, thorax, and pelvis bend into deformities;
2. Pain of the rheumatic type in bones of the legs and lower part of the back;
3. General weakness with difficulty in walking; there is especial difficulty in climbing stairs, and a waddling gait is frequent;
4. Spontaneous multiple fractures.

Since general malnutrition is no doubt present, osteomalacia is treated with a high-protein, high-calorie diet and therapeutic doses of vitamin D.

VITAMIN E

Discovery. Evans and Bishop established the fact that a fat-soluble factor was necessary for reproduction in rats. They showed that absence of vitamin E, or the antisterility factor, as it was designated, led to irreparable damage of the germinal epithelium in male rats, while female rats which had diets deficient in vitamin E were unable to carry their young to term. In severe deficiency the fetus dies and is resorbed completely. In the female the damage is not permanent; that is, normal reproduction could again take place if the diet were once more made adequate in this factor.

Chemistry and characteristics. Vitamin-E activity is exhibited by a number of compounds of related chemical structure including alpha-, beta-, gamma-, and delta-tocopherol. Alpha-tocopherol ($C_{29}H_{50}O_2$) is the compound possessing the greatest vitamin-E activity. Vitamin E and the sex hormones are chemically related.

High temperatures and acids do not affect the stability of vitamin E, but oxidation takes place readily in the presence of rancid fats or lead and iron salts. Decomposition occurs in ultraviolet light. Vitamin E itself acts as an antioxidant.

Measurement. Vitamin E in food and in body tissues may be measured in milligrams by physical, chemical, or biologic methods.

Physiology. Vitamin E requires the presence of fat and of bile salts for absorption into the intestinal wall, but much of the ingested vitamin is excreted in the feces. Vitamin E is stored in small amounts in various organs, muscle, and adipose tissue, although the concentrations are low.

Functions. Perhaps one of the more interesting discoveries with respect to vitamin E is its antioxidant properties; by accepting oxygen it is able to minimize oxidation of carotene and vitamin A in the intestine, and thus it may be said to "spare" vitamin A. Probably vitamin E also plays a role in preventing autooxidation of polyunsaturated fatty acids in the tissues, since the requirement is considerably greater when the diet is high in linoleic acid.

Vitamin E plays some role in hemopoiesis inasmuch as the life-span of the red blood cells and reticulocyte formation are correlated with the level of dietary intake. Utilization of the sex hormones, cholesterol, and vitamin D are possibly influenced by the presence of vitamin E.

Daily allowance. The tocopherol requirement of the adult probably varies from 10 to 30 mg per day,[2] the upper level representing the need when the diet contains a high level of polyunsaturated fatty acids. Trace amounts of selenium can replace part of the need for the vitamin, although the effective amount of selenium for human beings is not known. Likewise, other antioxidants such as ascorbic acid may reduce the tocopherol requirement.

Sources. The average American diet supplies about 14 mg of d-alpha-tocopherol daily.[8] Oils of the wheat germ, cottonseed, rice germ, and germs of other seeds are potent sources of vitamin E. Appreciable concentrations are present in dark-green leafy vegetables, nuts, and legumes. Foods of animal origin are low in vitamin E.

Effects of deficiency. Long periods of time on an experimental diet practically devoid of vitamin E are required before deficiency can be measured.[9] The rate of hemolysis of red blood cells is increased in vitamin-E deficiency, and the peroxide hemolysis test is therefore used to measure adequacy of vitamin-E nutrition. A serum vitamin-E level of less than 0.5 mg per 100 ml is indicative of deficiency, while normal levels range from 0.5 to 1.0 mg per 100 ml. It is unlikely that deficiency will occur in humans except when diets grossly deficient in many other nutrients are consumed. Although high intakes of polyunsaturated fatty acids may greatly increase the need for vitamin E, the oils that are rich in these acids are usually good sources of tocopherols as well.

A deficiency of vitamin E in various species of animals results in reproductive failure, macrocytic anemia, shorter life-span of red blood cells, creatinuria, and muscular dystrophy. There has been no therapeutic value of vitamin E, however, in the treatment of menstrual disorders, the prevention of abortion, the improvement of lactation, or the alleviation of muscular dystrophy, and cardiovascular disease.

VITAMIN K

The existence of vitamin K was first suggested by Dr. Dam of Copenhagen, who in 1935 found that a "Koagulations Vitamin" was necessary to prevent fatal hemorrhages in chicks by promoting normal blood clotting.

Chemistry and characteristics. Vitamin K refers to a group of substances of similar biologic activity. Vitamin K_1 ($C_{31}H_{46}O_2$) was isolated from alfalfa, and vitamin K_2 from putrefied fish meal. Vitamin-K activity is possessed by a number of other compounds, of which *menadione,* a bright-yellow, fat-soluble compound, is three times as potent as the vitamin itself. Vitamin K is fat soluble, and its activity is easily destroyed by irradiation.

Measurement. The activity of test materials is measured in terms of milligrams or micrograms by its ability to prevent hemorrhage in young chicks. Menadione is used as the standard for measuring vitamin-K potency.

Physiology and function. Vitamin K is synthesized by bacteria in the intestinal tract as well as being supplied by the diet. Bile salts are necessary for absorption, with a large proportion of the vitamin being excreted in the feces. The body stores only a limited amount of vitamin K, most of it in the liver.

Vitamin K is necessary for the formation of prothrombin, a constituent of normal blood. Prothrombin in turn is required for the production of thrombin before fibrin can be formed so that the blood can clot. The mechanism by means of which vitamin K works is not known, although it has been shown that impaired hepatic function leads to failure to utilize vitamin K in the formation of prothrombin. Vitamin K probably participates in oxidative phosphorylation in the tissues.

Daily allowances. The variations in intestinal synthesis and in the diet have made it impossible to establish a daily allowance. Dietary deficiency is not believed to be a problem.

Sources. Green leaves of plants such as spinach and kale are excellent sources of vitamin K, as are also cabbage, cauliflower, and pork liver. Cereals, fruits, and other vegetables are poor sources.

Effect of a deficiency. A lowered prothrombin content of the blood and increased tendency to hemorrhage result from a deficiency of vitamin K. In the newborn infant, intestinal bacteria are not sufficiently developed for the synthesis of vitamin K. Thus, some infants, especially those who are premature, show susceptibility to hemorrhage. Vitamin K is often administered to the infant immediately after birth if there is any indication of hemorrhagic tendency. The practice of giving vitamin K to the mother prior to delivery has been questioned since too much vitamin K may lead to hemolytic anemia in the infant.

Deficiency may occur in adults because of failure to synthesize or absorb vitamin K or inability to synthesize prothrombin. Oral therapy with sulfa

drugs or antibiotics interferes with the synthesis of the vitamin in the intestine —a factor of some importance when surgery is contemplated. In obstructive jaundice and lesions of the biliary tract, bile is not present in the intestinal tract to effect absorption of vitamin K. Severe diarrhea, as in sprue, celiac disease, and ulcerative colitis, may so interfere with absorption of vitamin K that the tendency to hemorrhage as well as to other deficiency symptoms is

Table 10–1. Summary of the Fat-Soluble Vitamins

Nomenclature	Units and Methods of Assay	Important Sources	Stability in Foods
Vitamin A provitamin A alpha-, beta-, gamma-carotene, cryptoxanthin	I.U. Rat growth or chemical assay	*Animal* fish-liver-oils liver butter, cream whole milk whole-milk cheeses egg yolk *Plant* dark green leafy vegetables yellow vegetables yellow fruits Fortified margarines	Insoluble in water Stable to heat by usual cooking methods Destroyed by oxidation, drying, and very high temperatures Fat soluble
Vitamin D vitamin D_2 calciferol, viosterol, activated ergosterol vitamin D_3 activated 7-dehydro-cholesterol antirachitic factor	I.U. Calcium line test on rats	Fish-liver oils Fortified milk Activated sterols Exposure to sunlight Very small amounts in butter, liver, egg yolk, salmon, sardines	Stable to heat and oxidation Fat soluble
Vitamin E alpha-, beta, gamma-, delta-, tocopherol antisterility vitamin	mg as tocopherol Ability to prevent resorption of fetus in rats, or chemical assay	Plant tissues—oils of wheat germ, rice germ, cottonseed; green leafy vegetables; nuts; legumes Animal foods are poor sources ?intestinal synthesis	Not affected by heat or acid Oxidized in rancid fats, presence of lead and iron salts, alkalies, ultraviolet light Fat soluble
Vitamin K antihemorrhagic vitamin coagulation vitamin menadione	mcg as menadione Clotting time of vitamin-K-depleted chicks	Green leaves such as alfalfa, spinach, cabbage Liver Synthesis in intestine	Fat soluble Unstable to alkali, oxidizing agents, and light Fairly stable to heat

increased. When severely damaged, the liver may be unable to effect synthesis of prothrombin.

Whenever there is insufficient bile for absorption, menadione is prescribed together with bile salts. Parenteral administration may be necessary when intestinal disease interferes with absorption. Vitamin K is not effective when the liver is unable to synthesize prothrombin.

Physiology and Functions	Effect of Deficiency	Daily Allowances*
Bile necessary for absorption of carotene Stored in liver Maintains integrity of mucosal epithelium, maintains visual acuity in dim light Large amounts are toxic	Faulty bone and tooth development Night blindness Keratinization of epithelium—mucous membranes and skin *Xerophthalmia*	Adult: 5000 I.U. Pregnancy: 6000 I.U. Lactation: 8000 I.U. Children: 1500–5000 I.U., depending on age
Synthesized in skin by activity of ultraviolet light Stored chiefly in liver Regulates absorption of calcium, phosphorus, and normal utilization in bones and teeth Large amounts are toxic	*Rickets* in children soft, fragile bones enlarged joints bowed legs chest, spinal, pelvic bone deformities delayed dentition *Tetanic* convulsions in infants *Osteomalacia* in adults	Need is small for adults Children, pregnant or lactating women: 400 I.U.
Not stored in body to any extent Related to action of selenium *Humans:* reduces oxidation of vitamin A, carotenes, and polyunsaturated fatty acids; hemopoiesis *Animals:* normal reproduction; utilization of sex hormones, cholesterol	*Humans:* hemolysis of red blood cells; mild anemia. Deficiency is not likely *Animals:* sterility in male rats; resorption of fetus in female rats; muscular dystrophy; creatinuria; macrocytic anemia	10 to 30 mg for adult
Bile necessary for absorption Formation of prothrombin Sulfa drugs and antibiotics interfere with intestinal absorption Large amounts are toxic	Prolonged clotting time Hemorrhagic disease in newborn infants	Not known

* See Recommended Dietary Allowances for complete listing, Table 4–1.

PROBLEMS AND REVIEW

1. The original source of all vitamin A is the carotene of plants. How is the carotene changed to vitamin A? How efficient is it?
2. A deficiency of vitamin A in the diet leads to clinical signs much sooner in young infants than in older children and adults. Why is this so? What are some signs of vitamin-A deficiency?
3. Vitamins A and D are the two fat-soluble vitamins which require particular emphasis in daily nutrition. By what means can you assure yourself of an adequate intake? Why do you not need to plan especially for vitamins E and K in your diet? When does vitamin K require particular attention?
4. Milk is the food most frequently fortified with vitamin D. Why is the fortification of milk desirable? How is it accomplished? How much milk must be taken daily by a child to assure adequate vitamin D?
5. Detectable signs of deficiency for the various fat-soluble vitamins seem to be much less prevalent in this country than are deficiencies of a number of water-soluble factors. Give several possible explanations for this.
6. Explain the relationship that exists between vitamin A and vitamin E; vitamin D and calcium.
7. *Problem.* Calculate the percentage of your own daily requirement for vitamin-A which 2 cups of milk would supply.
8. *Problem.* Calculate the vitamin-A content of your own diet for 2 days. What percentage of your daily allowance is provided by sources rich in preformed vitamin A? By sources rich in the provitamin?
9. What dangers may result from indiscriminate use of vitamin-A and -D concentrates?

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Chapter 11

THE WATER-SOLUBLE VITAMINS: ASCORBIC ACID

Discovery. One of the most serious problems of the sailor, adventurer, and explorer several hundred years ago was the frequent occurrence of scurvy. Although citrus and other fresh fruits and germinating seeds have long been known as both a preventive and a cure, the scientific foundations for the study of ascorbic acid were first initiated in 1907 when scurvy was produced experimentally in guinea pigs by Holst and Frölich in Norway. The isolation and synthesis of ascorbic acid, or vitamin C as it is also called, were accomplished in a number of laboratories after Dr. King and his co-workers at the University of Pittsburgh first effected chemical identification in 1932.

Chemistry and characteristics. Ascorbic acid, $C_6H_8O_6$, is a white crystalline compound of relatively simple structure closely related to the monosaccharide sugars. It is stable in its dry form, but dissolves readily in water. Of all vitamins, ascorbic acid is the most easily destroyed. Vitamin activity is possessed by two forms: L-ascorbic acid (the reduced form) and L-dehydroascorbic acid (the oxidized form). The latter is easily oxidized further with complete loss of activity. The oxidation of ascorbic acid is accelerated by heat, light, alkalies, oxidative enzymes, and traces of copper and iron. Oxidation is inhibited to a marked degree in an acid reaction, and when the temperature is reduced.

Measurement. The concentration of ascorbic acid is expressed in milligrams. In foods or in body tissues it may be determined chemically, one method being based on the strong reducing action which will bring about the bleaching of a blue dye under specified conditions. The amount of decolorization that takes place is proportional to the amount of vitamin present and may be determined quantitatively by means of a spectrophotomoter or colorimeter.

Physiology. Many animals are able to synthesize ascorbic acid from glucose, but the enzyme responsible for this synthesis is missing in man, guinea pigs, and monkeys. Therefore, the vitamin must be supplied in the diet. Ascorbic acid is rapidly absorbed and is distributed to the various tissues of the body where it is held to a certain point of saturation. The adrenal gland con-

tains an especially high concentration of ascorbic acid, but other glandular tissues such as the pancreas, thymus, spleen, liver, pituitary, and kidney also contain appreciable amounts. The amount of ascorbic acid held by the tissue is limited. Once the tissues are saturated, any excess will be excreted in the urine. Thus, if one gives a large amount of vitamin C in one dose, most of it will be excreted if the diet has been good in the past; but a high proportion of the dose will be held in the tissues and a smaller amount excreted if the previous diet has been so poor that the tissues are impoverished.

A blood plasma concentration of 0.4 to 1.0 mg per 100 ml is satisfactory, but only the upper level indicates a state of tissue saturation. A reduction in the daily intake is quickly reflected in lower blood plasma levels, but the concentration of the vitamin in white blood cells is less subject to change.

Functions. Ascorbic acid is essential for the production of collagenous or intercellular material which holds the cells in proper relation to each other. The healthy development and maintenance of the walls of the capillary vessels, the dentine of the teeth, the bones, the cartilage, and the connective tissues are dependent upon this function. The maintenance of this function helps to explain the importance of vitamin C in wound healing and in the ability to withstand stresses of injury and infection.

Ascorbic acid has many functions in the body related to cell respiration and to the functioning of enzymes. Some of these include (1) oxidation of phenylalanine and tyrosine; (2) reduction of ferric iron to ferrous iron in the gastrointestinal tract so that iron is more readily absorbed; (3) release of iron from transferrin, in the plasma, for incorporation into tissue ferritin; and (4) conversion of folic acid into its active form folinic acid.

An increase of adrenal cortical activity leads to decreased concentration of vitamin C and of cholesterol in the adrenal gland, but to an increased output of steroid hormones. It thus appears that ascorbic acid may be involved in the synthesis of these hormones from cholesterol.

During infections such as tuberculosis, rheumatic fever, and pneumonia additional amounts of ascorbic acid are required to maintain tissue levels. The mechanism for the increased need is not understood. Research has not shown that additional amounts of ascorbic acid have any value whatsoever in the prevention of common colds.

Daily allowances. The Food and Nutrition Board[1] recommends 70 mg ascorbic acid for the adult, 30 to 60 mg for infants and children up to 9 years, 70 to 80 mg for boys and girls, and 100 mg during pregnancy and lactation. One third to one sixth of these allowances, or about 10 to 20 mg ascorbic acid, will prevent scurvy but is not sufficient for optimum health.

Food sources. Almost all of the daily intake of ascorbic acid is obtained from the vegetable-fruit group (see Figure 11–1). Vitamin C has been called the "fresh food vitamin," since it is found in highest concentration just as the food is fresh from the plant. In general, the active parts of the plant contain appreciable amounts, while mature or resting seeds are devoid of the vitamin.

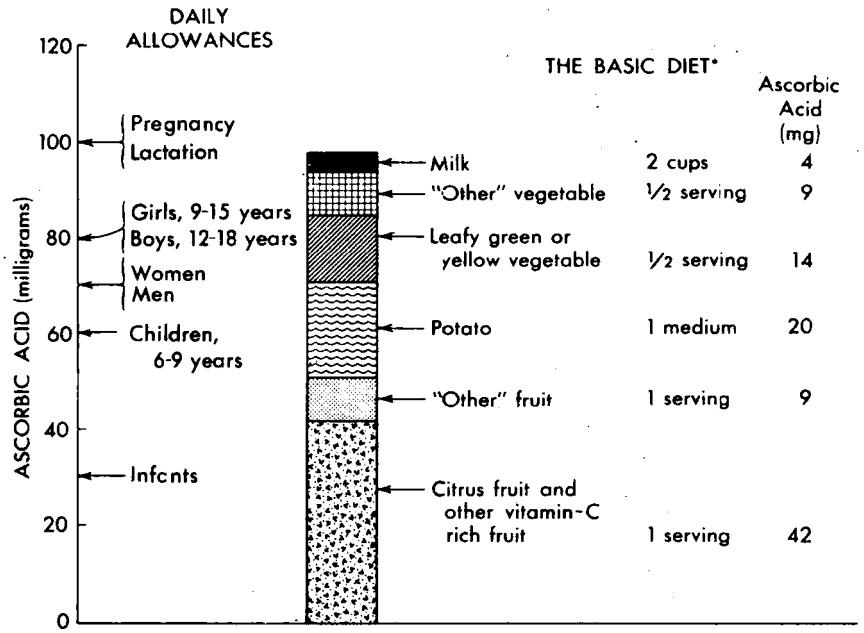


FIG. 11–1. The vegetable-fruit group of the Basic Diet fulfills the recommended allowances of adults and children for ascorbic acid. Note that potatoes and leafy green vegetables contribute significant amounts. (See Table 14–2 for calculation of ascorbic acid and other values.)

Raw, frozen, or canned citrus fruits such as oranges, grapefruit, and lemons are excellent sources of the vitamin. Orange sections including the thin white peel contain more vitamin C than an equal weight of strained juice.

Fresh strawberries, cantaloupe, pineapple, and guavas are also excellent sources. Other nonacid fresh fruits such as peaches, pears, apples, bananas, and blueberries contribute small amounts of the vitamin; when eaten in large amounts these fruits may be an important dietary source. The concentration of ascorbic acid in the nonacid canned fruits is considerably reduced.

Broccoli, Brussels sprouts, spinach, kale, green peppers, cabbage, and turnips are excellent-to-good sources even when cooked. The use of potatoes and sweet potatoes as stable food items enhances the vitamin-C intake considerably provided that preparation methods have been good.

Milk, eggs, meat, fish, and poultry are practically devoid of vitamin C as they are consumed. Human milk contains four to six times as much ascorbic acid as cow's milk, if the mother's diet has been adequate, and is able to protect the infant from scurvy. Liver contains a small amount of vitamin C, but most of this is lost during cookery.

The simplest way to ensure adequate intake of ascorbic acid is to include a serving of orange or grapefruit or a double portion of tomato, preferably at breakfast. If other fruits or juices are used at breakfast, the day's allowance

will be ample if two foods of fair concentration of ascorbic acid are included in the remaining meals.

Retention of food values. A warm environment, exposure to air, solubility in water, heat, alkali, and dehydration are detrimental to the retention of ascorbic acid in foods. The cutting of vegetables releases oxidative enzymes and increases the surfaces exposed to leaching by water. Since the vitamin is so soluble, losses are considerable when large amounts of water are used. Vegetables should be added to a small quantity of boiling water, covered tightly, and cooked until just tender for high retention of ascorbic acid. Retention is also good when a pressure cooker is used, providing that the cookery time is carefully controlled. The practice of adding baking soda to retain green color of vegetables not only may reduce the vitamin-C level but may also modify the flavor and texture of the vegetable. Leftover vegetables lose a large proportion of the ascorbic acid, although losses are reduced somewhat when the container is tightly covered in the refrigerator. On the other hand, citrus juices and tomatoes retain practically all the vitamin-C value for several days.

Effects of deficiency. If the tissues have been saturated with ascorbic acid, several months of dietary deprivation may occur before symptoms of deficiency become manifest. Poor wound healing, irritability, retardation of growth in the infant or child, and increased susceptibility to infection are among the signs of deficiency, but none of these can establish a diagnosis. A dietary history, the concentration of ascorbic acid in the blood plasma and in the white blood cells, and a measure of excretion of a test dose in the urine help to establish the diagnosis.

SCURVY. The classic picture of scurvy is rarely seen in adults in the United States. The incidence is also uncommon in infants, but a gross deficiency of ascorbic acid results in scurvy during the second 6 months of life. Infections, fevers, and hyperthyroidism may precipitate the symptoms when the intake has been inadequate. The symptoms are related to the weakening of the collagenous material.

Pain, tenderness, and swelling of the thighs and legs are frequent symptoms of infantile scurvy. The baby shows a disinclination to move and assumes a position with legs flexed for comfort (see Figure 11–2). He is pale, irritable, and cries when handled. Loss of weight, fever, diarrhea, and vomiting are frequently present. If the teeth have erupted, the gums are likely to be swollen, tender, and hemorrhagic. Bone calcification is faulty because of degeneration or lack of proper development of the bone matrix. The cartilage supporting the bones is weak, and bone displacement results. The ends of the long bones and of the ribs are enlarged somewhat as in rickets, but tenderness is a distinguishing characteristic in scurvy.

Scurvy in adults results after several months of a diet devoid of ascorbic acid. The symptoms include swelling, infection, and bleeding of the gums—gingivitis; tenderness of the legs; anemia; and petechial hemorrhages. The



FIG. 11–2. Child in scorbutic position. (*Courtesy, Dr. Bernard S. Epstein, The Long Island Jewish Hospital, New Hyde Park, New York, and* The Vitamin Manual, *published by The Upjohn Company.*)

teeth may become loose and eventually may be lost. As the disease progresses, the slightest injury produces excessive bleeding, and large hemorrhages may be seen underneath the skin. There is degeneration of the muscle structure and of the cartilage generally.

Acute scurvy responds within a few days to the administration of 100 to 200 mg ascorbic acid given in the synthetic form or as orange juice. Chronic changes that have occurred, such as bone deformities and anemia, require much longer periods for their correction.

A summary of ascorbic acid is included with three B-complex vitamins in Table 12–1.

PROBLEMS AND REVIEW

1. In what ways is ascorbic acid related to the functioning of each of these substances: iron, folic acid, cholesterol?
2. What are the clinical manifestations of a deficiency of ascorbic acid?
3. What is the effect of an intake of ascorbic acid in excess of the body's needs?
4. Why is a formula-fed baby more prone to scurvy than a breast-fed baby?
5. List the instructions you would give for the preparation and service of these foods in order that the maximum ascorbic acid would be retained: tossed green salad, buttered cabbage?
6. *Problem.* Calculate the ascorbic acid content of your own diet for 2 days. Compare your intake with the recommended allowances.
7. *Problem.* Plan food combinations for 2 days for a pregnant woman who is allergic to citrus fruits and tomatoes and who requires 100 mg ascorbic acid.

8. *Problem.* Calculate the amounts of each of the following foods necessary to furnish 25 mg of ascorbic acid: orange juice, tomato juice, sweet potato, cabbage, grapefruit, endive, strawberries, cantaloupe, apple, lettuce.

9. Mashed potatoes served in a restaurant probably should not be relied upon as a source of ascorbic acid. Give several reasons why this is true.

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Chapter 12

THE WATER-SOLUBLE VITAMINS: THE VITAMIN-B COMPLEX

In areas of the world where polished rice is a staple food, beriberi, a serious disease affecting the nerves, has been known for generations. Takaki, a Japanese medical officer, studied the high incidence of the disease among men of the Japanese navy during the years 1878–1883. Among 276 men serving on one sailing vessel he found 169 cases of beriberi at the end of 9 months, but only 14 cases occurred among a similar number of men on a second vessel who had received more meat, milk, and vegetables in their diet. Takaki believed this difference was related to the protein content of the diet.

About 15 years later (1897) Eijkman, a Dutch physician in the East Indies, noted that illness in fowls which ate scraps of hospital food was similar to beriberi seen in humans. He subsequently conducted a series of experiments which led to the first clear demonstration of a nutritional deficiency disease. He theorized that the starch of polished rice was toxic to the nerves, but that the outer layers of the rice kernel were protective. Another Dutch physician, Grijns, interpreted the findings as a deficiency of an essential substance in the diet.

A number of chemists demonstrated the effects of extracts from rice. Funk in 1911 coined the term *vitamine* for the substance which he found to be effective in preventing beriberi. McCollum and Davis applied the term *water-soluble B* to the concentrates which cured beriberi.

The water-soluble vitamin B described by Funk and others was soon discovered to be not a single substance but a group of compounds which we now designate as the vitamin-B complex. Many of these have now been synthesized, and their chemical and physical properties are fairly well understood. The role of these vitamins in metabolism is only partially known, but it is certain that they are essential for metabolic changes which take place in all cells. Principally these vitamins combine with specific proteins to function as parts of the various oxidative enzyme systems which are concerned with the breakdown of carbohydrate, protein, and fat in the body. Thus, they are inter-

related and are intimately involved in the mechanisms which release energy, carbon dioxide, and water as the end products of metabolism.

The student should become thoroughly familiar with the properties, functions, daily allowances, and factors in dietary planning with respect to thiamine, riboflavin, and niacin, since she will be expected to consider them in the planning and preparation of adequate diets. Other B-complex vitamins are equally necessary in human nutrition but will, in all likelihood, be supplied in sufficient quantities under normal conditions if the three above-named vitamins are provided in adequate amounts. The properties, functions, food sources, probable requirements, and effects of deficiency of other B-complex vitamins are presented in outline form on pages 177–80.

THIAMINE

Discovery. Crystalline vitamin B_1 was isolated from rice bran by Jansen and Donath in Holland in 1926. The synthesis and structure were accomplished in 1936 by Dr. R. R. Williams who had worked for a quarter of a century on studies of beriberi and on the factor in rice polishings which brought about cure of the disease. Noting the presence of sulfur in the molecule, the vitamin was named thiamine.

Chemistry and characteristics. Thiamine is available commercially as thiamine hydrochloride, $C_{12}H_{17}N_4OSCl.HCl$, in a crystalline white powder. It has a faint yeastlike odor and a salty nutlike taste, and is readily soluble in water. The vitamin is stable in its dry form, and heating in solutions at 120° C in an acid medium has little destructive effect. On the other hand, cooking foods in neutral or alkaline reaction is very destructive.

Measurement. Thiamine is now measured in milligrams or micrograms. It is determined by chemical or microbiologic methods, but in the past it was measured by using pigeons, rats, or chicks as assay animals.

Physiology. Thiamine is readily absorbed in aqueous solutions from both the small and large intestine and is then carried to the liver by the portal circulation. In the liver, as well as in all living cells, it normally combines with phosphate to form thiamine pyrophosphate, a coenzyme also known as cocarboxylase. It may be stored in the liver in this form, or it may combine further with magnesium and specific proteins to become active enzymes known as *carboxylases*.

Liver, heart, kidney, muscles, and brain are richer in thiamine than the blood which contains only traces. During a period of deficiency the thiamine is lost rapidly from these tissues, the muscles losing the reserves first while the brain clings most tenaciously to its supply. At no time are the stores sufficiently great to last for more than a few weeks, and hence a day-to-day supply is essential in the diet.

Any excess of thiamine is quickly excreted in the urine and to some extent in the perspiration. The body reserves of thiamine may be estimated by measuring the urinary excretion of thiamine following a test dose.

Function. As a component of the enzyme carboxylase, thiamine functions in the release of energy from the metabolism of carbohydrate. One of the intermediate products of glucose breakdown in the body is pyruvic acid, a three-carbon keto acid. Carboxylase effects the removal of the carboxyl group from this acid to produce acetate. The two-carbon unit is then degraded further to carbon dioxide and water. Other ketonic acids are similarly decarboxylated by specific carboxylases, of which thiamine is a component.

As a result of the role in energy metabolism, thiamine is related to the maintenance of a normal appetite, to the normal muscle tone of the gastrointestinal tract, and to a healthy nervous system.

Daily allowances. The thiamine requirement is related to the level of carbohydrate in the diet and for practical purposes may be expressed in terms of daily caloric intake. The minimum requirement is 0.2 mg per 1000 calories, while the recommended allowance[1] is 0.4 mg of thiamine per 1000 calories. Such a margin of safety is desirable since the body has little reserve, which may be rapidly depleted by febrile diseases or surgery.

The daily allowance for the reference man is 1.2 mg and for the reference woman, 0.8 mg. An allowance of at least 0.8 mg is provided for adults even when the caloric intake may be under 2000. For pregnant and lactating women the allowance is 1.0 and 1.2 mg, respectively. Infants should receive 0.4 mg daily, while children are allowed 0.5 to 0.8 mg.

Fat and protein exert a thiamine-sparing effect, so that diets with liberal allowances of these nutrients will require somewhat less thiamine for metabolism than will a high-carbohydrate diet of equal caloric value.

Sources. Grain products alone provide about one third of the thiamine of the daily diet in the United States and constitute the most important single source in the diet. Because such a small proportion of cereal foods is of the whole-grain variety, the cereal and flour enrichment program has been of special significance in improving the dietary level of thiamine during the last two decades. (See Table A–9.)

Meats, poultry, and fish as a group supply slightly more than one fourth of the daily intake of thiamine. Lean pork—fresh and cured—is especially high in its thiamine concentration; its frequent inclusion in the diet thus makes it a highly significant source. Liver, dry beans and peas, soybeans, and peanuts are also excellent sources. The thiamine in egg, a fair source, is concentrated in the yolk.

Although the concentration of thiamine in vegetables and fruits is low, the quantities of these foods eaten may be such that important contributions are made to the daily total. Milk is likewise a fair source because of the amounts taken in the daily diet and because milk is not subjected to treatment other than pasteurization, which does not materially reduce the thiamine level.

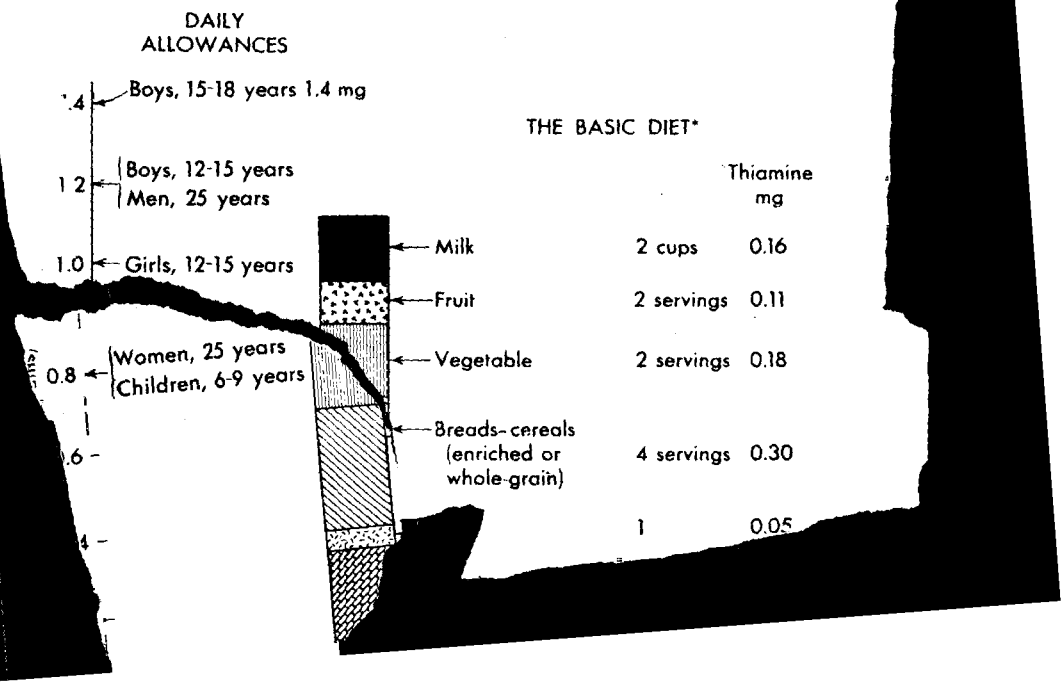
...e Vit...

...thiamine contribution of th... ...iet pattern...

Retention of food values. Appreciable losses of thiamine in foods throu... cookery may occur as a result of (1) the solubility of this vitamin in wate... (2) the ready destruction in the presence of alkali, (3) high temperature... and (4) the prolonged exposure to heat. Thiamine loss during cookery varie... widely, and no general rule applies to all methods of cookery.

Little loss occurs in the preparation of cooked breakfast cereals inasmuch... as the water used in preparation is consumed. On the other hand, losses may... be considerable when large amounts of water are drained off as in the prepara... tion of rice. Such losses are minimized when rice is cooked in just enough wate... so that all of it is absorbed by the grains. "Converted" rice retains much mor... thiamine and other nutrients than does refined rice, because the parboiling o... the rice in its processing distributes the water-soluble nutrients throughout th... grain. The baking of bread results in 15 to 20 per cent loss.

About 25 to 50 per cent of the thiamine may be lost in meat cookery. Th... smaller loss pertains to meats that have been broiled or roasted, whereas th... larger loss occurs when meats are cooked in liquid which is discarded. If th... drippings and the liquid in which meat is cooked are eaten, the thiamine con... tent of meat is about 75 per cent of the initial value.



getable co[illegible] be considerable if large am[illegible]
later discarde[illegible] if alkali is add[illegible]ed to retain
plor. Those principles of preparation that are essential for the retentio[illegible] of
sc rbic acid (see p. 161) serve well for maximum thiam[illegible]ine content.

ffect of deficiency. There is meager evidence that eve[illegible]n mild deficie[illegible]cy is
valent in the United States. Beriberi has been seen only on rare occasions
is not a public health problem. Chronic alcoholism may lead to thiamine
ficiency because the individual who drinks excessively eats very poorly as a
le.

Beriberi is still observed in the Orient although less commonly in recent years. High-carbohydrate diets of rice and wheat will consistently result in beriberi when the thiamine intake is less than 0.2 mg per 1000 calories. The effectiveness of rice enrichment was demonstrated in the Philippines by Williams.[2]

Thiamine deficiency may occur following gastrointestinal disturbances such s diarrhea and vomiting, or subsequent to febrile diseases or surgery when he dietary intake has been poor.

DIAGNOSIS. The symptoms of mild deficiency are so vague that a diagnosis f thiamine lack is difficult. Some of the laboratory tests may be helpful but necessarily conclusive. For example, an elevated level of pyruvic and lactic s in the blood, especially after exercise and the administration of a standard int of glucose, together with a low concentration of thiamine in the urine uggestive of deficiency. If such tests are further substantiated with a dietary ry of thiamine lack plus the appearance of peripheral neuritis and dis- s in the cardiovascular system, thiamine deficiency seems apparent.

e activity of an enzyme, erythrocyte transketolase, which is found in the ood cells correlates closely with thiamine nutrition.[3] A measure of this y is believed to be useful in detecting marginal deficiency before clin- nptoms have become apparent.

) THIAMINE DEFICIENCY. The individual who is deprived of sma[illegible]
s of thiamine daily builds up an increasing deficie[illegible]
be characterized by fatigue, lack of interest in hi[illegible]ency state which m
irritability, depression, anger and fear, and [illegible] affairs, emotional instabili
strength. As the deficiency becomes more ma[illegible] loss of appetite, weight,
indigestion, constipation, headaches, insomni[illegible]ked, the patient may compla
exertion. There appears a feeling of heavine[illegible]a, and tachycardia after mod
may be followed by cramping of the calf m[illegible]ss and weakness in the legs
an indication of the dev[illegible]scles and burning and nu
the c[illegible] of peripheral neuritis. Th
[illegible]cular system, and the per

prolonged and s[illegible]

symptoms being outstanding. Not infrequently cardiac symptoms may predominate and failure of the heart becomes imminent. The disease is characterized by the following symptoms:

1. Gastrointestinal disturbances resulting primarily from impairment of the motor processes throughout the gastrointestinal tract.
2. Muscular weakness or paralysis of the lower limbs caused by multiple neuritic conditions. The weakness affects first the foot, then the muscles of the calf, and then the thigh. The upper extremities are also affected in severe cases. The muscle degeneration may be so pronounced that coordination is impossible and a characteristic gait is present. The pain in the extremities at this stage is usually severe. The extent of muscular atrophy may be masked by edema in wet beriberi.
3. The heart becomes enlarged, and tachycardia, dyspnea, and palpitation occur on exertion. In the acute or pernicious type of beriberi, acute cardiac failure may be fatal before the seriousness of the disease has been fully appreciated.
4. Emaciation accompanies both dry and wet beriberi, but in the latter the edema may be so marked that the extent of malnourishment is not readily evident.

TREATMENT. Because beriberi is a complex vitamin-deficiency disease, patients make the greatest improvement when B-complex vitamins rather than thiamine alone are prescribed. In addition to the B-complex concentrates it is customary to prescribe a diet that is high in protein and calories.

RIBOFLAVIN

Discovery. As early as 1879 a pigment which possessed a yellow-green fluorescence had been discovered in milk. Other workers later obtained it from such widely varying sources as liver, yeast, heart, and egg white. The pigments which possess these fluorescent properties were designated as "flavins."

By 1928 the substance in yeast which prevented polyneuritis was shown to be more than one vitamin. The antineuritic fraction which was destroyed by heat was called vitamin B_1. Another fraction not destroyed by heat did not prevent or cure polyneuritis but it was needed for growth. It was designated as vitamin B_2 or vitamin G.

In 1932 a yellow enzyme necessary for cell respiration was isolated from yeast by Warburg and Christian, who also discovered that a protein and the pigment component were two factors in the enzyme. It then remained for Kuhn and his co-workers in 1935 to report on the synthesis of riboflavin and to note the relation of its activity to the green fluorescence, thereby establishing that lactoflavin and the vitamin are one and the same thing. Riboflavin is the preferred name for this vitamin, although the term vitamin B_2 is also used.

Chemistry and characteristics. Riboflavin was so named because of the similarity of part of its structure to that of the sugar ribose, and its relation to the general group of flavins. Its chemical formula is $C_{17}H_{20}N_4O_6$. In its pure state, this vitamin is a bitter-tasting, orange-yellow, odorless compound in which the crystals are needle-shaped. It dissolves sparingly in water to give a characteristic greenish-yellow fluorescence. It is quickly decomposed by ultraviolet rays and visible light. This vitamin is stable to heat, to oxidizing agents, and to acids; but it is sensitive to the effects of alkali, although to a lesser degree than is thiamine.

Measurement. Riboflavin is measured in terms of milligrams or micrograms. Chemical or microbiologic methods are both used extensively.

Physiology. Riboflavin is present in the free state in foods, or in combination with phosphate, or with protein and phosphate. It is utilized in either form. The body guards carefully its stores of riboflavin so that even in severe deficiency as much as one third of the normal amount has been found to be present in the liver, kidney, and heart of experimental animals. There may be some synthesis of riboflavin in the gastrointestinal tract, but how much absorption and utilization of the synthesized vitamin takes place is not known. Apparently the flavin content of the body tissues cannot be increased beyond a certain point, since the urinary excretion increases markedly if a great elevation of the intake occurs. On the other hand, a decided reduction in the supply leads to restriction or even curtailment of the urinary excretion.

Functions. Riboflavin functions as a coenzyme in a number of flavoproteins which are concerned with tissue oxidation. By means of these enzymes hydrogen is transferred from a variety of substances and later released to oxygen, with water as the end product. Thus, riboflavin is an essential link in the metabolism of amino acids, fatty acids, and carbohydrates, and their utilization for energy and for the synthesis of body substances. Recent studies[4] indicate that riboflavin may be involved in red cell formation.

Daily allowances. The minimum requirement for riboflavin is about 0.3 mg per 1000 calories, but the Recommended Dietary Allowance is 0.6 mg per 1000 calories; thus, a 100 per cent margin of safety is provided. For the 25-year-old man and woman of normal activity the allowances are 1.7 mg and 1.3 mg, respectively.

During pregnancy and lactation the allowance is increased to 1.6 mg and 1.9 mg, respectively. Infants are allowed 0.6 mg, children 0.8 to 1.3 mg, and boys and girls 1.3 to 2.0 mg.

Increased requirements for riboflavin occur whenever there is augmented metabolism as in pregnancy and lactation, during growth, hyperthyroidism, fevers, stress of injury or illness, diarrhea, and vomiting. Achlorhydria may precipitate deficiency because the vitamin is so quickly destroyed in an alkaline medium.

Food sources. The concentration of riboflavin in many foodstuffs is not high. Among the very best sources are milk—fresh, canned, or dried—and one

of the by-products of milk, powdered whey. Cheese is also a good source, but some of the riboflavin is lost in the removal of the whey. Dairy products, excluding butter, provide almost half of the riboflavin available for consumption in the United States.

Liver, kidney, and heart contain considerable quantities of riboflavin, while other meats, eggs, and green leafy vegetables contain smaller, but, nevertheless, important amounts.

It is noteworthy that cereals which are such excellent sources of thiamine are poor sources of riboflavin. During germination the riboflavin content of the grains increases strikingly. Enrichment of cereals and flours has added significant amounts of riboflavin to the diet.

Fruits, roots, and tubers are poor sources of riboflavin, and fats and oils are practically devoid of the vitamin. (See Figure 12–2.)

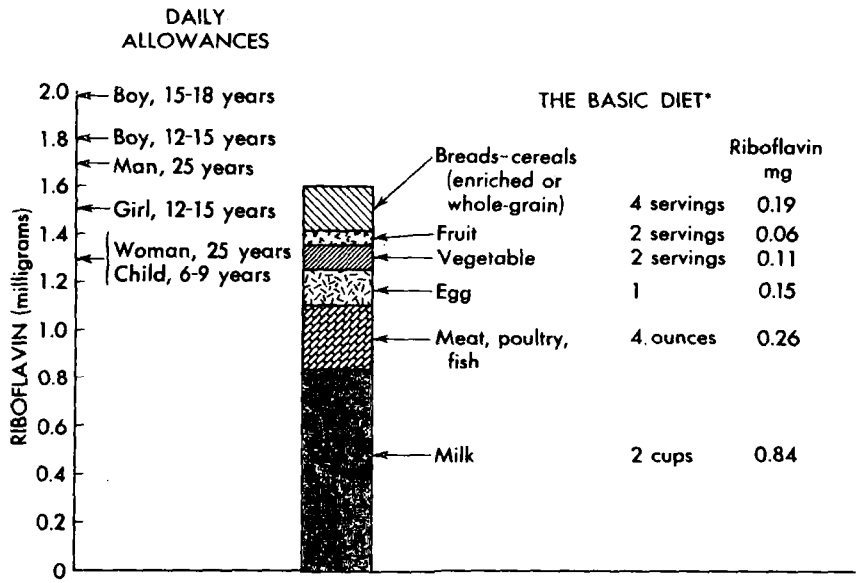


FIG. 12–2. Milk is the most important single source of riboflavin. The meat group, especially liver, also contributes significant amounts. See Table 14–2 for complete calculation.

Retention of food values. Pasteurization, irradiation for vitamin D, evaporation, or drying of milk account for not more than 10 to 20 per cent loss of the riboflavin content of milk. On the other hand, this vitamin's sensitivity to light may mean a considerable loss of potency if milk is allowed to stand exposed to light for any length of time. As much as three fourths of the riboflavin may be lost by exposure of a bottle of milk for 3½ hours to direct sunlight.

Because riboflavin is so sparingly soluble, the usual cooking procedures or freezing of vegetables do not contribute markedly to destruction of the vitamin.

The use of sodium bicarbonate is deleterious. Meats which have been boiled, roasted, or braised retain more than three fourths of the riboflavin, while most of the remainder can be accounted for in the drippings. Canned meats appear to retain most of the vitamin even when stored for periods of 10 months at 99° F.

Effect of deficiency. Ariboflavinosis is believed to be one of the most common of deficiency diseases. It is rare that an individual seeks medical advice for it alone, but it may accompany other deficiencies especially of the B complex.

SYMPTOMS. In 1939 Sebrell and Butler studied a group of women whom they placed upon a diet extremely low in riboflavin. This diet in the course of 94 to 130 days led to the development of definite symptoms such as "cracks in the skin at the corners of the mouth (cheilosis), a greasy eruption of the skin, changes in the tongue and keratitis caused by an invasion of the cornea by blood vessels."* (See Figure 12–3.) Glossitis caused by riboflavin deficiency may become apparent in pellagrins after therapy has corrected the acute



FIG. 12–3. Cheilosis—lesions of the lips and fissures at the angles of the mouth. (*Courtesy, Nutrition Section, Office of International Research, National Institutes of Health, U.S. Department of Health, Education, and Welfare.*)

* Sebrell, W. H., and Butler, R. E.: "Riboflavin Deficiency in Man," *Pub. Health Rep.*, 54:2121, 1939.

manifestations of niacin deficiency. The lips and tongue assume a purplish-red and shiny appearance in contrast to the scarlet color seen in niacin deficiency. The mouth becomes increasingly sore.

Ocular manifestations are believed to be among the earliest signs of riboflavin deficiency. The eyes become sensitive to light and easily fatigued. There is also blurring of the vision, itching, watering, and soreness of the eyes. An increased number of capillaries develop in the cornea, and the eye becomes bloodshot in appearance. Not all corneal vascularization is caused by riboflavin deficiency, however.

NIACIN (NICOTINIC ACID)

Early studies. Pellagra, which means rough skin, is a disease which was described in Italy in 1771. In the early part of this century it was one of the leading causes of mental illness and of death in this country. Its causes had been variously ascribed to toxic substances present in corn, infections from microorganisms, or toxicity produced by exposure to the sun.

Goldberger, of the United States Public Health Service, who was assigned to study the problem of pellagra in the South, early noted that the disease was almost always associated with poverty and ignorance, and that hospital attendants who worked with the patients never contracted the disease. In 1915 he performed a classic experiment on 12 prisoners who were promised release in return for their cooperation in eating a diet representative of the poorer classes in the southern states. The diet consisted of sweet potatoes, corn bread, cabbage, rice, collards, fried mush, brown gravy, corn grits, syrup, sugar, biscuits and black coffee. After a few weeks the prisoners developed headache, stomachache, and general weakness, and in about 5 months the typical dermatitis of pellagra appeared. Goldberger then suggested the existence of a pellagra-preventing (P-P) factor and related it to the B vitamins.

Identification of the vitamin. Goldberger in 1922 concluded that blacktongue in dogs was similar to pellagra in humans. Nicotinic acid had been known as a chemical substance since 1867, but it remained for Elvehjem and his co-workers in 1937 to discover its effectiveness as a curative agent for blacktongue in dogs. Following this discovery, Smith, Spies, and others were soon making reports of dramatic clinical improvement in pellagrous patients who had been given nicotinic acid. The term "niacin" was suggested by Cowgill to avoid association with the nicotine of tobacco.

Chemistry and characteristics. Niacin, which is $C_6H_5O_2N$, occurs in white, needlelike, bitter-tasting crystals. It is moderately soluble in hot water but only slightly soluble in cold water. It is very stable to alkali, acid, heat, light, and oxidation; even boiling and autoclaving do not decrease its potency. Niacinamide occurs in animal tissues and is more soluble in water than is niacin. Both forms are of equal biologic activity.

Measurement. Niacin is measured in terms of milligrams. It may be determined in food and other materials by microbiologic assay or by chemical methods.

Physiology. Niacin is readily absorbed from the small intestine. Some reserves are found in the body, but, as with the other B-complex vitamins, the amount appears to be rather limited so that a day-to-day supply is essential. Any excess of niacin which may be present is excreted in the urine in several forms so that it is somewhat difficult to account for all of it. In deficiency such as pellagra, the end products in the urine diminish markedly or are absent.

Tryptophan, one of the essential amino acids, is a precursor of niacin so that a diet which contains liberal amounts of tryptophan will provide enough niacin even though the diet itself may be low in preformed niacin. Vitamin B_6 is essential for this conversion. The experimental production of pellagra can be brought about only by diets low in both niacin and tryptophan.

Functions. Niacinamide is a component of two coenzymes: niacinamide adenine dinucleotide (NAD), also known as coenzyme I; and niacinamide adenine dinucleotide phosphate (NADP), or coenzyme II. When these coenzymes are combined with specific proteins, hydrogen can be removed from a variety of compounds and transferred to other substances. Thus, niacin is concerned with the utilization of glucose for energy and the synthesis of fats.

Daily allowances. Now that the quantitative tryptophan-niacin relationship is known, it is possible to define niacin requirements somewhat more precisely. Horwitt[5] has concluded that a minimum of 4.4 mg niacin equivalents per 1000 calories will protect against symptoms of pellagra. The recommended allowance[1] is based on a 50 per cent factor of safety, that is 6.6 mg per 1000 calories. Thus, the allowance for the reference man is 19 mg and for the reference woman is 14 mg. These levels include dietary sources of the preformed vitamin and also the equivalent from the precursor, tryptophan.

As with other B-complex vitamins, the niacin requirements are increased whenever metabolism is accelerated—growth, pregnancy, lactation, fevers, hyperthyroidism, stress of surgery or injury.

Sources. Foods must be considered (1) for their preformed niacin and (2) for the niacin available by conversion from the tryptophan. Poultry, meats, and fish constitute the most important single food group insofar as preformed niacin is concerned. Organ meats are somewhat superior to muscle tissue. Brewers' yeast, peanuts, and peanut butter are among the richest sources of niacin, but they are not ordinarily consumed in sufficient amounts to greatly affect the dietary level.

Whole grains are fair sources of niacin, but the milling leads to a loss of 80 to 90 per cent of the niacin value. The enrichment of corn products in many southern states has been effective since this cereal is such a staple in the diet of many families.

Potatoes, legumes, and some green leafy vegetables contain fair amounts of preformed niacin, while most fruits and vegetables are poor sources.

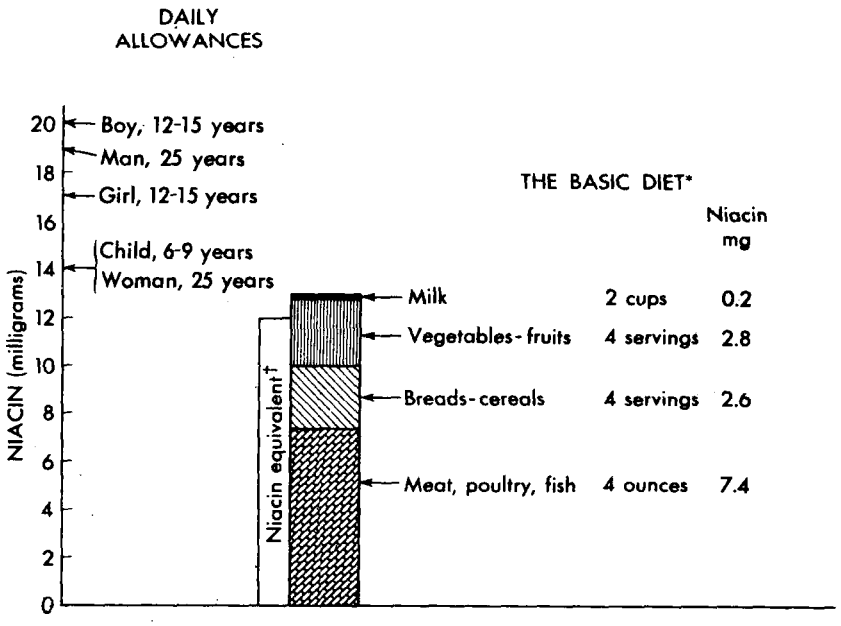


FIG. 12–4. The meat group contributes most of the niacin in the basic diet. Milk and eggs contain only small amounts of preformed niacin, but they are excellent sources of tryptophan.

Tryptophan constitutes approximately 1 per cent of the protein content of a diet in which complete protein foods predominate. Thus, an intake of 60 gm protein contributes 0.6 gm or 600 mg tryptophan. Since about 60 mg tryptophan are equivalent to 1 mg niacin, such a diet would provide 10 mg niacin in addition to the preformed niacin of the diet. Any reasonably good diet will contain 500 to 1000 mg tryptophan, equal to 8 to 17 mg niacin.

The preformed niacin contribution of the Four Food Groups may be seen in Figure 12–4.

Retention of food values. The cookery of foods does not result in serious losses of niacin, except insofar as part of the soluble vitamin may be discarded in cooking waters which are not used. The application of principles for the retention of ascorbic acid and thiamine which have been discussed earlier will result in maximum retention of niacin as well.

Effect of deficiency. Pellagra appears after months of dietary deprivation. The phenomenal decrease in the incidence of pellagra in the United States may be attributed to several factors including the enrichment program which is mandatory in some states, the concerted efforts in nutrition education, and the improvement in income. Pellagra is still a public health problem in some countries such as Spain, Yugoslavia, and certain areas of Africa.



FIG. 12-5. Dermatitis in pellagra. Patient in Duke Hospital, Durham, N.C.

SYMPTOMS AND CLINICAL FINDINGS. Pellagra involves the gastrointestinal tract, the skin, and the nervous system. While no two cases of pellagra are exactly alike, the following symptoms are characteristic.

1. Early signs include fatigue, listlessness, headache, backache, loss of weight, loss of appetite, and general poor health.

2. Sore tongue, mouth, and throat, with glossitis extending throughout the gastrointestinal tract are present. The tongue and lips become abnormally red in color. The mouth becomes so sore that it is difficult to eat and swallow.

3. A deficiency of hydrochloric acid with a resultant anemia similar to pernicious anemia may be found.

4. Nausea and vomiting are followed by severe diarrhea.

5. A characteristic symmetrical dermatitis especially on the exposed surfaces of the body—hands, forearms, elbows, feet, legs, knees, and neck—appears (see Figure 12-5). The dermatitis is sharply separated from the surrounding normal skin. At first the skin becomes red, somewhat swollen, and tender, resembling a mild sunburn; if the condition is untreated, the skin be-

comes rough, cracked, and scaly, and may become ulcerated. Sunshine and exposure to heat aggravate the dermatitis.

6. Neurologic symptoms which include confusion, dizziness, poor memory, and irritability, and leading to hallucinations, delusions of persecution, and dementia are noted as severity increases.

The classic "D's" are the final stages of the diseases—dermatitis, diarrhea, dementia, and death.

TREATMENT AND PROPHYLAXIS. Niacinamide is given in therapeutic doses, many times in excess of the Recommended Dietary Allowances. With such therapy it is possible to progress rapidly from an all-fluid to a soft and then a high-protein regular diet. Obviously, prophylaxis must include careful and persistent education in dietary improvement, emphasis upon enrichment programs, and efforts to improve the economic status of affected populations.

VITAMIN B_6 GROUP

Nomenclature—Three active forms: pyridoxine (plant products); pyridoxal and pyridoxamine (animal products)

Properties—$C_8H_{11}O_3N$ (pyridoxine); white, crystalline, odorless, bitter tasting

Water soluble; destroyed by ultraviolet light and heat

Measurement—Biologic or microbiologic; mg or mcg

Physiology and function—Pyridoxal is biologically active form. Pyridoxal phosphate is prosthetic group for enzymes which participate in degradation and interconversion of amino acids:

a) Remove carbon dioxide (decarboxylation) from amino acids
b) Transfer amino group (transamination) from one substance to another
c) Transfer sulfur groups (transsulfuration) from one substance to another

Aids in conversion of tryptophan to niacin

Participates in conversion of linoleic acid to arachidonic acid

Deficiency—Has not been observed in adults from dietary deficiency alone. Produced experimentally by administering an antagonist, desoxypyridoxine. Symptoms include: depression; sleepiness; loss of appetite, nausea, vomiting; seborrheic dermatitis; soreness of lips and tongue; conjunctivitis; peripheral neuritis

Increased urinary excretion of oxalates; may be involved in formation of renal calculi

Observed in infants receiving a formula deficient in vitamin B_6:[6] impaired growth; hypochromic anemia; convulsions

Large urinary excretion of xanthurenic acid following test doses of tryptophan indicates deficiency

Requirement—About 1.5 to 2.0 mg for adults

Increased need with high-protein diets

Therapeutic uses—Prophylaxis for tubercular patients receiving large doses of isoniazid. Peripheral neuritis occurs with frequency in such patients because isoniazid is apparently a vitamin B_6 antagonist

May be of some value in toxemias of pregnancy

Sources—Wheat germ, meat, liver, kidney, whole-grain cereals, soybeans, peanuts, corn; small amounts in milk and green vegetables

PANTOTHENIC ACID

Nomenclature—Name from Greek word means "from everywhere"

Properties—$C_9H_{17}NO_5$; commercially available as calcium pantothenate, a white, odorless, slightly bitter compound

Water soluble; easily destroyed by dry heat, alkali, and acid

Stable in neutral solutions; nontoxic

Measurement—Microbiologic; mg or mcg

Physiology and function—Probably synthesized by intestinal bacteria

Utilization depends on presence of biotin and folacin

Component of coenzyme A (CoA), which participates in:

a) Synthesis or breakdown of fatty acids through addition or removal of a two-carbon fragment from carbon chain
b) Synthesis of cholesterol, phospholipids, steroid hormones
c) Oxidation of pyruvic acid
d) Synthesis of porphyrins for hemoglobin

Closely related to functioning of adrenal cortex

Deficiency—Not observed with natural diet. Feeding antagonist produces these symptoms: loss of appetite, nausea, indigestion, abdominal pain; sullenness, mental depression; peripheral neuritis—pains in arms and legs; repeated infections; fainting sensations, rapid pulse, lowered blood pressure; disturbed electrolyte and water balance

Requirement—Not known. Diet of 2500 calories provides about 10 mg which is believed to be adequate

Therapeutic uses—Does not correct graying of hair in human beings

"Burning foot" syndrome corrected in prisoners with multiple B-complex deficiencies during World War II[7]

Needs probably increased during stress of severe illness, injury, or following antibiotic therapy

Sources—Almost universally present in plant and animal tissue

Liver, kidney, yeast, egg yolk, peanuts, whole-grain cereals, lean beef, skim milk, potatoes, tomatoes, broccoli, salmon

Loss of 50 per cent in milling of flour; 33 per cent lost in meat cookery

BIOTIN

Nomenclature—Vitamin H, coenzyme R, anti-egg-white-injury factor

Properties—$C_{10}H_{16}O_3N_2S$

Soluble in water; susceptible to oxidation and to alkali and strong acids; less labile in bound form

Stable to heat

Measurement—Microbiologic; mcg

Physiology and function—One of the most potent vitamins known

Synthesized in intestine; antibiotics interfere with synthesis; avidin, a protein in raw egg white, combines with biotin in intestine to prevent absorption; avidin is inactivated by cooking

Functions not clearly understood; probably participates in pyruvate metabolism, fixation of carbon dioxide, and in deamination of certain amino acids

Deficiency—Unlikely in man

Experimental deficiency produced in man by use of high egg-white intake (200 gm dried egg white daily);[8] dermatitis of arms, legs; nervousness; anorexia; anemia, ashen pallor

In rats: spectacle eye; falling out of hair; loss of weight; loss of muscular control

Requirement—Not known; probably 150–300 mcg daily

Intestinal synthesis may meet needs

Sources—Minute quantities widely distributed in foods

Liver, kidney, pancreas, molasses, milk, yeast, egg yolk

VITAMIN B_{12}

Nomenclature—Cobalamin; cyanocobalamin; antipernicious anemia factor; Castle's extrinsic factor

Properties—$C_{63}H_{84}O_{14}N_{14}PCo$; only known cobalt-containing substance essential for life

Deep-red needle crystals; slightly soluble in water

Stable to heat in aqueous solutions; inactivated in alkaline or strongly acid solutions or by light

Obtained as by-product in fermentations which produce antibiotics such as Aureomycin, streptomycin

Measurement—Microbiologic or chemical assay; mcg

Physiology and function—Absorption from ileum only; depends on presence of Castle's *intrinsic factor,* a mucoprotein enzyme secreted in the stomach. Intrinsic factor controls level of absorption

Stored in the liver

Involved in purine metabolism and synthesis of nucleic acid and nucleoproteins

Essential for maturation of red blood cells in bone marrow

Transfer of single carbon units; synthesis of choline and methionine; has lipotropic activity

Metabolism of nervous tissue

Deficiency—Pernicious anemia. Deficiency occurs when there is a genetic defect in the production of intrinsic factor. Macrocytic anemia and degenerative changes of nervous system. May occur following gastrectomy

Vegetarian diets deficient in vitamin B_{12} retard growth but do not produce anemia

Requirement—About 3 to 5 mcg daily

Sources—Occurs in minute concentrations chiefly in animal tissues; practically absent in higher plant forms

Liver and kidney contain 40–50 mcg per 100 gm

Milk, eggs, cheese, muscle meats contain 1–5 mcg per 100 gm

Amply provided by small intakes of animal protein

FOLIC ACID GROUP

Nomenclature—Folacin or pteroylglutamic acid (PGA); tri- and heptapteroylglutamates are also active

Folinic acid; citrovorum factor; leucovorin: biologically active form of folic acid

Properties—$C_{19}H_{19}N_7O_6$; contains pteridine, para-aminobenzoic acid, glutamic acid molecules

Bright yellow crystals slightly soluble in water

Easily oxidized in acid medium and in sunlight

Not toxic except in massive doses

Measurement—Biologic, microbiologic, colorimetric, or fluorometric assay; mcg or mg

Physiology and function—Excreted in both urine and feces in excess of dietary levels; indicates bacterial synthesis occurs in intestine

Free and conjugate forms are interchangeable

Folic acid is transformed into biologically active folinic acid by ascorbic acid

Transfer of single carbon units

Participates in synthesis of purines and pyrimidines and of nucleoproteins; thus necessary for regeneration of blood cells

Biosynthesis of methyl groups

Related to metabolism of glutamic acid, tyrosine, phenylalanine

Deficiency—Not likely in man from dietary defects, but may occur secondary to disease; sprue, megaloblastic anemias of infancy, pregnancy. Symp-

toms include macrocytic anemia, glossitis, diarrhea, malabsorption
Requirement—Not known; probably about 0.1 to 0.2 mg
Therapeutic uses—Sprue, macrocytic anemias of infancy and pregnancy; not a substitute for vitamin B_{12} in treatment of pernicious anemia
Sources—Widespread in foods, both in free and conjugate forms
Liver, kidney, yeast, deep-green leafy vegetables are good sources; lean beef, veal, wheat cereal foods are fair; root vegetables, dairy foods, pork, light-green vegetables are low
Appreciable loss occurs in foods stored at room temperature and during cookery

CHOLINE

Properties—$C_5H_{15}NO_2$
Colorless, highly soluble, bitter tasting
Stable in acid solution; decomposed in strong alkali
Toxic in amounts of 15 to 70 gm
Measurement—gm or mg
Physiology and function—Synthesized by the body from methionine; is probably not a true vitamin
Present in almost all cells as constituent of phospholipids: lecithin, cephalin, sphingomyelin
Provides labile methyl ($-CH_3$) group which can be transferred from one substance to another (transmethylation)
Interrelated with methionine, vitamin B_{12}, and folic acid in prevention of fatty livers
Involved in transmission of nerve impulses through production of acetylcholine
Deficiency—Not known in man
In animals: hemorrhagic degeneration of kidneys, adrenals, heart, lungs, eyes; cirrhosis; slipped tendon disease in chicks
Requirement—250–600 mg in average diet is ample
Methionine exerts sparing effect
Sources—Egg yolk, best; liver, brain, kidney, heart, sweetbreads, tongue; milk, meat, nuts, cereals, vegetables, fruits

INOSITOL

Properties—$C_6H_{12}O_6$, water-soluble; sweet taste
Not toxic
Physiology—Significance in human nutrition not established
Possesses lipotropic activity
Deficiency—Not reported in man
In animals: loss of hair, failure of lactation and growth, reproductive failure
Sources—Fruits, milk, meat, nuts, whole grain, yeast, vegetables

PARA-AMINOBENZOIC ACID

Nomenclature—Abbreviated PABA
Properties—$NH_2C_6H_4COOH$
Colorless crystalline compound slightly soluble in water
Stable in dilute acids and alkalies
Easily oxidized
Physiology—Component of folic acid
Prevents gray hair in rats and mice, but has no value in restoring natural color of gray hair in humans
Deficiency—Not observed in man
Requirement—Its need is questioned in animal nutrition
Therapeutic uses—Effective in treatment of typhus fever, Rocky Mountain spotted fever
Sources—Yeast, liver, molasses, rice bran, wheat germ

VITAMIN ANTAGONISTS

"An antivitamin may be defined as any substance that interferes with the synthesis or metabolism of a vitamin as, for example, by (a) inactivation or chemical destruction, (b) irreversible combination, or (c) competetive inhibition."*

A number of vitamins such as vitamin K, and several members of the B complex are synthesized in the intestinal tract, thus accounting for at least part of the body's requirement. When chemotherapeutic agents are used to combat the growth of pathologic organisms in the gastrointestinal tract, the normal bacterial flora are also destroyed. These agents therefore impose a deficiency of the vitamins since they are not being synthesized.

Avidin is a protein occurring in raw egg white which combines with biotin so that it cannot be absorbed. However, a very large intake of raw eggs would be necessary to provide sufficient avidin to provoke a biotin deficiency.

A number of compounds are closely similar in chemical structure to vitamins but do not possess vitamin activity. Such compounds may take the place of the vitamins in certain reactions but are unable to complete the reaction so that a deficiency of the vitamin occurs. These vitamin antagonists have been used to produce experimental deficiency when the omission of the vitamin from the diet of the experimental subject has not been practical for one reason or another. Only through the use of antagonists has it been possible to describe pantothenic acid and vitamin B_6 deficiency.

Raw fish and bracken ferns contain an enzyme, thiaminase, which splits thiamine so that it is rendered ineffective. Thiaminase is inactivated by cookery.

Dicoumarin, which has been isolated from spoiled sweet clover, produces hypoprothrombinemia in a number of species. It is often used as an anticoagulant. Vitamin K counteracts this action.

PROBLEMS AND REVIEW

1. Explain how the following nutrients are interrelated:

riboflavin and niacin	tryptophan and vitamin B_6
tryptophan and niacin	folic acid and folinic acid
glucose and thiamine	cobalt and vitamin B_{12}
pyridoxine and protein	folic acid and ascorbic acid

choline and fat

2. What is the effect on carbohydrate metabolism of a deficiency of thiamine? What are clinical signs of such deficiency?
3. What is the role of niacin in metabolism? What clinical symptoms are observed in a niacin deficiency?
4. How can you explain the fact that milk is a pellagra-preventive food even though it contains very little niacin?

* Wright, L. D.: "The Significance of the Anti-Vitamins in Nutrition," *J. Am. Dietet. A.*, **23**:289, 1947.

Table 12–1. Summary of Four Water-Soluble Vitamins*

Nomenclature	Units and Methods of Assay	Important Sources	Stability in Foods
Ascorbic acid vitamin C antiscorbutic vitamin	mg Chemical	Citrus fruits Tomatoes Strawberries Cantaloupe Cabbage Broccoli Kale Potatoes	Highly soluble in water Most easily destroyed of all vitamins—heat, air, alkali enzymes Acid inhibits destruction Copper accelerates destruction
Thiamine vitamin B_1 antiberiberi vitamin	mg or mcg Chemical Microbiologic	Pork Liver, other organs Brewers' yeast Wheat germ Whole-grain cereals and breads Enriched cereals, breads Soybeans, legumes, peanuts Milk	Stable in slightly acid solution Quickly destroyed by heat in neutral or alkaline solution Sulfite quickly destroys it Highly soluble in water
Riboflavin vitamin B_2 (formerly: lactoflavin; vitamin G)	mg or mcg Chemical Microbiologic	Milk Powdered whey Liver, kidney, heart, meats Eggs Green leafy vegetables Dried yeast Enriched foods	Quickly decomposed by light and very sensitive to alkali Relatively resistant to heat in acid Sparingly soluble in water
Niacin nicotinic acid niacinamide antipellagra vitamin	mg Chemical Microbiologic	Lean meat, fish, poultry Liver, kidney Whole-grain cereals, breads Enriched cereals, breads Green vegetables Peanuts Brewers' yeast	Stable to heat and oxidation, light Slightly soluble in water Stable to acid and alkali

* See Recommended Dietary Allowances, Table 4–1, for complete listing.

PROBLEMS AND REVIEW (continued)

5. The dietary intake of vitamins may appear to be satisfactory when compared with recommended allowances, but a physician may prescribe a vitamin supplement. Under what circumstances would you expect such a supplement to be necessary?

6. What is the possible significance of each of the following in human nutrition: folic acid; choline; biotin; pantothenic acid; pyridoxine; inositol; vitamin B_{12}; antivitamins?

Physiology and Functions	Effect of Deficiency	Daily Allowances
Very little storage in body Greatest concentrations in most active tissues Forms and maintains intercellular substance Metabolism of some amino acids Facilitates absorption of iron Conversion of folic acid to folinic acid	Cutaneous hemorrhages Improper bone development Weakened cartilages Muscle degeneration Anemia Stunted growth Susceptibility to infection Scurvy	Adults: 70 mg Pregnancy: 100 mg Lactation: 100 mg Children under 9: 30–60 mg Boys and girls: 70–80 mg
Possibly some synthesis in body Limited storage in body Part of enzyme system, *carboxylase*, which removes COOH group from pyruvic acid	Lack of appetite Nervous instability Depression Fatigue Gastrointestinal atony and constipation *Beriberi*, polyneuritis, cardiac failure, edema	0.4 mg per 1000 calories Adults: 0.8–1.2 mg Pregnancy: 1.0 mg Lactation: 1.2 mg Children under 9: 0.4–0.8 mg Boys and girls: 0.9–1.4 mg
Storage in body is limited, but body retains supplies carefully Constituent of enzyme system—transfers hydrogen from one metabolite to another	Cracks at corners of lips (*cheilosis*) Inflammation of lips and tongue Burning and itching of eyes Photophobia Blurred vision	Adults: 1.2–1.7 mg Pregnancy: 1.6 mg Lactation: 1.9 mg Children under 9: 0.6–1.3 mg Boys and girls: 1.3–2.0 mg
60 mg tryptophan equivalent to 1 mg niacin Active constituent of enzyme system—transfer of hydrogen	*Pellagra*: gastrointestinal, skin, and neurologic changes	Adults: 13–19 mg Pregnancy: 17 mg Lactation: 21 mg Children under 9: 6–14 mg Boys and girls: 15–22 mg

7. *Problem.* Examine the label information on three packages of dry cereals. Calculate the percentage of the recommended allowances provided by 1 ounce of each cereal, using your own allowances as the basis for calculation. How do these percentages compare with those indicated on the label? Explain any differences.

8. *Problem.* Mrs. Smith has asked for your guidance in the selection, storage, and preparation of foods so that maximum nutritive value will be retained. On the basis of your information concerning the stability of vitamins, indicate briefly a set of instructions for guiding Mr. Smith. Show how these rules apply to the preparation of a meal that includes roast beef, potatoes, green beans, cole slaw, milk, and fruit cup. Which vitamin or vitamins are especially concerned in each rule you have laid down?

9. *Problem.* Calculate the thiamine, riboflavin, and niacin content of your own diet

for 2 days. Compare your intake with the recommended allowances. If there are any deficits, show how you could correct them.

10. *Problem.* A dietary calculation showed an intake of 80 gm protein and 12 mg niacin. Calculate the total niacin equivalent of this diet.

11. *Problem.* Calculate the percentage of your own daily requirement for thiamine and riboflavin which 3 cups of milk would supply. For each of these nutrients list two foods which would serve as effective supplements to the milk in supplying your daily needs.

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Chapter 13
WATER

The body's need for water is second only to that for oxygen. It is possible to live for days and even weeks without food, but death is likely to follow a deprivation of water within a few days. Approximately 55 to 70 per cent of the total body weight is made up of water. Infants and young children have a higher percentage of water in their bodies than adults. The percentage of water in lean individuals is higher than that in obese persons.

Fluid within the cells (intracellular fluid) accounts for about three fourths of the total body water, while the remainder is found in the circulating plasma and as interstitial fluid (lymph and fluid which bathes the tissues). The circulating plasma is about 5 per cent of the total body weight.

Functions. All the chemical changes that occur in the cells of the body take place in the presence of water. It is the medium of the body fluids, the secretions, and the excretions—blood, lymph, digestive juices, bile, perspiration, urine, and feces. Water acts as a solvent for all the products of digestion, holding them in solution and permitting them to pass through the absorbing walls of the intestinal tract into the blood stream. The blood, which is about 90 per cent water, carries nutritive elements to the cells and is the vehicle for carrying carbon dioxide to the lungs and waste nitrogenous material and salts to the kidneys. Urine consists of about 97 per cent water and holds the waste materials in solution, while bowel wastes can be eliminated only if sufficient water is present to avoid constipation.

Water is also an important lubricant, for it prevents friction between moving body parts. It regulates body temperature through evaporation from the skin and lungs.

Sources of water to the body. There are three sources of water to the body: (1) water as such, (2) water contained in foods, and (3) water formed by oxidation of foodstuffs in the body.

All foods, even those considered to be dry, contain appreciable quantities of water. (See Table 13–1.) The average diet, including milk, contains roughly 1000 ml water.

Table [illegible]-1. Water in Foods

	Per Cent	
Milk	87	
Eggs	75	
Meat	40–75	The higher values in rare meats
Fruits, vegetables	70–95	The higher values in low-carbohydrate foods
Cereals	8–20	
Bread	35	

The oxidation of nutrients by the tissues results in the release of water. For example:

$$C_6H_{12}O_6 + 6O_2 = 6H_2O + 6CO_2$$

The amount of water thus released has been estimated to be:[1]

100 gm of fat	give 107.1 gm of water
100 gm of carbohydrate	give 55.5 gm of water
100 gm of protein	give 41.3 gm of water

For an average mixed diet this will approximate 300 to 450 ml daily.

Avenues of water loss from the body. Water is lost from the body through the kidneys and skin, and to a lesser degree from the lungs and gastrointestinal tract. The rate of filtration in the normal kidney is about 125 ml per minute or approximately 180 liters daily for an adult. About 99 per cent of the water filtered is reabsorbed into the blood, while 500 to 2000 ml are excreted as urine. The volume of urine reflects to some extent the fluid intake of the individual. The urine volume decreases when perspiration is excessive, unless the fluid intake is proportionately increased.

A relatively constant amount of water is lost daily from the skin as *insensible perspiration;* that is, the water loss is not noticeable because evaporation takes place immediately. This evaporation is an important means by which the body temperature is maintained. The loss of water is proportionate to the surface area of the body. During very warm weather or considerable increase in activity, much water is lost as visible perspiration. Some athletes may lose several quarts of water during a strenuous game.

Air expired from the lungs also contains water, which may amount to 300 ml or so a day under ordinary circumstances. As one's activity increases and hence the rate of respiration increases, more water will be lost by this route.

Normally, the water lost from the gastrointestinal tract is small. The volume of water contained in the daily secretion of saliva, gastric juice, bile, pancreatic juice, and intestinal juice is roughly 7000 to 8000 ml. These fluids are poured into the alimentary tract for their respective functions, and then as digestion is completed the water from these juices is reabsorbed into the blood stream. About 100 ml of water are normally lost each day in the saliva and in the feces.

Water balance. The importance of keeping the body in fluid balance is universally recognized. The body is said to be in water balance when the available water equals that of the water excreted or lost from the body. Newburgh* has illustrated this in Table 13–2.

Table 13–2. Normal Water Balance

Available Water	gm	Excreted Water	gm
Water intake as such	1100	In urine	1000
Water in diet	900	In stool	200
Water of oxidation	200	In vapor (skin and lungs)	1000
TOTAL	2200	TOTAL	2200

The body maintains water balance precisely even though the fluid intake from day to day varies widely. The regulatory mechanisms are not fully understood, but certain regions of the hypothalamus are believed to regulate thirst just as other regions regulate the appetite. Several hormones are known to control the rate of water excretion. One of these is an antidiuretic hormone produced by the posterior portion of the pituitary gland. This hormone decreases excretion of water by the kidney by increasing the rate of reabsorption from the kidney tubules. The hormones produced by the adrenal cortex regulate the excretion of sodium and hence the excretion of water, since the body fluids are maintained with constant levels of sodium. To some extent the female sex hormones influence water excretion. It is a common finding that women show slight increases in weight just before menstruation begins, and that this weight is subsequently lost.

Abnormal loss of water occurs from prolonged vomiting, as in pernicious vomiting of pregnancy and postoperative vomiting. Hemorrhage, prolonged diarrhea, protracted fevers, excessive perspiration, and burns may bring about great losses of water from the body. A deficiency of the antidiuretic hormone leads to excessive thirst and large volumes of urine, a condition known as diabetes insipidus. A loss of 10 per cent of fluid from the body represents a serious menace to health. It may lead to poor absorption of food, elevation of body temperature, circulatory failure, and impairment of renal function.

To compensate for abnormal losses of water from the body, the intake may be increased by (1) beverages, broth, ices, etc., and (2) by parenteral fluids. When the food intake is limited, and when dehydration has occurred, the replenishment of water also requires the adjustment of electrolyte balance, a subject beyond the scope of this text.

The body, in certain pathologic conditions, may be in positive water balance; that is, the intake of fluids is greater than the excretion, and the patient

* Newburgh, L. H., and MacKinnon, F.: *The Practice of Dietetics.* The Macmillan Company, New York, 1934.

is said to have *edema*. Severe disturbances of protein nutrition may lead to a lowered concentration of the serum proteins, especially albumin, so that the normal osmotic pressure is not maintained. As a result, the tissues hold water. Circulatory and renal disturbances may likewise lead to retention of sodium and of water. Congestive heart failure, cirrhosis of the liver, nephritis, and nephrosis are examples of cardiovascular and renal disturbances in which edema may be a complication.

Daily allowances. Thirst is a good guide to water intake except during abnormal conditions when dehydration has developed. Water taken in excess will be eliminated by the kidney. An intake of 6 to 8 cups of water daily is sufficient under normal conditions, but in hot weather or during strenuous activity the intake may need to be several times as great. Water with meals is not objectionable if it is not used to wash down food before it is properly masticated.

PROBLEM AND REVIEW

1. List specific functions that water performs in the body.
2. What is meant by water balance? Under what circumstances does a negative water balance occur? A positive water balance?
3. If you found yourself in a situation where the amount of water for drinking was extremely scarce, what would you do to conserve your body water as much as possible?
4. During warm weather the urine volume is sometimes reduced. How can you explain this?
5. *Problem.* Keep a record of your fluid intake for a day, including all beverages taken with meals. By referring to a table of food values, calculate the water content of all the foods you ate. About how much water would be formed in oxidation if your body metabolized 80 gm protein, 100 gm fat, 250 gm carbohydrate?
6. By what routes is the water you have ingested excreted? What are the relative amounts by each route?

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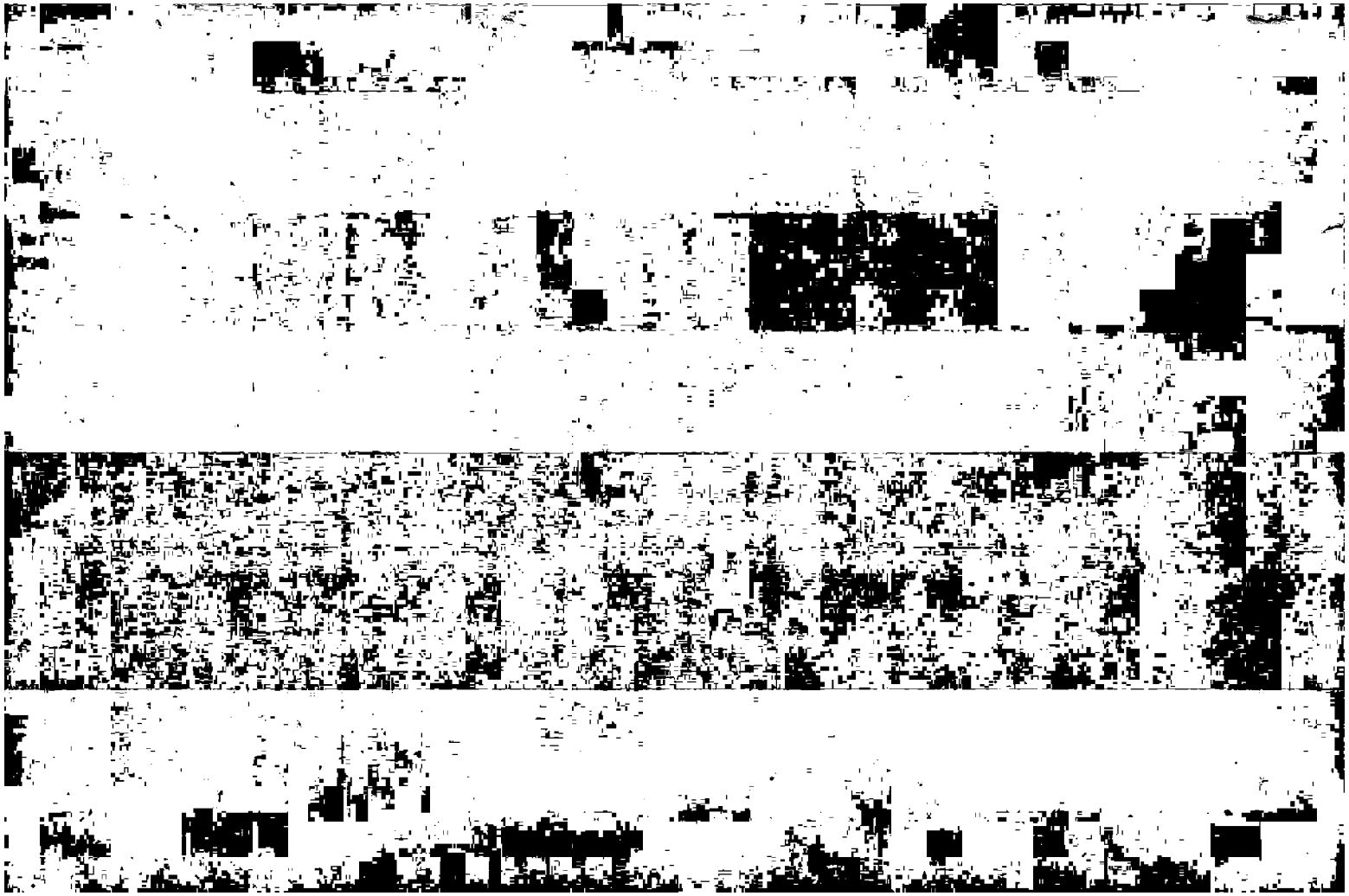
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UNIT III

Food Selection for Nutritional, Psychologic, and Cultural Values

Chapter

14 CHARACTERISTICS OF THE FOOD GROUPS AND THEIR NUTRITIVE CONTRIBUTION TO A BASIC DIETARY PATTERN

15 FACTORS INFLUENCING FOOD HABITS AND THEIR MODIFICATION

16 CULTURAL FOOD PATTERNS IN THE UNITED STATES

Chapter 14

CHARACTERISTICS OF THE FOOD GROUPS AND THEIR NUTRITIVE CONTRIBUTION TO A BASIC DIETARY PATTERN

One instrument does not make up an orchestra; neither does one food, no matter how good it is, make up a well-balanced diet. In preceding chapters the contributions made by specific foods to individual nutrient requirements have been described. Foods should be evaluated, however, for their total contribution and not solely in terms of one or two nutrients. The discussion in this chapter aims to show the contribution of each food group to the total nutrient intake and to describe a basic dietary pattern for the adult.

The national food supply. The Economic Research Service of the U.S. Department of Agriculture annually estimates the per capita nutritive values of the food supplies available for consumption at the retail level and also supplies data on the percentages of nutrients provided by each class of food. The per capita nutritive value of the available food supply in 1965 was as follows:[1]

Energy	3130 calories	Iron	16.5 mg
Protein	96 gm	Vitamin A	7700 I.U.
Fat	144 gm	Thiamine	1.80 mg
Carbohydrate	372 gm	Riboflavin	2.25 mg
Calcium	0.96 gm	Niacin	21.4 mg
Phosphorus	1.50 gm	Ascorbic acid	104 mg

The values for iron, thiamine, riboflavin, and niacin include the estimates of nutrients added through enrichment of flour and cereal products. Vitamin A values include those of fortified margarine and milk products. Vitamin C figures include quantities added to fruit juices and drinks through processing. The percentage of total nutrients contributed by major food groups is shown in Table 14–1.

The chief contributions by major food groups to nutrient levels of the American diet are charted in percentages in Figure 14–1. The chart not only summarizes the relative importance of each food group in supplying nutrient

Table 14–1. Contribution of Major Food Groups to Nutrient Supplies Available for Civilian Consumption, 1965[1,4]

Food Group	Food Energy	Protein	Fat	Carbohydrate	Calcium	Phosphorous	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid
	Per Cent	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*
Meat (including pork fat cuts), poultry, and fish	19.2	38.6	34.1	0.1	3.3	23.8	28.6	21.5	27.4	22.9	44.6	1.1
Eggs	2.2	5.8	3.5	.1	2.4	5.9	6.0	6.6	2.5	5.7	.1	0
Dairy products, excluding butter	12.6	23.8	14.8	7.5	76.7	38.2	2.3	12.3	10.4	44.6	1.9	5.0
Fats and oils, including butter	16.4	.1	40.3	[2]	.4	.2	0	8.7	0	0	0	0
Citrus fruits	.7	.4	.1	1.4	.7	.5	.7	1.1	2.1	.4	.7	21.1
Other fruits	2.6	.7	.3	5.5	1.3	1.3	4.1	6.9	2.1	1.7	2.1	12.5
Potatoes and sweet potatoes	2.8	2.4	.1	5.3	.9	3.9	4.3	6.8	6.4	1.8	7.4	20.6
Dark-green and deep-yellow vegetables	.3	.5	[2]	.5	1.6	.6	1.7	20.8	.9	1.2	.7	9.3
Other vegetables, including tomatoes	2.4	3.2	.4	4.4	4.6	4.7	9.0	14.9	7.0	4.4	6.1	30.4
Dry beans and peas, nuts, soya flour	2.9	5.1	3.5	2.2	2.6	5.7	6.9	[2]	5.9	1.8	6.5	[2]
Flour and cereal products	20.9	19.1	1.5	36.9	3.3	12.9	28.0	.3	35.2	14.7	24.1	0
Sugars and other sweeteners	16.3	[2]	0	35.4	1.0	.2	5.3	0	[2]	.1	[2]	[2]
Coffee and cocoa[3]	.8	.5	1.5	.7	1.1	2.1	3.0	[2]	.1	.8	5.9	0
Total[4]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Percentages were derived from nutrient data which include quantities of iron, thiamine, riboflavin, and niacin added to flour and cereal products; quantities of vitamin A value added to margarine and milk of all types; quantities of ascorbic acid added to fruit juices and drinks.

[2] Less than 0.05 per cent.

[3] Chocolate liquor equivalent of cocoa beans.

[4] Components may not add to total due to rounding.

* Friend, B.: "Nutritional Review," *National Food Situation.* U.S. Department of Agriculture, Washington, D.C., Nov. 1965.

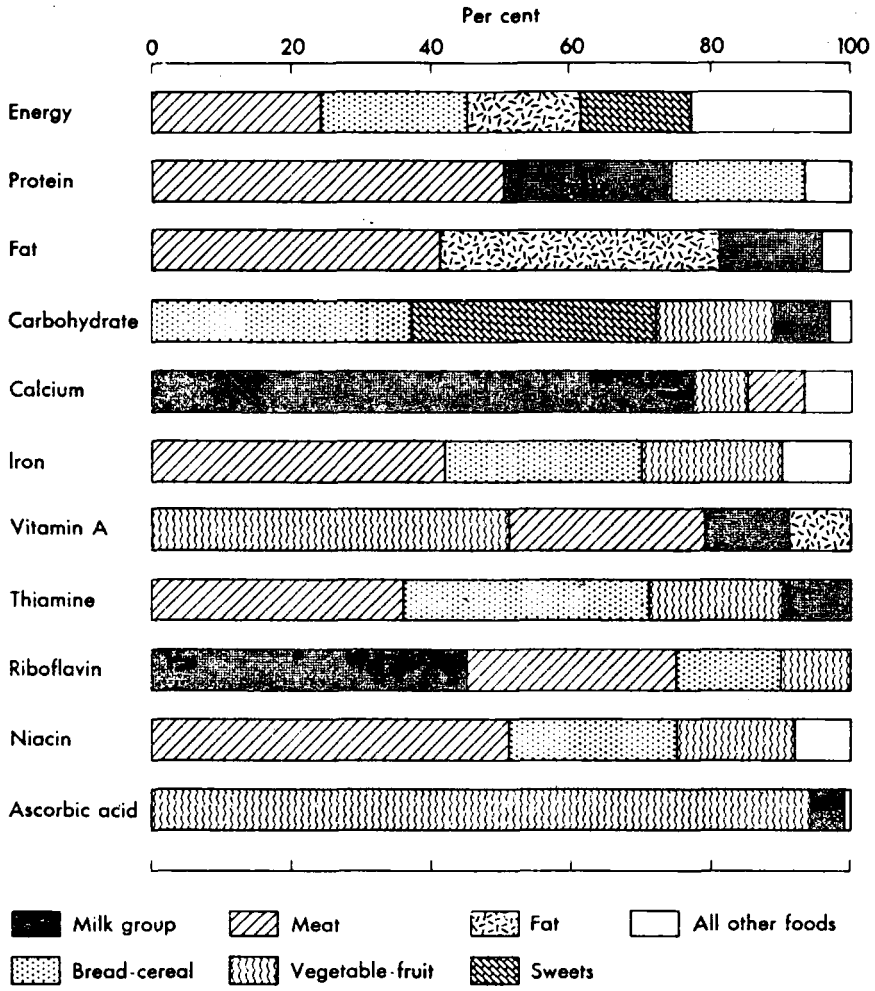


FIG. 14–1. Major contributions of food groups to the nutrient levels of the American civilian food supply in 1965. (*Data from "Nutritional Review," by B. Friend in* National Food Situation, *U.S. Department of Agriculture, November 1965.*)

intakes but also demonstrates how some food groups are important suppliers of several nutrients. Note especially the following five points.

1. Milk and dairy products far exceed other food groups for calcium and riboflavin; they are second only to the meat group for the protein contribution.

2. The meat group (including eggs and dry beans, peas, nuts) ranks first for protein, iron, and niacin as might be expected. Because of the high level of consumption, this group is also in first rank as a source of energy and second as a supplier of riboflavin.

3. Fruits and vegetables are the only important sources of ascorbic acid and contribute half of the vitamin A; they supply one fifth of the iron, ranking just below the meat and bread-cereal groups.

4. The flour-cereal group takes second place as a source of calories and iron, and ranks first as a source of thiamine and niacin. The low cost of foods in this group makes the protein, calorie, iron, and vitamin contribution increasingly significant as income is reduced.

5. Sugars and sweets, and fat and oils each contribute about one sixth of the energy value of the diet but do not add appreciably to the protein, mineral, or vitamin levels.

MILK GROUP

Milk serves as the sole food for the young during the most critical period of life for some 8000 species. Although the milk of various mammals is used for food, cow's milk is by far the most common and will be discussed here. The milk group includes fresh and processed milks, cheese, and ice cream.

Importance of milk as a food. There is no adequate substitute for milk. No food has a wider acceptability or offers a greater variety of uses. Adults of all ages should include about 2 cups of fluid milk daily, or its equivalent as evaporated milk, dry milk, or hard cheese. This allowance should be raised to 3 cups or more for school children and pregnant women, and to 4 cups or more during the adolescent years and for the nursing mother.

Milk is a complex substance in which over 100 separate components have been identified.[2] It is fluid in spite of the fact that it contains more solids than many solid foods. Fresh cow's milk contains 87 per cent water and 13 per cent solids, while such foods as cabbage, strawberries, and summer squash, to name but a few examples, are lower in solids content and higher in water content.

The exact composition of milk varies with the breed of cattle, the feed used, and the period of lactation. Pooled market milk has a uniform composition which may be varied slightly by local or state regulations for butterfat and solids content.

One cup of whole milk contains 9 gm protein, 9 gm fat, and 12 gm carbohydrate, and provides 160 calories. Skim milk contains the same level of protein and carbohydrate but has only a trace of fat so that the energy value per cup is only 90 calories.

The essential amino acids present in milk proteins are supplied in almost ideal proportions for maximum tissue synthesis. Casein accounts for four fifths of the protein in milk, while various whey proteins, including lactalbumins and lactoglobulins, constitute the remaining protein fractions. The latter proteins are especially rich in tryptophan.

Milk supplements cereal proteins in an excellent fashion, for it supplies the amino acids lysine and tryptophan which are limited in the cereals. The biologic value of proteins in white wheat flour is only 50 per cent when used alone, but this is raised to 75 per cent when milk is used with the wheat flour.[3]

The fat of milk is highly emulsified and is easily digested. In the homogenization of milk the fat globules are still further reduced in size to give a perfect

emulsion. Milk fat contains a high proportion of short-chain fatty acids which are especially well tolerated. About 60 to 75 per cent of the fatty acids in milk are saturated, 24 to 40 per cent are monosaturated, and 2 to 10 per cent are polyunsaturated. In modified-fat diets, when saturated fats must be kept to a minimum, skim milk may be substituted for whole milk.

Lactose is a carbohydrate occurring only in milk. This sugar is peculiarly adapted to making milk an ideal food for the young because it is much less sweet, less soluble, and more stable than sucrose and other sugars. It gives to milk a bland flavor. Lactose favors the growth of lactic-acid–producing bacteria which are believed to retard or prevent the growth of putrefying bacteria. Lactose probably favors the absorption of calcium and phosphorus and the synthesis of some B-complex vitamins in the small intestine.

Milk supplies several mineral elements abundantly. Only the milk group provides a practical basis for meeting the recommended allowance for calcium. Phosphorus occurs in correct proportions with calcium to support optimum skeletal growth. Milk contains appreciable amounts of sodium, potassium, and magnesium, but it furnishes very little iron, so that the infant's diet must be supplemented at an early age to prevent anemia.

Milk is an outstanding dietary source of riboflavin and also supplies fair amounts of vitamin A, thiamine, vitamin B_6, and vitamin B_{12}. It is low in preformed niacin but is an excellent source of tryptophan which functions as a precursor of niacin. About 85 per cent of market milk today is fortified with vitamin D to a level of 400 I.U. per quart, which is the recommended allowance for children. Milk furnishes only small amounts of ascorbic acid. Too many

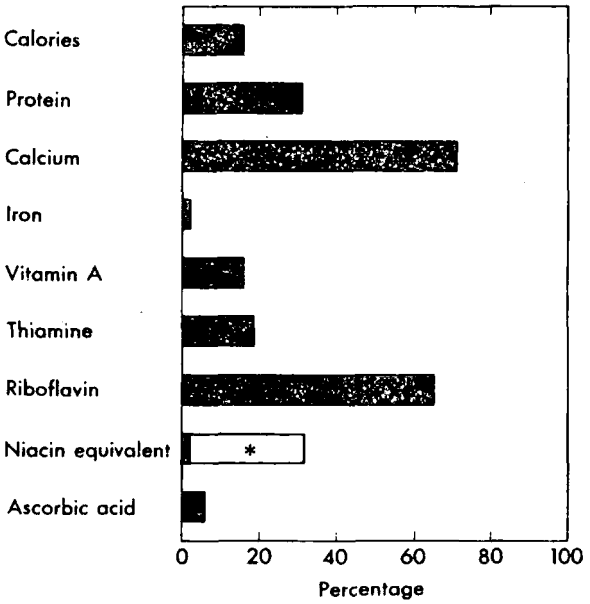


FIG. 14–2. Percentage contribution of two cups of milk to the Recommended Dietary Allowances for the woman of 18–35 years.

people become concerned with the caloric value of milk and will sometimes eliminate milk from their diets for this reason. From Figure 14–2 it may be seen that 2 cups of whole milk furnish about 15 per cent of the calories for the moderately active young woman, but the percentage contribution for most of the nutrients is considerably greater. By adjusting the fat levels of milk, caloric modifications can be made for low-calorie and high-calorie diets.

1 cup skim milk = 90 calories
1 cup whole milk = 160 calories
½ cup whole milk + ½ cup light cream = 330 calories

Cheese. The composition of cheese depends upon the kind of milk used—whole or skim—and the amount of water present. A pound of hard cheese contains the casein and fat of 1 gallon of milk (see Figure 14–3). One ounce of Cheddar cheese is about equal to ¾ cup milk for its protein, calcium, and calories. The proteins in cheese contain all the essential amino acids and are therefore of high biologic value. Only a trace of the lactose present in milk remains in the cheese. Varying amounts of calcium, thiamine, and riboflavin are lost depending upon the method of preparation.

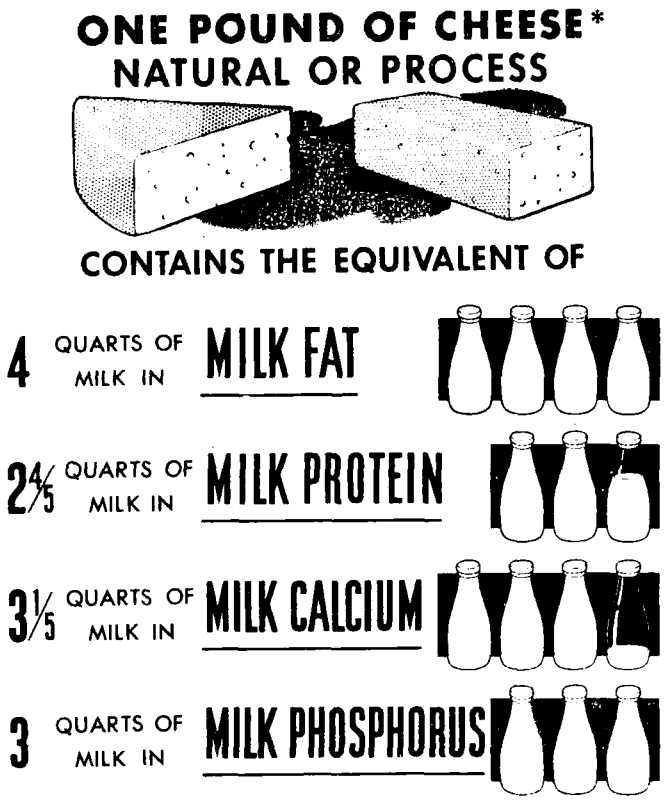


FIG. 14–3. The milk equivalents of one pound of cheese for four nutrients. Both milk and cheese are also good sources of vitamin A and riboflavin. (*Courtesy, Kraft Foods Company.*)

Soft cheeses vary widely in their composition. If made with skim milk, cottage cheese will contain as little as 1 per cent fat; the protein content is about 19 per cent. Creamed cottage cheese is made by mixing the curd with cream or a cream-milk mixture; the fat content of the final product is about 4 per cent. The caloric values of creamed and uncreamed cottage cheeses do not differ greatly, being 120 and 98 per ½-cup serving, respectively. Cottage cheese is considerably lower than Cheddar cheese in its calcium content since some of the calcium is lost in the whey with acid coagulation. Almost 11 oz cottage cheese are needed to provide the calcium of 1 cup of milk.

Cream cheese, which is made from whole milk with cream added, contains approximately 9 per cent protein and 37 per cent fat. It is therefore high in calories but is not a good substitute for cottage or hard cheese in terms of protein. Its calcium content is low.

MEAT GROUP

The meat group includes the flesh of animals such as beef, veal, mutton, lamb, and pork. It also includes poultry, fish, eggs, legumes, and nuts. The daily recommendation from this group is two servings, the equivalents for one serving being:

2 or 3 oz lean cooked beef, veal, pork, lamb, poultry, or fish, without bone
2 eggs
1 cup cooked dry beans, peas, or lentils
4 tablespoons peanut butter

Place of meat in the diet. Since the days of the cave man and all through ancient and medieval history, meat has occupied a position of first importance in the diet. The pioneers of this country had an abundance of meat, and even as recently as 50 years ago the use of it three times a day was commonplace. Today meat is the most expensive item of the daily menu and accounts for a large proportion of the food budget. Even at lower income levels most families manage to have a fairly liberal allowance of meat.

PER CAPITA CONSUMPTION. On the basis of available food supplies, the per capita consumption each year of meat is about 156 pounds; of poultry, 39 pounds; and of fish, 14 pounds.[1] About half of the meat consumed is beef, while pork accounts for almost two fifths. Thus, veal, lamb, and mutton together account for about 10 per cent of the meat consumed (see Figure 14–4).

The use of variety meats depends to no small extent on family traditions and beliefs. The tongue, liver, brain, and heart of beef, lamb, veal, or pork, the sweetbreads or thymus gland of calves, and tripe of beef are all useful and highly nutritious meats.

FISH AND POULTRY IN THE DIET. Fish and shellfish are gradually gaining in popularity. However, some reasons for the more limited use of fish may be the

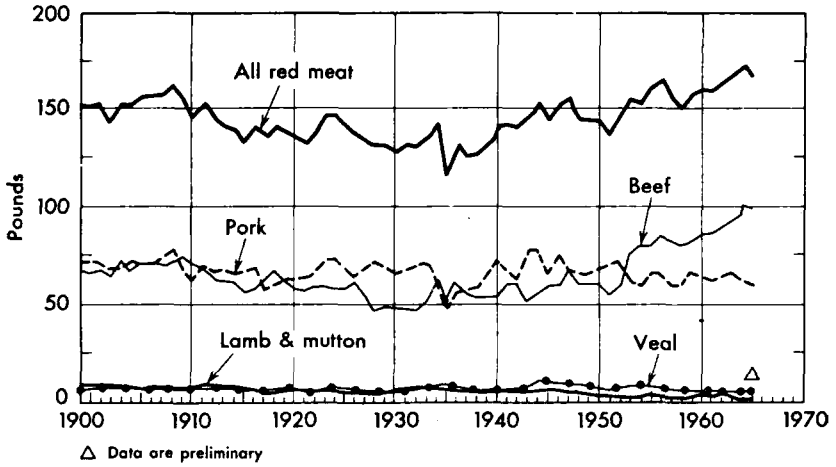


FIG. 14–4. Per capita consumption of meat. (*Courtesy, Economic Research Service, U.S. Department of Agriculture.*)

idea held by some people that fish is inferior food because it is used on fast days instead of meat; that it is a food selected by the poor; that it has not always been available far away from the seacoast, lake, or river regions; and that it is so often poorly cooked and unpalatable. As a food, fish is equal in nutritive value to meat except that the caloric value is usually lower by reason of the lower fat concentration. The small amount of connective tissue in fish makes it especially suitable for diets of the sick. Some people are allergic to shellfish in particular, and this fact must be kept in mind.

Chicken and turkey have become increasingly popular during recent years. Young chickens suitable for broiling or frying are available during the entire year, while turkeys of smaller size are being produced in greater numbers for year-round use by the average family.

ACCEPTABILITY OF MEAT AND FISH. Aside from its high nutritive value, meat is an important dietary item because the aromas and flavors given by meat extractives stimulate the appetite. Meat and fish have a high satiety value because the protein and fat content prolong the digestive period. The often heard comment "It doesn't seem like a meal without meat" attests to the importance of this food on a popular and psychologic basis.

EGGS. As breakfast, luncheon, or dinner main dishes, eggs may be used in numerous ways. They are essential ingredients in many desserts and in baked foods. In fact, the individual who is allergic to eggs soon discovers that a diet without eggs poses many problems in choice and in variety.

LEGUMES AND NUTS. Dried peas, beans, and soybeans are not widely used in this country. Peanuts, which are also leguminous seeds, are popular not only as a snack food but also as peanut butter. These foods can be important contributors to the protein, iron, and niacin levels of the diet as well as being inexpensive and interesting variations for menus.

Nutritive values of the meat group. Variations in the composition of meat, from one cut to another, and from one kind to another, are due largely to the proportion of lean and fat tissue. Considering the entire carcass, the proportion of fat is greater in older animals than in young animals; it is also higher in pork than in beef, and in lamb than in veal, and so on. Moreover, one cut of meat may be extremely lean, that from another part of the animal may be well marbled with fat—that is, tiny fat streaks are intertwined with the muscle fibers and inseparable from them, and that from still another part may be high in adipose tissue and low in muscle fiber.

Such considerations as the above do not necessarily modify the nutritive value of meat as consumed since (1) fat may be trimmed off and discarded before meat is cooked, (2) fat lost in drippings may not be used, and (3) surrounding fat on meat may be left as plate waste. Obviously, it is important to know the values for cooked meat as it is actually consumed. Leverton and Odell[4] have conducted extensive analyses of cooked meat and have suggested the following values as a guide in dietary planning:

	CALORIES	PROTEIN	FAT
	(per 100 gm cooked meat)		
		gm	*gm*
Extremely lean portion	200	32	8
Lean-plus-marble portions	255	28	16

The extremely lean portion would represent a selection of meat suitable for fat-restricted diets; it would contain no visible traces of fat. The lean-plus-marble portion represents meat as it is usually consumed.

Leverton and Odell found that no one kind of cooked lean meat or of lean-plus-marble meat was distinctly different from other kinds. Cooked pork was no higher in fat than similar portions of beef, veal, or lamb. For most dietary purposes, then, the four kinds of meat may be used interchangeably on a protein, fat, and caloric basis.

On a cooked basis, 1 oz lean meat, one egg, ½ cup dried beans or peas, or 2 tablespoons of peanut butter are about equal in quantity of protein furnished; that is, approximately 7 gm.

PROTEIN. The proteins of eggs are so well proportioned in their amino acid composition that the Food and Agriculture Organization has recommended whole egg as a reference standard for comparing the quality of protein in other foods.

Regardless of the species, the amino acid composition of the proteins in flesh foods is relatively constant and of such balance and quality that meats, fish, and poultry rank only slightly below eggs and milk in their ability to effect tissue synthesis. The protein differences between so-called red and white meats are insignificant. The proteins in legumes and nuts are of somewhat lesser

quality because the amounts of methionine and lysine are below optimum levels.

FATS. The fatty acids in beef, veal, and lamb are more saturated than those in pork, poultry, and fish. Depending upon the diet of the animal, pork and poultry may contain appreciable amounts of linoleic acid. Fatty acids in fish are more highly unsaturated, with a more generous proportion of linoleic and other polyunsaturated fatty acids.

Some legumes, such as peas and beans are very low in fat, but soybeans and peanuts provide much more liberal amounts. An important proportion of the fatty acids is polyunsaturated.

The meat group is the principal source of cholesterol in the diet, but this lipid is not uniformly present in all flesh foods. Egg yolk, liver, brains, and shellfish are the outstanding sources.

MINERALS. The mineral element of especial importance in the meat group is iron, all foods of this group being valuable. Light meats, including fish and light meat of poultry are somewhat lower in iron content than the red muscle meats of beef. Meats are also rich in phosphorus, sulfur, potassium, moderately high in sodium, and poor in their calcium content. Some shellfish and canned salmon with the bones are richer in calcium. Saltwater fish contains an appreciable amount of iodine.

VITAMINS. All foods of the meat group are good sources of the B-complex vitamins. Pork, liver, and other organ meats, and legumes are excellent for their thiamine content; poultry, veal, peas, and peanuts are rich in niacin. Vitamin B_{12} is supplied by organ meats, muscle meats, and eggs, but it is not found in the legumes.

Liver is an outstanding source of vitamin A; other organs such as the kidney contain some vitamin A. Otherwise, meats do not provide vitamin A, and they are not a source of ascorbic acid.

EXTRACTIVES AND PURINES. Various nonprotein nitrogenous substances, especially the purines, give meat its characteristic flavor. They are readily extracted from meat with water, as in the preparation of broth. They have very little nutritive value.

VEGETABLE-FRUIT GROUP

No group of foods lends greater variety to the diet in terms of color, flavor, and texture than does the vegetable-fruit group. This group is unique for its contribution to the ascorbic acid value of the diet; it is the major source of vitamin A value; it makes an excellent contribution to the iron level of the diet; and it is a fair source of other minerals and B-complex vitamins.

The vegetable group includes practically every part of the plant—leaves, stems, roots, tubers, bulbs, flowers, and seeds. Mature seeds of the grasses are

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included in the cereal group, while those of leguminous plants such as peas and beans are included in the meat group.

In order to ensure optimum vitamin and mineral contributions the daily recommendation of 4 servings from the vegetable-fruit group should be governed as follows:

1 serving citrus fruit or other source of vitamin C
1 serving at least every other day of dark-green or deep-yellow vegetables for vitamin A
2 servings other vegetables and fruits, including potatoes

A serving is equivalent to ½ cup cooked vegetable or a whole piece of vegetable or fruit such as a banana, an apple, or a medium-sized potato. Teenagers should have larger servings of each, while young children may have smaller-size servings.

Nutritive characteristics. The composition of vegetables and fruits covers a wide range depending upon the part of the plant represented. Moreover, the handling of the food from farm to table may be so variable that the amounts of vitamins and minerals retained may be high or low. The vitamin concentration is affected by the season, the degree of maturity, and the storage conditions.

WATER as the chief constituent of fruits and vegetables constitutes 75 to 95 per cent of the weight. Foods relatively high in carbohydrate such as bananas and potatoes are lower in water content than those which are low in carbohydrate such as tomatoes, lettuce, melons.

ENERGY. As a group, these foods are not important contributors to the caloric value of the diet, although potatoes and sweet potatoes when eaten in quantity may make an appreciable contribution in low-cost diets. Many vegetables such as tomatoes, celery, asparagus, salad greens, and others furnish no more than 20 calories per serving. Potatoes, lima beans, fresh corn, and bananas, for example, are slightly below 100 calories per serving unit. Other vegetables and fruits range from 40 to 80 calories per average serving.

PROTEIN AND FAT. The protein concentration of most fresh vegetables ranges from 1 to 2 per cent and is even lower in fruits. Fresh peas and lima beans are slightly above these levels. All foods of this group are extremely low in fat with the exception of avocados and olives.

CARBOHYDRATE. The carbohydrate composition of this group ranges widely, being as low as 3 to 5 per cent for rhubarb, greens, summer squash, tomatoes, and others, to more than 30 per cent for a few foods such as sweet potatoes. Dried fruits contain about 65 per cent carbohydrate.

The exchange lists (Table A–4) provide a convenient classification for fruits and vegetables according to carbohydrate content. Fruits (list 3) are listed in the amounts required to furnish 10 gm carbohydrate. The group A vegetables in list 2 are those which, for practical purposes, are of negligible carbohydrate and calorie value, while the group B vegetables are those which contain about 7 gm carbohydrate per ½ cup serving. A few vegetables (pota-

toes, sweet potatoes, corn, lima beans) are included in the bread list since their carbohydrate value is more comparable to that of 1 slice of bread.

Starches, dextrins, sucrose, fructose, glucose, and cellulose occur in vegetables and fruits. The starch content of immature fruits is converted to sugars during ripening. The skins, seeds, and fibers of fruits and vegetables contribute variety to the textures of the diet and are also of value in the maintenance of normal gastrointestinal motility. Some fruits are also rich in pectin.

MINERALS. Turnip greens, mustard greens, collards, kale, and broccoli are excellent sources of calcium. The calcium of spinach, poke, dock, beet greens, chard, and lamb's quarters is probably not nutritionally available because of the high oxalic acid content of those plants which results in insoluble calcium salts that are not absorbed. Some fruits contribute small amounts of calcium, but the daily contribution cannot be considered important.

The dark-green leafy vegetables are fair-to-good sources of iron. Likewise, fresh and dried apricots, raisins, prunes, dates, figs, peaches, and berries are good sources of iron.

Fruits and vegetables are rich sources of potassium, but the sodium content is negligible except for a few vegetables such as beets, carrots, spinach, celery, and chard.

Fruits and vegetables contribute to an alkaline ash. The acid or sour taste of some fruits including citrus fruits, peaches, and others, is accounted for by several organic acids (citric, malic, tartaric) which are fully oxidized in the body. The mineral content of these fruits is such that they also yield an alkaline ash. Plums, prunes, rhubarb, and cranberries, on the other hand, contain benzoic acid which cannot be utilized by the body; hence, they contribute to an acid reaction.

VITAMINS. Among the best contributors to ascorbic acid are the citrus fruits, fresh strawberries, cantaloupe and honeydew melon, broccoli, and dark-green leafy vegetables. Potatoes and sweet potatoes contain lesser concentrations of this vitamin, but the amounts eaten daily by some people may appreciably add to the total intake.

Dark-green leafy vegetables and deep-yellow vegetables and fruits are outstanding for their carotene content. The concentration of the vitamin is directly proportional to the depth of the color. Lightly colored foods such as lettuce, cabbage, and white peaches are poor sources of the vitamin, although the outer green leaves of lettuce may contain 30 times as much vitamin A as the inner pale leaves.

Vegetables and fruits are fair sources of the B-complex vitamins.

BREAD-CEREAL GROUP

Today in nearly every country of the world some cereal grain is regarded as "the staff of life." Man's discovery thousands of years ago that he could

cultivate the land and grow grains meant that he no longer had to lead the nomadic life of the hunter. The word "cereal" is derived from Ceres, the ancient Roman goddess of agriculture and harvest. Numerous references in the Bible attest to the importance of cereals. For example, in Psalm 65:13 we read: "The pastures are clothed with flocks; the valleys also are covered over with corn; they shout for joy, they also sing." In the Bible and other early literature "corn" referred to grains such as wheat, millet, and barley.

By reason of its availability, high yield per acre, low production cost, and excellent keeping qualities, grain is used more abundantly than any other food material. Bread constitutes the chief use of grain. In one form or another it has been used for thousands of years and is referred to both as unleavened and leavened loaves and cakes in the Old Testament. The grains from which bread is made are grown in almost every quarter of the globe and are therefore available as a foodstuff for practically all peoples.

Rice is the chief dietary staple for half of the world's population and constitutes as much as 80 per cent of the calories for most of Asia's peoples. Wheat ranks second to rice in worldwide use but is the principal cereal grain used in the United States and some European countries. Corn is widely used in Central and South America.

Nutritive significance of cereal foods. The seed or kernel of the cereal grain (Figure 14–5) is divided into three parts, the bran, germ, and endosperm. The aleurone layer just below the bran layer is sometimes identified as a fourth part. While cereal grains vary somewhat in composition, the average percentage composition of the whole grain is: protein, 12; fat, 2; carbohydrate, 75; water, 10; minerals, especially iron and phosphorus, and the B-complex vitamins, especially thiamine, 1.

The quality of the protein of cereal grains is somewhat inferior to that of animal sources because some of the essential amino acids are present in less than needed amounts. Lysine is a limiting amino acid in wheat, rice, and corn, while tryptophan and threonine are also present in too small amounts in corn and rice, respectively. The aleurone layer of the grain contains protein which is superior to that found in the endosperm, while that found in the germ compares favorably in biologic value with animal protein. Unfortunately, these better-quality proteins are removed when cereals are refined. However, when even small amounts of milk, cheese, eggs, or meat are fed simultaneously with cereal foods, either whole-grain or refined, an economical protein intake of excellent biologic value results. Recent knowledge of the amino acid composition of foods is making it practicable to develop mixtures of cereals and other plant foods so that the protein approaches the quality of animal proteins.[5] Lysine is now being added to some cereals and breads, although the need for such supplementation of the American diet has not been demonstrated.

The greater part of the minerals, iron and phosphorus, and of the B-complex vitamins occurs in the bran and germ of the grain. Consequently, most of

hibitor. Most commercial breads now contain 4 per cent nonfat dry milk resulting in a further improvement of the calcium level as well as of the quality of the protein.

The nutritive contribution of bread is illustrated in Figure 14–6.

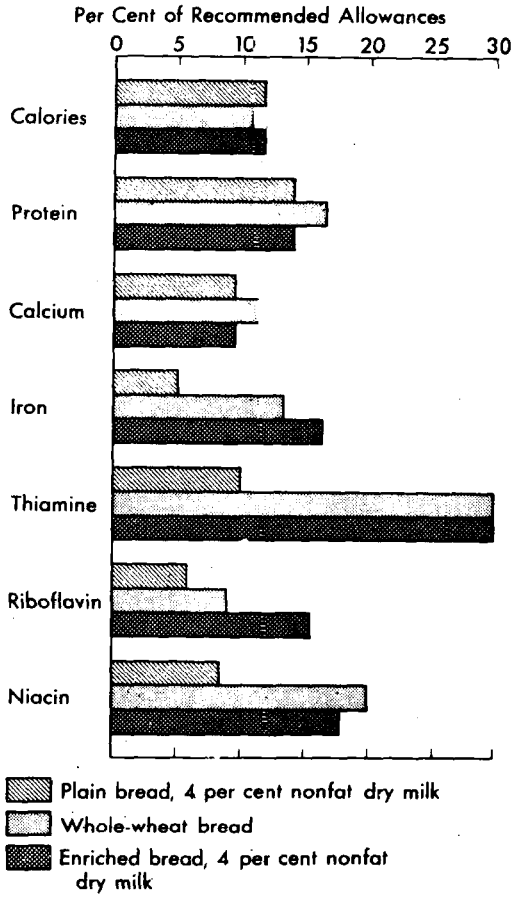


FIG. 14–6. Percentage contribution of four slices of bread tc Recommended Dietary Allowances for the woman 18–35 years.

OTHER FOOD GROUPS

Fats and oils. Butter, margarine, hydrogenated fats, lard, and vegetable oils constitute the visible fats used in the diet. All the fats are concentrated sources of energy, but margarine and butter are the only fats that contain vitamin A. Margarine is fortified with 15,000 I.U. vitamin A per pound, thus equalling the year-round average for butter.

Butter, regular margarine, and hydrogenated fats contain higher proportions of saturated fatty acids than do the vegetable oils. Cottonseed, corn, soybean, sesame, and safflower oils are rich in linoleic acid, but olive and coconut oils are poor in this polyunsaturated acid.

Sugars and sweets. Cane and beet sugars comprise the primary source of sweets in America, while corn sugar (glucose), corn syrup, molasses, honey, and maple syrup are other sweetenings of varying importance. Except for honey and maple syrup they are an inexpensive source of energy, but since they are almost 100 per cent carbohydrate they make no appreciable contribution to any other nutrient. Molasses is an exception in that it contains a fair concentration of iron; however, the quantities used in the average diet are too small to make this a contribution of significance.

Sugars and sweets are valued for the way in which they enhance the acceptability of some cooked fruits, and their role in making possible the many desserts and baked goods we enjoy so much.

A BASIC DIETARY PATTERN

A dietary pattern based on the Four Food Groups of the Daily Food Guide (p. 46) has been referred to time and again in the chapters pertaining to the nutrients. The nutritive values for foods in each of these groups are summarized in Table 14–2. The values assigned to each food group give consideration to the per capita consumption of foods in the United States. For example, the consumption of beef and pork is much higher than is that of lamb, veal, poultry, or fish; thus the values cited for meat, poultry, and fish are based on a greater weighting for beef and pork.

The basic dietary pattern provides the Recommended Dietary Allowances for the woman of 18 to 35 years for some nutrients, while for others the allowances are substantially met (see Figure 14–7). Sufficient calories to maintain optimum body weight are obtained by eating larger amounts of any of the foods in the basic diet, or by adding fats, sweets, desserts, and other foods. Usually the foods added for a satisfactory caloric level will also contain some protein, minerals, and vitamins, but it is necessary to emphasize that an excessive use of fats and sweets may jeopardize the satisfactory intake of essential nutrients.

Alternate basic pattern. Many basic plans could be constructed for individual needs. The plan in Table 14–2 permits considerable flexibility in day-to-day choice of foods and is applicable in any part of the United States. Nevertheless, it might be desirable to use a plan which includes greater or lesser amounts of meat, cereals and bread, milk, fruits, vegetables, and so on, and still achieve nutritive adequacy. An alternate low-cost basic diet is presented in Table 14–3. This includes a selection of foods typical of the low-income groups in the southeastern states.

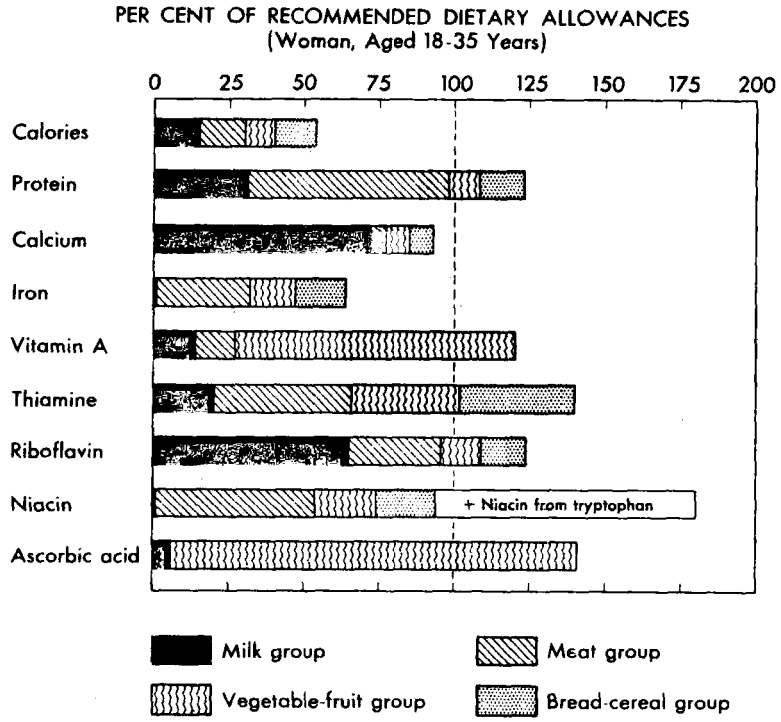


FIG. 14–7. The Four Food Groups of the Basic Diet meet, or nearly meet, the recommended allowances in all respects except calories and iron for the woman 18–35 years.

There are several points of interest in the low-cost plan. It will be noted that there is less milk and meat and no citrus fruit. Larger amounts of plant foods, including corn grits, corn meal, self-rising flour, cowpeas, and sweet potato, are included.

Nonfat dry milk has been used in this plan because of low cost and excellent keeping qualities in the dry state without refrigeration. This addition to the present dietary practices of low-income groups would greatly improve nutrition. Whenever whole milk or buttermilk is available, it may be substituted for the nonfat dry milk.

Egg is the only animal source of vitamin A. While the carotene is less well utilized than true vitamin A, the levels in this diet provide a wide margin of safety for the person in health.

The allowances for the B-complex vitamins are satisfactory because of the use of enriched cereal foods. If unenriched products are used, the diet would not fully meet the recommended allowances.

Table 14–2. Nutritive Value of a Basic Diet Pattern for the Adult in Health[1]

Food	Measure	Weight	Energy	Protein	Fat	Carbohydrate	Minerals		Vitamins				
							Ca	Fe	A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm	*calories*	*gm*	*gm*	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*
Milk	2 cups	488	320	18	18	24	576	0.2	700	0.16	0.84	0.2	4
Meat Group													
Egg	1	50	80	6	6	tr	27	1.1	590	.05	.15	tr	0
Meat, fish, poultry (lean cooked)[2]	4 ounces	120	240	33	10	0	17	3.6	35	.32	.26	7.4	0
Vegetable-Fruit Group													
Leafy green or deep yellow	¼–⅓ cup[3]	50	15	1	tr	3	14	.5	3590	.03	.04	.3	14
Other vegetable	¼–⅓ cup[4]	50	20	1	tr	4	13	.5	300	.04	.03	.4	9
Potato	1 medium	122	80	2	tr	18	7	.6	tr	.11	.04	1.4	20
Citrus fruit[5]	1 serving	100	40	1	tr	10	18	.2	150	.07	.02	.3	42
Other fruit[6]	1 serving	100	60	1	tr	16	12	.5	600	.04	.04	.4	9

Food	Measure	Weight	Energy	Protein	Fat	Carbohydrate	Minerals		Vitamins				
							Ca	Fe	A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm	calories	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg
Bread-Cereal Group													
Cereal, enriched or whole grain[7]	¾ cup	30 (dry)	105	3	tr	22	10	.8	0	.12	.04	.8	0
Bread, enriched or whole grain	3 slices	69	180	6	3	36	57	1.8	tr	.18	.15	1.8	tr
			1140	72	37	133	751	9.8	5965	1.12	1.61	13.0[8]	98
Recommended Dietary Allowances													
Woman (18–35 years)			2100	58			800	15	5000	0.8	1.3	14	70
Man (18–35 years)			2900	70			800	10	5000	1.2	1.7	19	70

[1] Values for foods in the meat, vegetable-fruit, and bread-cereal groups are weighted on the basis of the approximate consumption in the United States, as published in *U.S. Food Consumption*, Statistical Bulletin No. 364, Economic Research Service, U.S. Department of Agriculture, 1965.

[2] Calculations based upon an average weekly intake for meat of 11 ounces beef, 7 1/2 ounces pork, 6 1/2 ounces poultry, 1 1/2 ounces lamb and veal, and 1 1/2 ounces fish.

[3] Dark-green leafy and deep-yellow vegetables include carrots, green peppers, broccoli, spinach, endive, and kale. It is assumed that an average serving of 1/2 cup is eaten at least every other day.

[4] Other vegetables include tomatoes, lettuce, cabbage, snap beans, celery, peas, onions, corn, cucumbers, beets, and cauliflower. It is assumed that an average serving of 1/2 cup is eaten at least every other day.

[5] Citrus fruit includes fresh, canned, and frozen oranges, orange juice, grapefruit, and grapefruit juice.

[6] Other fruit includes apples, peaches, pears, apricots, grapes, plums, and berries.

[7] Cereals include corn flakes, wheat flakes, rice, farina, macaroni, and oatmeal.

[8] The protein in this diet contains about 720 mg tryptophan, equivalent to 12 mg niacin; thus, the niacin equivalent of this diet is 25 mg.

Table 14–3. Alternate Low-Cost Basic Diet Pattern for the Adult in Health (Southern)[1]

Food	Measure	Weight	Energy	Protein	Fat	Carbohydrate	Minerals		Vitamins				
							Ca	Fe	A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm	calories	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg
Nonfat dry milk[2]	⅜ cup	30	110	11	tr	16	390	0.2	10	0.11	0.54	0.3	2
Meat Group													
Egg	1	50	80	6	6	tr	27	1.1	590	.05	.15	tr	0
Pork, lean and fat	2 ounces	60	215	13	17	0	6	1.7	0	.30	.14	2.7	—
Cowpeas, cooked, immature	1 cup	160	175	13	1	29	38	3.4	560	.49	.18	2.3	28
Vegetable-Fruit Group													
Greens[3]	½ cup	75	20	2	tr	3	110	.8	4460	.10	.14	.7	40
Sweet potato	1 medium	147	170	2	1	39	47	1.0	11,610	.13	.09	.9	25
Fruit, noncitrus	1 serving	100	60	1	tr	16	12	.5	600	.04	.04	.4	9
Bread-Cereal Group													
Corn grits, degermed, enriched, cooked	½ cup	121	60	2	tr	14	1	.3	75	.05	.04	.5	0
Corn meal, degermed, enriched, dry	½ cup	72	260	6	1	57	5	2.1	320	.32	.19	2.6	0
Flour, enriched, self-rising	½ cup	55	190	5	1	41	146	1.6	0	.25	.15	2.0	0
			1340	61	27	215	782	12.7	18,225	1.84	1.66	12.4[4]	104
Recommended Dietary Allowances													
Woman (18–35 years)			2100	58			800	15	5000	.8	1.3	14	70
Man (18–35 years)			2900	70			800	10	5000	1.2	1.7	19	70

[1] Nutritive values have been calculated using Table A–1 in the Appendix. Calories have been rounded off to the nearest 5, protein fat, and carbohydrate to the nearest gram, and vitamin A to the nearest 10 units.

[2] Nonfat dry milk may be used in cooking or as a beverage. The liquid milk equivalent is 1 1/3 cups.

[3] The average of collards, kale, mustard greens, and turnip greens has been used.

[4] The protein in this diet contributes about 610 mg tryptophan, equivalent to 10 mg niacin; thus the niacin equivalent of this diet is about 22 mg.

PROBLEMS AND REVIEW

1. On the basis of the national food supply, what are the two principal sources of protein, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid?
2. *Problem.* Select three foods that you eat regularly. Calculate the nutritive values of one serving of each of these foods. Which of these foods provides the greatest nutritive value per 100 calories?
3. Why is milk not a perfect food?
4. What reasons can you suggest for a more widespread use of cheese?
5. *Problem.* Compare the nutritive value of 1 cup whole milk, 1 ounce Swiss cheese, 2 ounces cottage cheese, ⅛ quart ice cream, 1 ounce cream cheese.
6. *Problem.* Compare the nutritive values of 2 ounces lean roast beef, 2 ounces lean roast pork, 2 eggs, 4 tablespoons peanut butter, ½ cup baked beans.
7. How does the protein quality of peanut butter and beans compare with that of meat?
8. *Problem.* List 5 fruits and vegetables which are outstanding sources of ascorbic acid; vitamin A; iron.
9. *Problem.* Calculate your daily intake of ascorbic acid, vitamin A, and iron. What per cent of this intake was provided by fruits? By vegetables?
10. *Problem.* What nutrients are supplied especially abundantly by oatmeal, strawberries, prunes, broccoli, tomatoes, cowpeas, buttermilk, ham, eggs?
11. Why is enrichment of cereals of great importance? How can you be sure that the bread you buy is enriched?
12. Cereals are said to be of lower biologic value than milk. Explain.

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Chapter 15

FACTORS INFLUENCING FOOD HABITS AND THEIR MODIFICATION

Just as "You can lead a horse to water, but you can't make him drink," so the presentation of well-prepared, highly nutritious food to people does not mean that they will eat it. The subject of food acceptance is an exceedingly complex one, concerning which numerous articles based on physiologic, psychologic, and cultural approaches are appearing continuously in professional journals and books. The improvement of an individual's state of nutrition can be effected only when one understands the factors that influence his choice of food as well as the nutrient requirements for an adequate diet.

Man is not completely rational in his acceptance or rejection of food. Indeed, few aspects of living are as likely to be emotionally charged as those associated with food. Manufacturers, for example, who develop new food products know that they must plan skillful advertising campaigns to gain acceptance of their products. Large sums of money are spent by them on so-called motivation research. An analysis of much food advertising shows that it is planned to appeal to the emotions rather than to the intellect.

To understand fully the factors that determine food acceptance requires the multidisciplinary approach of the anthropologist, psychologist and psychiatrist, educator, social worker, and nutritionist. It is beyond the scope of a single chapter, such as this, to provide the depth of understanding of all factors influencing food acceptance. The objectives of the discussion that follows are (1) to create for the reader an awareness of the complexity of factors that determine food acceptance; (2) to provide some basis for understanding that the same food may have quite different meanings to different individuals; (3) to develop attitudes of respect and tolerance for individuals who may have food habits differing widely from those of others; and (4) to provide some guides for helping people to improve their food habits.

PHYSIOLOGIC BASES FOR FOOD ACCEPTANCE

Hunger. Probably several mechanisms serve to explain hunger. Physiologic studies have established that contractions of the empty stomach are governed by the hypothalamus, and that hunger sensations are associated with a drop in the blood sugar level. Anliker and Mayer[1] have developed the *glucostatic* theory to explain the sensations of hunger. According to this theory, the difference between the level of the glucose in arterial and venous blood (called delta glucose, designated Δ-glucose) determines whether one experiences sensations of hunger or satiety. The hypothalamus contains a so-called "feeding" center and a "satiety" center. Following the eating of a meal, the Δ-glucose is relatively large so that the glucose receptors in the hypothalamus cause a cessation of hunger. On the other hand, when some time has elapsed since the last meal, the difference between the arterial and venous glucose is small; when this occurs, there is a stimulation of the feeding center, the hunger contractions of the stomach result, and eating ensues.

Starving people will usually, but not always, accept anything edible that will fill the stomach. This might even be that which would normally be quite repellent. It is also true that people may refuse food for the relief of acute hunger when religious or cultural taboos are strongly entrenched.

Man does not choose by instinct that which is best for him. In different environments, he eats what is available and sometimes learns through experience that some foods may be better for him than others. This method of trial and error, at best, is time consuming and may, in the meantime, jeopardize one's state of health. It could also lead to gross misconceptions concerning foods. Quite obviously the scientific planning of diets, rather than guidance by hunger and instinct, is the only sound basis for being sure that physiologic needs are being met.

Sensations produced by food. The palatability of food is a composite of taste, smell, texture, and temperature. It is further conditioned by the surroundings in which food is consumed.

Sweet, sour, salty, and bitter are terms used to describe the sensations that result when foods placed in the mouth produce specific stimuli to the taste buds on the tongue. (See Figure 15–1.) The sense of taste is more highly developed in some individuals than in others; foods may be too salty for one individual and just right for another; or they may be too sweet for one, but not quite sweet enough for another. Some persons can detect slight differences in taste, others cannot. The number of taste buds varies not only from individual to individual, but also from age to age. Later in life the taste buds diminish in number, and this fact may explain, in part, why adults prefer spiced and tart foods while children voluntarily select bland or sweet foods.

Taste and smell of foods are directly linked. If one were to hold the nose while eating a piece of fruit, much of the enjoyment would be lost. As a mat-

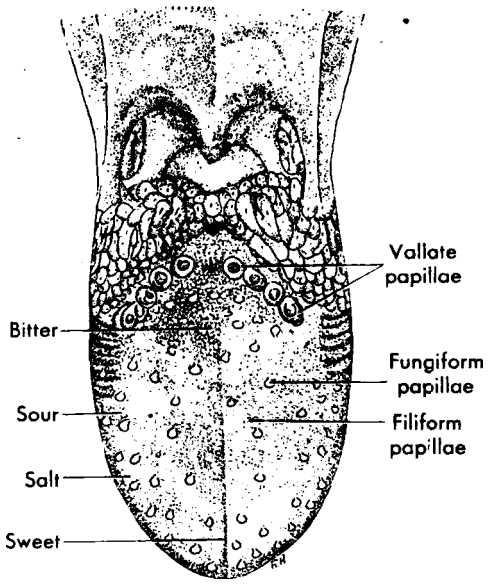


FIG. 15–1. The upper surface of the tongue, showing kinds of papillae and areas of taste. (*From Kimber, D. C., Gray, C. E., Stackpole, C. E., Leavell, L. C., and Miller, M. A.:* Anatomy and Physiology, *15th ed. The Macmillan Company, New York, 1966.*)

ter of fact, odor is the most important component of flavor and an individual would derive limited pleasure from food if the tongue were the sole source of the sensations. The stimulation of the olfactory organs is brought about by certain volatile oils. Foods may be accepted because of their aromas, or they may be rejected because of their repulsive odors. No doubt, the odors of certain cheeses, for example, are the determinants in their acceptance by some and their rejection by others.

The sense of touch is highly developed in the tongue. Temperature, pain, and variations in texture or "feel" are experienced. Steaming hot foods are necessary to enjoyment by some, but children usually prefer foods that are lukewarm. A choice of ice cream may be influenced as much by its texture—smooth, creamy, and velvety, or crystalline and grainy—as by its other flavor qualities. Children may reject foods that are slippery such as baked custard or a gelatin dessert only later to learn to enjoy this texture sensation. The stringiness of certain vegetables, the stickiness of some mashed potatoes, the greasiness of fried foods may be important factors in rejection.

SOCIAL AND EMOTIONAL FACTORS INFLUENCE FOOD ACCEPTANCE

Role of culture. Montagu,[2] Lee,[3] and many other writers have pointed out that the circumstances under which one eats are largely determined by one's culture. Food habits may have existed among a given ethnic group for cen-

turies, and such a heritage may account for great conservatism in accepting change. These patterns reflect the social organization of the people, including their economy, religion, beliefs about the health properties of food, and their attitudes toward the various members of the family. The emotional reactions to the consumption of certain foods may be so deeply rooted that effecting acceptance of them is almost impossible.

A few comparisons of American cultural patterns with those of other parts of the world may serve to illustrate some of the problems of effecting change in food habits. In America advances in agriculture, technology, and transportation have combined to make it possible to provide a variety of foods literally undreamed of even 50 years ago. Mass communication media daily place before the public the values of new foods, using an appeal that is as often emotional as it is geared to nutritional benefits. Great emphasis is placed on providing variety in meal planning; yet Americans, too, rebel against variety if it includes at one time too many foods with which they are unfamiliar. In other cultures, bread is literally the "staff of life" to some people, rice is to others, and corn to still others; the availability of those foods represents life itself and is, in no sense, thought of in terms of a monotonous diet. In America today, the cereal grains do not occupy the important place in the diet they held a century ago.

Meal patterns, themselves, are dictated by culture. For many Americans, breakfast is a hearty meal which can be well rationalized on the basis of physiologic need; the European, however, is accustomed to a light breakfast—perhaps bread or a roll without butter, and coffee—and finds it difficult to consume a meal he considers to be heavy. The farmer may prefer to have dinner at noon, while the urban worker, away from home all day, has his biggest meal in the evening. Recreation, itself, may modify one's meal patterns —witness the trend to frozen dinners and meals frequently eaten in front of the television set!

Today, as never before, people all over the world are eager to accept that which is new. Even food habits of long-standing origin can be changed providing that new innovations are worked into existing patterns as a means of enrichment rather than attempting to eliminate entrenched food habits. More detailed description of the food habits of several ethnic groups is included in the following chapter.

Social values of food. "To break bread" together has been from time immemorial an act of friendship. One provides food for friends during a visit in the home; one likewise extends friendship to the stranger by inviting him to share food. The food served to guests is the best that one can afford and the table appointments are as beautiful as one can make them. Important family events are joyously celebrated with meals: the wedding breakfast or reception; birthday parties; Christmas dinner; a Fourth of July picnic. To eat together, whatever the occasion, is to provide friendly relaxation and conversation. The

loneliness of eating by oneself, day after day, is not appreciated by those who have never tried it.

Eating together also has connotations of status. Throughout history one's place at the table has been governed by his social standing. To be placed "above the salt" at a medieval banquet, to sit at the "head" table at a banquet today, and to be invited to eat at the captain's table while on board ship are marks of social distinction. In some societies women are considered to be inferior to men, and must wait to eat until the men and boys have finished the meal. In other authoritarian situations, children may not be permitted to eat until the father has had his meal; in such a society, the father is always served the choicest foods. Many bonds of business or of politics are cemented at businessmen's luncheons or political dinners.

Prestige, it would appear, may be ensured when one serves foods that are costly, difficult to obtain, distinctive in flavor, or time consuming in preparation. Caviar, lobster, filet mignon, champagne, flaming crepes suzette are examples of such prestige foods. In the nineteenth century, the purchase of white sugar and white flour conveyed the idea that one could afford to buy that which was refined and therefore "better." Is the purchase today of the more costly breads prepared from hand-ground meals an expression of status with respect to one's supposed knowledge of nutrition, or to one's ability to buy or bake that bread which is distinctive from the more commonly available loaf?

Some foods are looked down upon by many people as lacking status; thus, a delicious stew, or ground meat, or fish—no matter how good they may be—are considered by some to be food for the poor. However, these attitudes also are subject to change. Tourists to seacoast cities now seek out restaurants that specialize in seafoods, and may be willing to spend considerable amounts of money for a specialty. Teen-agers are likely to look upon hamburger as a food fit for the gods!

Some people delight in being epicures or gourmets. They derive a certain satisfaction from adventurous eating of food which is unusual, or which might be, in fact, unacceptable to most people—rattlesnake meat, for example. Others make a specialty of dining at unusual or expensive restaurants, or in becoming known for their abilities to prepare complex, unusual dishes.

Religious and moral values attributed to foods. Almost all religions place some regulations on the use of foods. The association of a food with religion may give some clue to its importance in daily living. In the Middle East, bread becomes a symbol in the religious ceremonies of the people; to the Indians of Mexico, corn, the staple food, is invested with religious significance.

Certain foods are forbidden by religious regulation. Pork is forbidden to the Orthodox Jews and to the Islamites. Buddhists are vegetarians; they will eat no flesh of any animal, and many of them also abstain from eggs and milk.

Fasting is common to most, if not all, religions. On fast days one food may

be substituted for another or foods may be abstained from altogether. A substitute food, such as fish for meat, is likely to be associated with denying oneself, and so when one wishes enjoyment, he doesn't choose to eat fish!

Moral attributes—"good" and "bad"—are often ascribed to foods. A child may be told to eat liver even if he doesn't like it because it is "good" for him; he may also be told not to eat candy, which he does like, because it is "bad" for him. Or he might be told that he may have candy if he eats some liver!

Food is often used as a reward, punishment, or as a means of bribery. Thus, if a child has behaved well he is often rewarded with a prized food—candy, ice cream, cake; but if he has behaved badly he may be punished by being deprived of a food such as dessert. Adults, too, may reward themselves after a strenuous day or a trying experience by eating a special food or an expensive meal, often saying as they do so, "I certainly earned this today!" The family may feel a sense of reward, as well as the expression of a mother's love, when they sit down to a meal of their favorite foods; they may feel punished and unloved when the meal includes foods they dislike.

Age and sex influence food choices. Too often foods are categorized as being suitable for a given age group, or as more suitable for one sex than the other. Peanut butter, jelly, and milk are looked upon as foods for children, but olives and coffee are appropriate for adults! Teen-agers adopt current fashions in foods—hot dogs, hamburger, pizza, ice cream with many sauces and toppings. Women are said to prefer light foods such as soufflés, salads, fruits, and vegetables, while filling meals such as meat, potatoes, and pie represent the more usual choice of men.

Emotional outlets provided by food. Eating provides gratification for life stresses—the difficult examination in school; the homely adolescent who has no date to take her to the movies; the quarrel with a friend; the frustration and loneliness of having no friends; the profound grief at the death of a dear one; and countless others.

Food is a symbol of security to many. Milk, the first food of the infant, may be associated with the security of the infant held lovingly in his mother's arms. A person may be away from home, or may be ill, and looks upon milk as expressing the comfort and security of the home; or, milk might be refused because the individual drinking it experiences a feeling of dependence which he does not want to admit, and so he says he doesn't "want to be treated like a baby."

Food may be used as a weapon. An insecure child may refuse to eat food so that his mother will be concerned about him. The ill and the lonely may impose dietary demands upon those caring for them in an effort to gain as much attention as possible.

Illness modifies food acceptance. Disease processes and drug therapy often modify the appetite. The anxiety of illness, the loneliness experienced if one eats from a tray alone, the lack of activity, and perhaps a modified diet are likely to interfere with food intake. (See also Chapter 27.)

EFFECTING CHANGE IN FOOD HABITS

Food habits develop early. Eating is one of life's first experiences. The newborn infant rapidly adapts to breast or bottle feeding and soon associates feeding with security and comfort, or in rare instances with pain. His acceptance of new foods will be determined by his readiness in terms of his physical development and by the environment in which these foods are provided. The food habits of a lifetime are formed during infancy and childhood, and efforts of the mother to provide nutritious foods with due consideration for the mental and emotional development of the child will be richly rewarded. Food habits, good or bad, become more firmly established with each year that passes and become less amenable to change. Practical suggestions for the establishment of good food habits throughout childhood are included in the chapters on infant and child feeding (see Chapters 23, 24).

Determining the need for change. The first step in bringing about a change in food habits quite obviously is to find out just what the needs of the individual or group may be. The need for improvement in food habits may be grossly apparent in an individual who has physical evidences of malnutrition. In others, modified diets are prescribed by a physician as the sole or supportive therapy in disease. For still others, the desirability for dietary improvement is in terms of achieving optimum health as well as the prevention of the deficiency states.

When counseling the healthy or the ill, the dietitian, nurse, or teacher needs first to determine the present and previous patterns of eating. Having obtained a reliable dietary history, she must interpret this pattern in terms of the adequate diet for the given individual. She must avoid the tendency to judge a diet as being inadequate simply because it doesn't conform to a specific food pattern which she, in her limited experience, may think is the only correct way of eating. Numerous widely varying food patterns provide the essential nutrients for health. Nor must she fall into a second error by assuming that a state of deficiency exists because the daily intake of one or more nutrients is below the Recommended Dietary Allowances. She must remember that these allowances were established to provide for the nutritional needs of individuals varying widely within each age group.

Motivation. Few people are motivated to change their food habits simply because they are told that foods are good for them or that they will be healthy. Any attempts to modify food acceptance must be directed to finding what goals are important to the individual or group. When these goals are known, the individual must then be brought to see that what he eats may have an effect on his achievement of these goals.

Mothers are believed to be the group who can bring about significant improvements in food habits. A pregnant woman is desirous of doing what is best for the baby, and when prospective fathers can be involved, the strength-

ening of desirable food habits is further enhanced. Mothers serve as an example by their own food habits, they provide the food for the family, and they continue to be motivated in terms of doing what is best for each member. When they are given guidance in their management of the feeding of infants and preschool children, subsequent feeding problems are likely to be few. Montagu has stated that emphasis on the family meal is a "contribution to better nutrition, a better family and social relationships."*

Teen-agers scorn suggestions that they must eat certain foods to be healthy. However, the training table for the team is evidence of the adolescent boy's acceptance of correct diet as a means of achieving physical strength and athletic prowess. The adolescent girl desires a sli[illegible] clear skin, beautiful hair, and pep to take part in school a[illegible] hand, s[illegible]

Th[illegible]

pe[illegible]

good nutrition for various age categories can be found in many newspapers and magazines. Local libraries may be helpful if their selection includes up-to-date books and pamphlets that have been prepared by professionally qualified dietitians and nutritionists. Radio and television, through programs and through advertising, are powerful media for influencing the attitudes and actions of people. In all these media, one must be able to distinguish between factual information supported by research on the one hand, and faddism and quackery with its emotional appeal on the other.

REVIEW

insofar as you are able the meanings which you especially like; those you especially
other?
any
er?

...slim figure, ...
...social activities; but, on the other
...he probably does ... want to become too muscular or too tall.
...e improvement of health itself is sometimes a motivating factor to the ...son who has experienced illness. Such a person if obese, for example, may willingly accept the dietary restriction; but for another obese person the goal which serves to motivate her may be a slender figure so that she can wear the current fashions. Return to one's home, or to work or school, or to avoid pain or recurrent illness may be the goals of the patient. When illness strikes the older person, motivation to change the habits of a lifetime is not easy.

Avenues of action. From the foregoing discussion two facts stand out, namely, that numerous influences determine food habits; and, as a consequence, the pathways of effecting change must be many. Education in nutrition implies that one's food habits have been changed in the desired direction. For example, it is not enough for the adolescent to know that a quart of milk is essential in his diet; he must follow through by actually consuming the milk each day!

Nutrition education appropriately belongs in the elementary and secondary school. Suitable references pertaining to the teaching of nutrition in the school are noted at the end of the chapter. The school lunch probably has a more far-reaching effect on food habits than many people realize (see p. 374). In a less formal way, nutrition education has a place in many programs for youth—4-H clubs, Girl Scouts, Boy Scouts, and others.

Many opportunities exist within the community for extending nutrition education: mothers' clubs and other women's organizations, parent-teacher associations, prenatal clinics, well-baby clinics, and others. Official and voluntary public health agencies employ numerous programs and many techniques to bring about change in food habits. Further discussion concerning community nutrition is presented in Chapter 26.

The media of communication must not be overlooked. Reliable information on food economy, recipes utilizing plentiful foods and giving emphasis to wider use of unusual foods, suggestions for menu planning, and articles on

* Montagu, M. F. A.: "Nature, Nurture, and Nutrition," *Am. J. Clin. Nutrition*, 5:243, 1957.

1. How do you feel about food? List [illegible] clearly associate with foods. List the foods yo[illegible] dislike. Can you give any specific reason for placing the food in one category or a[illegible]

2. Note for one day the comments made by people around you about food. Do [illegible] of these fall within the physiologic or psychologic categories discussed in this chap[illegible] Do they give you any clue concerning readiness to change food habits?

3. Suppose you were trying to introduce nonfat dry milk to a group of people who were entirely unfamiliar with it. How would you go about gaining their acceptance?

4. What is the difference between hunger and appetite?

5. Describe the physical factors in food acceptance.

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Chapter 15

CULTURAL FOOD PATTERNS IN THE UNITED STATES

Travel and study provide understanding. Each year hundreds of thousands of Americans travel from one part of the United States to another or to practically every part of the globe. Most of them will be adventurous and eager to try the favorite dishes of a given locality; many of them may later prepare certain typical dishes in their homes, and thus the American cuisine, at its best, becomes truly cosmopolitan. Some persons find the study of foreign food patterns to be a fascinating and rewarding hobby, for knowledge of a people's dietary habits leads to better understanding of its culture. One can find an almost limitless array of articles in journals and books, including cookbooks, for a lifetime of browsing and reading.

Perhaps an especially significant group of world travelers are the students who spend a year or longer in one country or another. Those who come to the United States from various countries of Europe are able to make adjustments quite readily since the foods to which they are accustomed are everywhere available. On the other hand, students from the Far East and from tropical climates often require a longer period of adjustment. Fruits and vegetables with which they are familiar may not be available in the northern markets, so they need to acquire new tastes. Many of these students, used to highly seasoned dishes, may describe American dishes as "having no flavor" or "bland"; others are vegetarians and find the typical American meal does not provide enough of the plant protein foods to which they are accustomed. The fact that the majority of these students do adapt their dietary regimens readily to the usual foods served in public dining rooms attests to the ability of people to change their food habits when the motivation is sufficiently great. Be that as it may, one recognizes the important role of the cultural food patterns when one experiences the enjoyment these students show at being able to entertain their American faculty and friends at a meal typical of their country. And so, through student interchange of ideas, a bridge of understanding is provided between various cultures.

Dietary planning for various ethnic groups. Nurses, dietitians, and teachers come in contact with people from many ethnic origins. Today, in America, most of the population are those whose forebears have been here for many generations. They have come not only to accept but also to enjoy the abundance and endless variety of foods available. The pressures of advertising, the nutrition education in the classroom and through the school lunch program, and the frequency with which people today eat in restaurants have done much to unify the food patterns. Many people, however, continue to relish favorite dishes associated with holidays and religious customs even though their food habits as a whole can no longer be described in the light of those prevailing in the country of their origin. It is quite important to make allowance for the inclusion of such dishes in menu plans in order to gain the fullest acceptance of the meals.

Relatively speaking, only a small number of the people living in the United States have been born in another land or climate, and have experienced at first hand the cultural environment of the land of their origin. Such a group of people, for example, are the Puerto Ricans who have come in considerable numbers especially to the eastern cities, and who encounter the multiple problems of employment and income, inability to speak English, and inability to make satisfactory substitutions for the foods they used in abundance in Puerto Rico. For such groups of people, one must be thoroughly conversant with the native food habits in order to make the best recommendations for adjustment in this country.

So vast a study as that of cultural food patterns can be only touched upon in this chapter. The discussion that follows is limited to those patterns which fairly frequently may pose problems in working with individuals and their families.

The physical development of any people depends upon the available supply of energy foods, protein, minerals, and vitamins. Food the world over supplies these nutrients, although the agriculture and technologic development of a country may be such that the supply is inadequate to meet fully the needs of the population. It is important for the health worker to recognize that widely varying patterns may provide the essentials of good nutrition and that she should learn to build upon the desirable characteristics of any given diet. She needs to remember that people who have had little education, who are economically underprivileged, or who are ill are less readily motivated to effect change in their existing food habits.

REGIONAL FOOD PATTERNS OF THE UNITED STATES

Perhaps nowhere in the world can one find so great a variety of foods and of preparation as in the United States. The dietary patterns are an ination of the foods native to the region and the habits and customs

handed down by generations of foreign-born. The foods vary from the wheat of the North Central plains to the rice of Louisiana, the potatoes of Maine to the citrus fruits of Florida, the dairy products of Minnesota and Wisconsin to the beef of the western ranges, the fish of the seacoast to the fruits of the Far West. One might associate baked beans with New England, chile con carne with the Southwest, and fried chicken with the South, but today these dishes are served everywhere in the United States. Advances in technology and modes of transportation bring foods within days—or even hours—from all parts of the country to our American homes, especially those in metropolitan areas.

A dietary survey of households in the United States was begun in 1965 by the U.S. Department of Agriculture, but the results of this study are not available at this writing. A similar survey conducted in 1955 illustrates regional variations within this country.[1] It brought out that the greatest variations in food consumption in the United States occur between rural and urban families, regardless of region. Farm families were found to consume greater quantities of energy-rich foods such as grain products, sugars, sweets, and fats, presumably because their work increases their energy requirement over that of city dwellers. Farm families also consumed more milk and eggs but somewhat less meat, fruits, and vegetables than city families. These differences are readily apparent in Figures 16–1 and 16–2. Farm families received larger amounts of all nutrients except vitamins A and C than did city families. They consumed less beer, wine, and the like, but equal quantities of coffee, tea, and soft drinks. They ate fewer meals away from home.

Comparisons were made in this survey between the northeastern, central, southern, and western regions. Although some slight differences were found to exist, they were no greater than might be found between individual families within a community, and were not as great as the variations between city and farm families of a given region. The South differed more from the other three regions than these regions differed from each other. The people of the South consumed more fats, sugars, grain products, and fresh vegetables, but somewhat less meat, milk, and processed fruits and vegetables. The effects of these differences may be seen in Figure 16–3. The Northeast was somewhat lower in thiamine than the remaining three regions owing to the lower consumption of grain products and pork. In all other nutrients the South fared least well. The most serious lack in the southern diets was in calcium because of the lower consumption of milk and in ascorbic acid because of the less frequent use of citrus fruits and tomatoes.

Although the regional differences in the amounts of food consumed from each of the food groups were not great, somewhat wider variation occurred in the selection within groups. Thus, in the South sweet potatoes and corn products are extensively used, while in the North Central region white potatoes and wheat products are the comparable items of choice. It is pertinent to list even briefly, some of the traditional dishes and patterns of each region, for

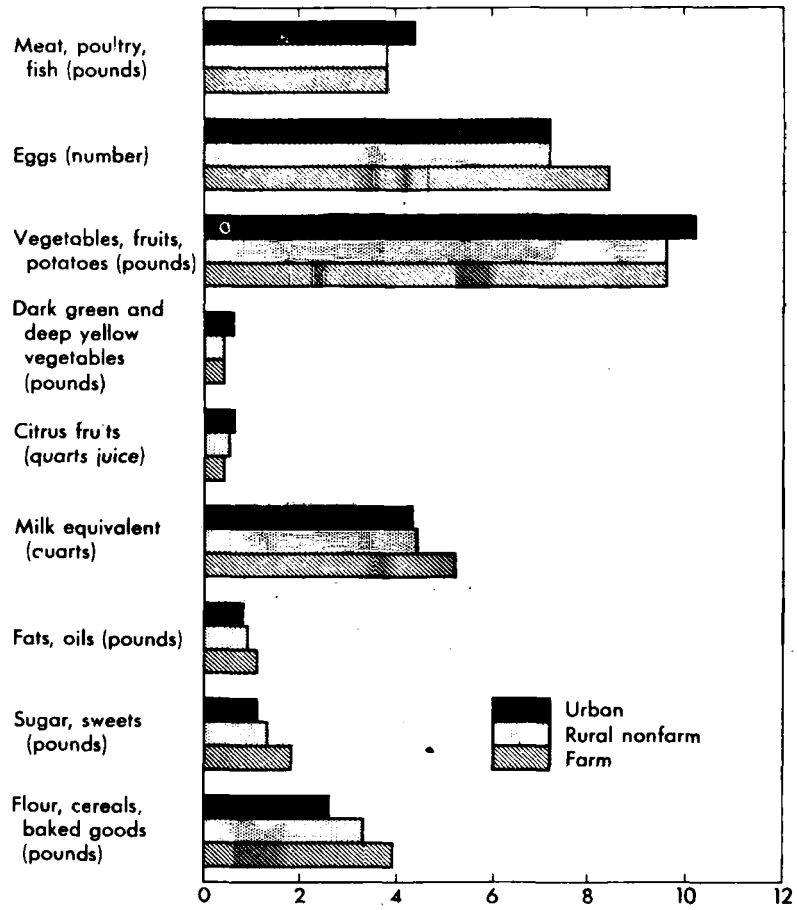


FIG. 16–1. Quantities of food eaten per person per week by urban, rural nonfarm, and farm families. (*Data from Agricultural Research Service, ARS 62–6, U.S. Department of Agriculture, Washington, D.C.*)

people derive a sense of well-being when such a favorite dish, even though it does not dominate the dietary, is served to them.

In addition to the baked beans and brown bread on a Saturday night, in New England one is likely to encounter such favorite dishes as codfish cakes, lobster, clam chowder, and other seafood specialties. Pumpkin pie, squash, and turkey originated with the Pilgrim fathers.

The Pennsylvania Dutch are known for many rich foods including potato pancakes, many kinds of sausage, Philadelphia scrapple, sticky cinnamon buns, pickles and relishes ("seven sweets and seven sours") and shoofly pie.

Fried chicken, country ham, and hot biscuits are specialties of the South. Green vegetables such as turnip tops, collards, kale, and mustard greens are well liked; they are likely to be cooked for a relatively long time with fat pork

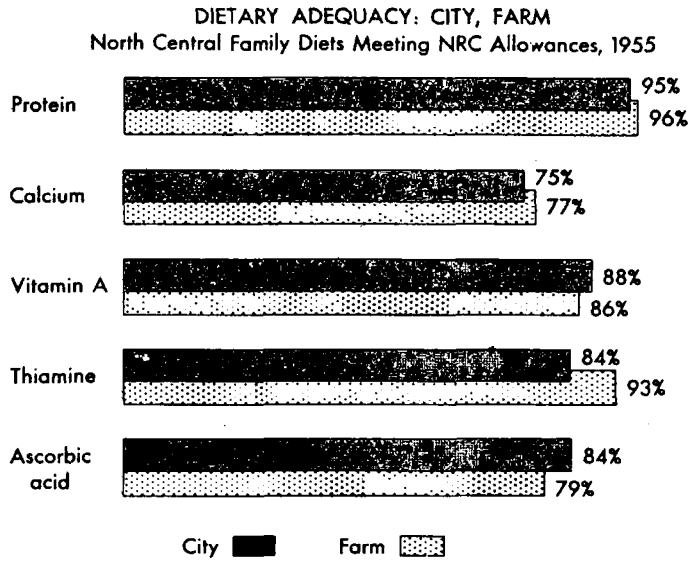


FIG. 16–2. The family survey of 1955 showed fewer differences in city and farm diets than in earlier surveys. Farm diets still supply more of all nutrients except vitamin A and ascorbic acid. (*Courtesy, Agricultural Research Service, U.S. Department of Agriculture.*)

as a flavoring agent. The water in which the vegetables are boiled (pot liquor) is often consumed, thus retaining some of the minerals and vitamins that would otherwise be lost. Sweet potatoes are preferred to white potatoes, and corn is the cereal of choice, although rice and wheat are also widely used. Corn appears in such forms as corn pone, corn bread, hominy grits, spoon bread, and hush puppies—in Florida and Texas, especially.

Dairy products, meat, and eggs abound in the Middle West. Here one finds dietary patterns similar to those of Scandinavia, Germany, Poland, England, and other northern European countries.

New Orleans is noted for its fine restaurants, which show the influence of French and Creole cookery. Soups and fish dishes are often highly seasoned, and sauces are used for many meats and vegetables.

The Mexican and Spanish influences are felt in the Southwest where pinto beans, tortillas made from flour or lime-treated corn, and chili, a hot pepper, are important constituents of the diet.[2] Usually these staple food items are served with highly seasoned sauces (see Mexican dietary patterns, p. 232).

The abundance of luscious fruits and vegetables in the Far West leads to a much greater consumption of salads as main dishes as well as accompaniments of the meal. The Oriental influence is especially noted in the delicious vegetables of Japanese and Chinese cookery. Seafoods abound in great variety on the West Coast, as in the East, but the salmon of the Pacific Northwest is especially prized.

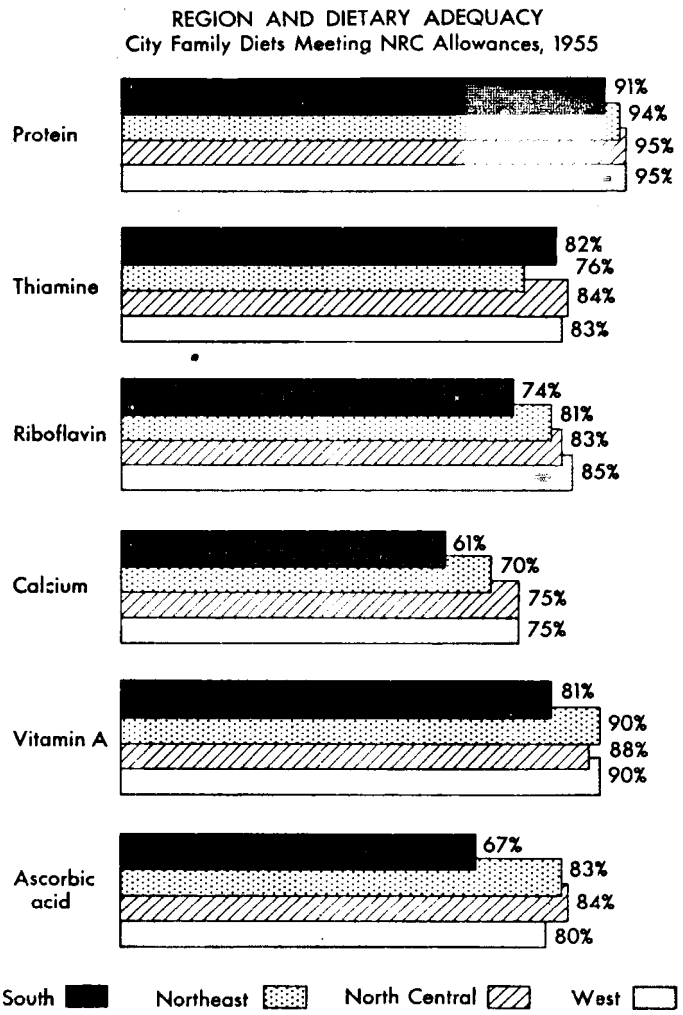


FIG. 16–3. Some regional differences in food consumption and dietary adequacy still exist. People of the southeastern region consumed less of all nutrients except thiamine. (*Courtesy, Agricultural Research Service, U.S. Department of Agriculture.*)

ORTHODOX JEWISH FOOD HABITS

Outstanding characteristics. The description of the dietary pattern of the Jewish people presented here is based, in large part, on a recent article by Kaufman.[3] Orthodox Jews observe dietary laws based on Biblical and rabbinical regulations. These laws pertain to the selection, preparation, and service of food. Conservative Jews nominally observe the laws but make distinctions within and without the home, while Reform Jews minimize the significance of

dietary laws. Food habits of the Jewish people may also be influenced by the country of origin—for example, Russia, Poland, and Germany.

Milk and its products are never eaten in the same meal as meat. Usually two meals contain dairy products and one meal contains meat and its products.

Religious festivals include certain food restrictions. No food is cooked or heated on the Sabbath. Yom Kippur (Day of Atonement) is a 24-hour period of fasting from food or drink. For 7 days during the Passover, only unleavened bread and cakes may be used (Exod. 12:15–20; 13:3–10; 23:15). Only utensils and dishes that have made no contact with leavened foods may be used during this time.

The diet is generally rich in pastries, cake, many preserves, and relishes. Breads, cereals, legumes, fish, and dairy products are used abundantly. Encouragement should be given to the inclusion of more fruits and vegetables.

TYPICAL FOODS AND THEIR USES

MILK GROUP

Milk, cottage and cream cheese, sour cream used abundantly. Milk and its products may not be used at same meal as meat (Exod. 23:19; 34:26; Deut. 14:21). Milk may not be taken until 6 hours after eating meat. Separate dishes and utensils must be used for milk and meat dishes.

MEAT GROUP

ALLOWED FOODS

All quadruped animals that chew the cud and divide the hoof (Lev. 11:1–3; Deut. 14:3–8): cattle, deer, goats, sheep. Organs of these animals may be used.

Animals must be killed in prescribed manner for minimum pain to animal, and for maximum blood drainage.

Meat must be *kosher*, that is, drained of blood (Gen. 9:4; Lev. 3:17; 17:10–14; Deut. 12:23–27). Meat is soaked in cold water, thoroughly salted, allowed to drain, washed in three waters.

Poultry: chicken, duck, goose, pheasant, turkey. Chicken is common for Sabbath eve meal.

Fish with fins and scales (Lev. 11:9; Deut. 14:9–10): cod, haddock, halibut, salmon, trout, tuna, whitefish, etc.

Eggs. Fish and eggs may be eaten at both meat and milk meals.

Dried beans, peas, lentils, in many soups.

Corned beef, smoked meats, herring, *lox* (smoked, salted salmon) are well liked.

Cholent: casserole of beef, potatoes, and dried beans. Served on the Sabbath.

Gefillte fish: chopped, highly seasoned fish.

Kishke: beef casings stuffed with rich filling and roasted.

Knishes: pastry filled with ground meat.

Kreplach: noodle dough filled with ground meat or cheese filling.

PROHIBITED FOODS

Animals which do not chew the cud or divide the hoof (Lev. 11:4–8): pork.

Diseased animals or animals dying a natural death (Deut. 14:21).

Birds of prey (Lev. 11:13–19; Deut. 14:11–18).

Fish without fins or scales (Lev. 11:10–12): eels, shellfish such as oysters, crab, lobster.

Hindquarters of meat, unless part of thigh with Sinew of Jacob (Gen. 32:33) is removed.

VEGETABLE-FRUIT GROUP

All kinds used without restriction.
Cucumber, lettuce, tomato very frequently used.
Cabbage, potatoes, and root vegetables are often cooked with the meat.
Borsch: soup with meat stock and egg, or without meat stock and with sour cream; includes beets, spinach, cabbage.
Dried fruits are used in many pastries.

BREAD-CEREALS GROUP

All kinds used without restriction. Rye bread (pumpernickel), white seed rolls; noodles and other egg and flour mixtures.
Bagel: doughnut-shaped hard yeast roll.
Blintzes: thin rolled pancakes filled with cottage cheese, ground beef, or fruit mixture; served with sour cream.
Bulke: light yeast roll.
Challah: braided loaf or light white bread.
Farfel: noodle dough grated for soup.
Kasha: buckwheat groats served as cooked cereal or as potato substitute.
Kloese: dumplings, usually in chicken soup.
Latkes: pancakes.

OTHER FOODS

Unsalted butter preferred.
Chicken fat or vegetable oils for cooking.
Rich pastries are common.
Cheese cake.
Kuchen: coffee cake of many varieties.
Leckach: honey cake for Rosh Hashana (New Year).
Strudel: thin pastry with fruit, nut filling.
Teiglach: small pieces of dough cooked in honey, with nuts.
Sponge cake and macaroons at Passover.
Many preserves, pickled cucumbers, pickled green tomatoes, relishes.
Many foods are highly salted.

PUERTO RICAN FOOD HABITS

Outstanding characteristics. Most of the Puerto Ricans now living in the eastern states have come recently from the island and are therefore accustomed to the foods of that tropical climate. Many of these foods may not be available in the northern cities to which they have come. Because of unfamiliarity with the English language, expensive imported foods are often bought in stores managed by other Puerto Ricans. Some familiarity with the American supermarket would help these people to obtain similar, if not identical, foods more in keeping with their limited income. The typical dietary pattern of the Puerto Rican has been described by Torres.[4]

Rice, legumes, and *viandas* (starchy vegetables) are basic to all diets. Dried codfish (*bacalao*) and milk are used as the income permits. Meat is well liked,

but it is too expensive except for the well-to-do. Fruits on the island are abundant and provide ample ascorbic acid; green vegetables are also abundant. Neither fruits nor vegetables are eaten as much as they should be. The diet is high in carbohydrate and fat. Increased amounts of protein, vitamin A, and ascorbic acid should be provided.

A typical breakfast for the very poor consists of *café con leche* with or without bread; oatmeal and egg are included when income permits. Lunch in the rural areas is a plateful of viandas with codfish and oil; rice and stewed beans might be used in the city. Dinner in urban and rural areas consists of rice and beans, and viandas or bread. Between-meal eating is frequent.

Families with a more liberal income add meat to the daily meals. Chicken, pork, and beef are well liked. Desserts are not always used, but fruits cooked in syrup are especially well liked.

TYPICAL FOODS AND THEIR USES

MILK GROUP

Milk is well liked but low-income groups cannot afford it. Nonfat milk solids well accepted; people must be shown how to use it.

Most of the milk is used in strong coffee (*café con leche*); 2–5 ounces milk per cup. May drink this several times a day.

Cocoa and chocolate used widely.

MEAT GROUP

Chicken, pork especially well liked. Seldom used by low-income groups, but liberally by the prosperous.

Chicken often cooked with rice (*arroz con pollo*).

Codfish used frequently; served with viandas.

Legumes (*granos*): chick peas, kidney beans, navy beans, dried peas, pigeon peas, and other varieties. Stewed and dressed with sauce (*sofrito*). About 3–4 ounces legumes eaten daily.

VEGETABLE-FRUIT GROUP

Viandas (starchy vegetables): green bananas and green plantain most common; white sweet potatoes; ripe plantain; white *ñame;* white *tanier;* breadfruit in some parts of the island; yautia; cassava, occasionally. Viandas are boiled and served hot with oil, vinegar, and some codfish—often as a one-dish meal in rural areas.

Beets and eggplant most commonly used vegetables.

Carrots, green beans, okra, and tomatoes in small amounts.

Some spinach and chard but insufficient succulent vegetables eaten.

Yellow squash (*calabaza*) used in soups or fritters. Yellow sweet potato is little used.

Fruits usually eaten between meals rather than at meals. Include: acerola (richest known source of vitamin C), cashew nut fruit, grapefruit, guava, mango, orange, papaya, pineapple.

Preference often shown for imported canned peaches, pears, apples, fruit cocktail.

In the United States, potatoes and sweet potatoes may be used instead of tropical viandas. Citrus fruits should be stressed.

BREAD-CEREALS GROUP

Rice (*arroz*) used once or twice daily by all (7 ounces per capita daily). Enriched by Puerto Rican law. May be boiled with lard added or may be combined with legumes, chopped pork sausages, dry codfish, or chicken.

Corn-meal mush made with water or milk is popular.

Oatmeal may be cooked in thin gruel for breakfast.

Corn-meal may substitute for rice, and may be eaten with beans and codfish.

Wheat bread, noodles, spaghetti are widely used. Cream of Wheat and other cereals imported by the well-to-do

In the United States suggest whole-grain and enriched cereals and potatoes for some of the rice.

OTHER FOODS AND SEASONINGS

Sofrito: sauce made of tomatoes, onion, garlic, thyme, and other herbs, salt pork, green pepper, and fat. This is basis for much of cooking.

Annato: yellow coloring used with rice.

Lard, oil, salt pork, or ham butts used in cooking. Lard is used on bread.

Sugar in large amounts in coffee, cocoa, chocolate; molasses.

Coffee (Mocha, never a blend) is very strong; consider American coffee to be very weak and dislike it. Coffee usually served with hot milk.

Carbonated beverages are being used more frequently.

MEXICAN FOOD HABITS

Outstanding characteristics. The chief foods of the Mexicans are dried beans, chili peppers, and corn, but wheat is gradually replacing corn (see Figure 16–4). Many families eat one good meal daily at noon, such as lentil-noodle vegetable soup, while breakfast and supper consist of a sweet coffee or sometimes milk and tortillas.[5] Calcium, riboflavin, and ascorbic acid intakes are low; the quantity and quality of the protein are also low. Greater emphasis should be placed on the use of whole-grain or enriched cereals and flours, milk, eggs, and vegetables.

TYPICAL FOODS AND THEIR USES

MILK GROUP

Very little milk is used; some evaporated milk for infant feeding.

MEAT GROUP

Beef and chicken well liked; meat used only two or three times weekly.

Eggs: two or three times a week.

Fish: infrequently.

Pinto or calico beans used daily by some; two or three times weekly by others.

Chile con carne: beef with garlic seasoning, beans, chili peppers.

Enchiladas: tortilla filled with cheese, onion, shredded lettuce, and rolled.

Taco: tortilla filled with seasoned ground meat, lettuce, and served with chili sauce.



FIG. 16–4. Tarascan woman grinding corn on the metate to make tortillas. (*Courtesy, E. Tejada and Department of Public Information, Food and Agriculture Organization.*)

Tamales: seasoned ground meat placed on masa, wrapped in corn husks, steamed, and served with chili sauce.

VEGETABLE-FRUIT GROUP

Corn: fresh or canned; *chicos,* corn steamed while green and dried on the cob; *posole,* similar to hominy.

Chili peppers: fresh, canned, or frozen are good source of ascorbic acid.

Beets, cabbage, many tropical greens, peas, potatoes, pumpkin, squash, string beans, sweet potatoes, turnips.

Bananas used frequently. *Chayotes* (cactuslike fruit), oranges.

BREAD-CEREALS GROUP

Corn is staple cereal with wheat gradually replacing it. Rice, macaroni, spaghetti. Some yeast bread; sweet rolls very popular.

Atole: corn-meal gruel.

Masa: dried corn which has been heated and soaked in lime water, washed, and ground while wet into puttylike dough; contains appreciable amounts of calcium.

Tortilla: thin, unleavened cakes baked on hot griddle, using masa; wheat now replacing lime-treated corn.

OTHER FOODS AND SEASONING

Ground red chili powder is essential to most dishes; garlic and onion very common; salt in abundance.

Cinnamon, coriander, lemon juice, mint, nutmeg, oregano, parsley, saffron.

Butter rarely used.

Coffee with much sugar used in large amounts.

Sugar and sweets in large amounts.

ITALIAN FOOD HABITS

Outstanding characteristics. The favorite foods for the Italian diet are readily available, and the nurse or dietitian should experience no difficulty in adapting the diet of a given locality to the Italian pattern. Cantoni[6] has recently summarized the prevailing pattern for Italian people in the United States.

Pastas, available in a great variety of shapes, are an important staple of the Italian diet. They are prepared from durum wheat of high-gluten content. Crusty white bread is widely used. The Italians use fruits, vegetables, and cheese liberally and should be encouraged in continuing to do so. Milk is not as widely used as it should be, although cheese will substitute in part. Dietary instruction should include emphasis on the use of enriched flour for bread and pastas.

The typical breakfast consists of fruit, Italian bread with butter, and coffee with hot milk and sugar. The main meal of the day comes at noon if all members of the family are at home but will come in the evening when some members are away from home all day. The main meal may consist of broth with noodles, meat or chicken or pasta with sauce, vegetables, green salad, bread without butter, fruit, and coffee with milk. The evening meal (or lunch) includes a substantial soup as a main dish, Italian bread, coffee with milk and sugar, sometimes cold cuts or cheese or salad, and sometimes wine.

TYPICAL FOODS AND THEIR USES

MILK GROUP

Goat milk is preferred. Most adults drink milk with coffee or chocolate; dislike plain milk.

American cheese disliked. Prefer expensive Italian cheeses: *Mozzarella* and *Ricotta* for cooking and with bread; *Parmesan* and *Romano* for grating; *Gorgonzola.*

MEAT GROUP

Chicken: roast; baked with oil, garlic, salt, pepper; *cacciatora,* browned in oil, simmered in wine, tomato sauce.

Lamb.

Pork: roasted or fried sausages; baked or fried chops.

Veal: cutlets, *scallopine* or with tomato sauce.

Cold cuts: *coppa* (highly peppered), *mortadella* (bologna), *prosciutto* (cured ham), salami.

Meats often browned in salt pork or oil and simmered in a sauce with combinations of celery, garlic, onion, parsley, green pepper, tomato purée, wine; meat balls; meat loaf. Smaller quantities of meat eaten than by Americans.

Fish, canned: anchovies, sardines, tuna. Fish sauces (anchovy, clam, tuna) for spaghetti on fast days.

Chick peas, kidney beans, lentils, split peas in soups. *Pastafasiole:* bean soup. *Minestrone:* substantial soup of vegetables, chick peas, pasta.

Frittata: omelet with eggs, cheese, bread crumbs, seasonings.

VEGETABLE-FRUIT GROUP

Favorite vegetables: artichoke, asparagus, broccoli, eggplant, escarole, peppers, squash (zucchini and others), string beans, tomatoes in sauce. Vegetables are cooked in water, drained, dressed with olive oil or oil and vinegar or lemon juice.

Insalata: salad of greens; may be mixed with celery, onions, green peppers, tomatoes. Dressed with olive oil, vinegar (often wine vinegar), garlic, pepper, salt.

Fruits are well liked and eaten abundantly when available: apricots, cherries, dates, figs, grapes, melons, peaches, plums, quinces.

BREAD-CEREALS GROUP

White crusty bread forms substantial part of meal. Made of high-protein flour, water, yeast, salt, and little if any fat. Flour not likely to be enriched except where state law requires it.

Pasta: includes macaroni, spaghetti, noodles in many forms and shapes. Used two to three times a week. Spaghetti is usual pasta of southern Italy, but rice, corn meal, and noodles are more common in northern Italy.

Pastasciutta: pasta with gravy or sauce.

Noodle doughs filled with meat, vegetable, or cheese mixtures: *cannelloni, lasagne, manicotti, ravioli, tortellini.*

Polenta: thick corn-meal mush served plain, or in casserole with sausages, tomato sauce, grated cheese.

Risotto alla Milanese: rice cooked in broth, flavored with Parmesan cheese, onion, mushroom, saffron, wine.

OTHER FOODS AND SEASONINGS

Butter, olive oil, salt pork. Oil in cooking; preference for olive oil.

Pies and pastry used more in America than in Italy.

Cannoli: filled pastries.

Farfalleti dolci: dough mixtures fried in fat.

Torta: cake.

Zabaglione: soft custard with egg yolks, white wine, sugar.

Tutti-frutti ice creams.

Seasonings: basil, celery, garlic, nutmeg, onion, oregano, parsley, pepper, green pepper, hot peppers, rosemary, saffron, tomato purée, wine.

DIETARY PATTERNS OF THE NEAR EAST—ARMENIA, GREECE, SYRIA, TURKEY

TYPICAL FOODS AND THEIR USES

MILK GROUP

Cow's, goat's, or sheep's milk; fermented preferred to sweet (yogurt).

Soft and hard cheeses.

MEAT GROUP

Lamb is preferred; also mutton, goat, beef, pork, poultry.

Fish: fresh, salted, or smoked; octopus, squid, shellfish, roe.

Eggs.

Beans, peas, and lentils.

Nuts may be used with wheat and rice in place of meat; pignolias, pistachios.

Ground or cut meat often cooked with wheat or rice, or in stews with cereal grains and vegetables. For example:

Breast of lamb stuffed with rice, currants;
Squash stuffed with chopped meat, onions, rice, parsley;
Cabbage rolls with ground meat, rice, and baked in meat stock; served with lemon juice.

Barbecued meats on special occasions: skewered meats are broiled.

Shashlik: mutton or lamb marinated in garlic, oil, vinegar; roasted on skewers with tomato and onion slices.

VEGETABLE-FRUIT GROUP

Eggplant, greens, onions, peppers, tomatoes: also cabbage, cauliflower, cucumbers, okra, potatoes, zucchini.

Vegetables cooked with olive oil and served hot or cold; cooked in meat or fish stews; stuffed with wheat, meat, nuts, beans; salads with olive oil, vinegar.

Grapes, lemons, oranges; also apricots, cherries, dates, figs, melons, peaches, pears, plums, quinces, raisins. Fresh fruits widely used in season; fruit compotes.

BREAD-CEREALS GROUP

Bread is staff of life; used at every meal. Baked on griddles in round, flat loaves.

Cracked whole wheat (*bourglour*) and rice used as starchy food, or with vegetables, or with meat (*pilavi*).

Corn in *polenta.*

OTHER FOODS AND SEASONINGS

Olive oil and seed oils used in cooking. Butter is not much used.

Nuts (hazel, pignolia, pistachio) used for snacks, in desserts, pastries.

Paklava: pastry with nuts and honey.

Black olives.

Herbs, honey, sugar, lemon juice, seeds of caraway, pumpkin, and sesame.

Apricot candy, Turkish paste.

Wine, coffee.

DIETARY PATTERNS OF THE CHINESE

TYPICAL FOODS AND THEIR USES

MILK GROUP

Milk and cheese are well liked but need to be emphasized.

MEAT GROUP

Pork, lamb, chicken, duck, fish and shellfish, eggs, and soybeans. Organ meats including brain and spinal cord, blood, and bone are used.

Egg rolls: shrimp or meat and vegetable filling rolled in thin dough, and fried in deep fat.

Egg foo yung: combination of eggs, chopped chicken, mushrooms, scallions, celery, bean sprouts cooked similar to an omelet.

Sweet and pungent pork: pork cubes coated with batter and fried in oil; then simmered in a sauce of green pepper, cubed pineapple, molasses, brown sugar, vinegar, and seasonings.

Chow mein: veal, chicken, shrimp, with celery, mushrooms, water chestnuts, bamboo shoots, in sauce; served with soy sauce. A popular dish made for American tastes.

VEGETABLE-FRUIT GROUP

Cabbage, cucumbers, many greens, mushrooms, bamboo shoots, soybean sprouts, sweet potatoes.

Vegetables are thinly sliced or chopped; cooked in a little oil for a short time before water is added to seal in flavor, preserve crispness, and fresh green color. Any juice remaining is served with the vegetable.

BREAD-CEREALS GROUP

Rice is staple food served with every meal.

Wheat and millet are widely used.

OTHER FOODS AND SEASONINGS

Lard, soy, sesame, and peanut oils used in cooking.

Soy sauce present in almost every meal contributes to high salt intake.

Almonds, ginger, sesame seeds for flavoring.

Tea is beverage of choice.

PROBLEM AND REVIEW

1. What factors must be kept in mind in teaching normal nutrition to people whose food habits differ widely from our own?
2. What technologic advances of the twentieth century have tended to eliminate regional differences in food patterns of the United States?
3. *Problem.* Select any one ethnic group and plan menus for one day including recipes for special dishes.
4. Make a survey of the ethnic groups represented in the class. List favorite dishes for each of these ethnic groups. Discuss the nutritive values of these dishes. What foods require emphasis in the patterns of these ethnic groups?
5. What problems in dietary adjustment would you expect to encounter for a Puerto Rican child; a student from India who is a strict vegetarian?
6. Compare the principal cereal foods and meats used by the Chinese, the Mexicans, and the Greeks.

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UNIT IV

Meal Planning, Food Selection, and Food Preparation

Chapter

17 MEAL PLANNING FOR THE FAMILY

18 QUALITY AND ECONOMY FACTORS IN FOOD SELECTION

19 BASIC PRINCIPLES AND PRACTICES IN FOOD PREPARATION

Chapter 17

MEAL PLANNING FOR THE FAMILY

In addition to the continuous application of the principles of nutrition, good menu planning calls for an understanding of family needs, careful management of time and money, and imagination. Advertisements in newspapers, the colorful illustrations and numerous suggestions for menu planning in feature articles of newspapers and women's magazines, and innumerable cookbooks are valuable aids in menu planning.

Meal patterns must fit the family. Planning meals for the family group entails consideration of the needs of each individual. Specific requirements for various periods of the life cycle are detailed in Chapters 22 through 25. Obviously, a young child will not be allowed the wide choice of foods given to adults. The amount of food for the overweight individual will be considerably less than that for the hard-working underweight person. The adolescent boy or girl, the elderly person, the pregnant woman, or the sick individual—each has his specific needs. However, one can readily adapt the family menu to meet these needs if care is exercised in planning meals. For example, if steak appears on the menu for the adult members of the family, a meat patty would be suitable for the young child. A baked apple is readily prepared for the child at the same time an apple pie is being baked. The same salad can usually be used for both the overweight and underweight members of the family if the dressing is omitted for the former. (See Figure 17–1.)

Save time in food preparation. The wise expenditure of time in the preparation of meals can mean leisure hours for the homemaker and her family. For no group is this more important than the low-income group in which the homemaker has many duties in relation to the care of the children and the home, or who, perhaps, is working to increase the family income. Time, like money, needs to be budgeted for its best use. These suggestions may help:

1. Plan meals for several days at one time.
2. Write a market order and restrict shopping to once or twice a week.
3. Shop when markets are less crowded.



FIG. 17–1. Appetizing food, attractively served for a well-nourished happy family. (*Courtesy, U.S. Department of Agriculture.*)

4. Use simplified menus suitable for all age groups. Do not cater to every individual whim of each family member.

5. Make use of convenience foods when time saved is more important than the slightly higher cost of the item, but compare costs. Some convenience foods are no more expensive; most are slightly more expensive; and some are quite costly.

6. Arrange the kitchen in terms of efficient work units, keeping utensils and food supplies at point of first use.

7. Plan a work schedule for each day. In time this will show where important savings in minutes and hours can be made.

Use variety in meals. If one prepares varied meals, the diet is more likely to be nutritionally adequate than it would be if just a few foods were used day after day. A very common error in meal planning is emphasizing one type of food to the exclusion of others. A meal consisting of roast beef, macaroni and cheese, and custard predominates in protein, while spaghetti, potatoes, and cake in another meal would be equally poor because of the preponderance of carbohydrate. First of all, then, variety means selecting foods each day from

each of the basic food groups. Thus, a breakfast of orange juice, egg, toast, butter, and milk includes foods from the Four Food Groups. The orange juice contributes ascorbic acid not found in any of the other foods, egg and milk are the chief sources of protein, egg and cereal provide most of the iron, milk is the outstanding contributor of calcium and riboflavin, and so on. Used together these foods comprise a good breakfast, but used singly some nutrients would be provided in less than desirable amounts.

Variety in meals means better acceptability; even the most avid enthusiast for steak would tire of a steady diet of it. Variety is introduced through changes in color, texture, flavor, and methods of preparation. The first appeal to the appetite is through the eye. Attractive color combinations are important, for food must look good enough to eat. Chicken a la king, mashed potato, and cauliflower are monotonous in appearance, whereas changing the cauliflower to green peas or beans would add color appeal. Sometimes color appeal consists merely in using a garnish such as chopped parsley and paprika on fish, radish roses, green pepper rings, or some red jelly in a tiny lettuce cup. One need not restrict garnishes to the much overworked cherry or to the wilted-sprig of parsley!

Texture variation is equally important. For example, a meal made up of meat loaf, mashed potatoes, stewed squash, white bread, and baked custard would be greatly improved by changing the vegetable to one requiring some mastication and by adding a green salad and crusty rolls. Children will not eat well if all the foods in a given meal require a lot of chewing, while most adults rebel against all soft foods.

Taste appeal depends on the blending of bland and sharp flavors. Creamed onions, spicy cole slaw, pickles, and sharp cheese represent too many strongly flavored foods in a single meal; on the other hand, boiled potatoes, mashed squash, and vanilla pudding are all bland and lack interest unless contrasted with some sharper flavor. Spicy foods and marked flavors should not dominate the meal, but should provide the accent. Flavor variety precludes using the same food in two forms at one meal; for example, tomato juice and tomato salad would not be a good choice.

Even the season of the year requires some consideration, for on a cold winter day hearty soups and stews may seem especially desirable. Summer meals also require that the same nutrients be provided, but one is likely to prefer less of heavy and rich foods. One should not make the mistake, however, of serving cold foods only, or of planning salad meals that do not include protein.

Variety can be introduced by using many methods of preparation. For example, eggs may be soft cooked, poached, in omelets of various kinds, creamed, or deviled, to mention but a few methods of preparation; likewise, tomatoes may be fresh in salads, broiled, stewed, escalloped, fried green or ripe, in cream soups, in tomato juice, and so on.

Variety in meal planning is the sum total of many kinds and classes of foods served in pleasing color combinations, with a judicious mixture of soft and crisp foods, of bland and sharp flavors, and hot and cold dishes—all prepared in the best tradition of American cookery. It ensures better nutrition and enhances the interest in any meal. (See Figures 17–2 and 17–3.)



FIG. 17–2. A variety of salad greens add crisp textures and mild-to-tangy flavors to a meal. (*Courtesy, United Fresh Fruit and Vegetable Association.*)



FIG. 17–3. Breads of many shapes textures, and flavors add interest to any meal. (*Courtesy, General Mills, Inc., Minneapolis.*)

Provide satiety value. A satisfying meal is one that will allay the sense of hunger until almost time for the next meal. A breakfast of orange juice and toast is digested in such a short time that a sense of hunger and fatigue quickly appears. The addition of cereal and egg will, however, postpone these sensations.

Protein foods such as meat and eggs are high in satiety value, as are foods

cooked with fat. Carbohydrate foods, fruits, vegetables, and liquids are somewhat low in their staying power. The choice of foods will then depend upon the interval between meals, long intervals demanding those of higher satiety value.

Begin with a good breakfast. Far too many people eat nothing but one or two doughnuts or a sweet roll and a cup of coffee for breakfast; many others skip breakfast entirely. Careful planning can overcome the excuses customarily given for skipping, or skimping on, breakfast. (See Figure 17–4.)



FIG. 17–4. A good breakfast supplies one fourth to one third of the day's nutrient needs. (*Courtesy, the Cereal Institute, Chicago.*)

Over a period of 6 years, a series of experiments was conducted by the Departments of Physiology and Nutrition at the State University of Iowa to determine the effectiveness of various breakfast plans on physical and mental efficiency. Seventy different subjects of various ages were used in the studies which have been reported in 20 scientific papers in professional journals. In brief, the results of these studies showed that[1] (1) efficiency in physiologic performance, as measured by bicycle ergometer, treadmill, and maximum grip strength, decreased in late morning hours when breakfast was omitted; (2) attitude toward school work and scholastic achievement was poorer when breakfast was omitted; (3) the content of the breakfast did not determine its

efficiency so long as it was nutritionally adequate; (4) a basic breakfast providing one fourth of the daily caloric requirement and one fourth of the daily protein allowance was superior to smaller or larger breakfasts for maintaining efficiency in the late morning hours; (5) a protein intake of 20 to 25 gm was most suitable for the maintenance of the blood glucose level during the late morning hours; and (6) the omission of breakfast was of no value in weight reduction. In fact, those who omit breakfast while on a weight reduction regimen experience greater hunger in addition to being physiologically inefficient.

TWO MENUS FOR SEDENTARY PERSONS

Orange juice
Oatmeal with sugar and milk
Popovers with butter or fortified margarine
Coffee with cream and sugar
Milk for children

Stewed prunes
Poached egg on
Buttered toast
Coffee with cream and sugar
Milk for children

TWO MENUS FOR MODERATELY ACTIVE PERSONS
(Adults and School-age Children)

Cantaloupe
Shredded wheat with milk, sugar
Ham slice with fried eggs
Whole-wheat toast with
Butter or fortified margarine
Coffee with cream and sugar
Milk for children

Sliced peaches on rice flakes with cream and sugar
Griddle cakes with syrup
Sausages
Coffee with cream and sugar
Milk for children

A change to better breakfast habits means (1) planning simple, easy-to-prepare, but varied meals; (2) arising sufficiently early so that there is time for eating breakfast; (3) eating breakfast with the family group so that it, like other meals, has pleasant social associations.

Many combinations of foods are possible for breakfast. Breakfast should provide at least one fourth of the daily nutritive needs. It may include some protein food such as egg or milk, cereal or breadstuff, or both, and a beverage. Children and teen-agers should include milk for breakfast. If citrus fruit or another good source of ascorbic acid is included at breakfast, the day's allowance is assured. Cereal may be hot or cold; breads may vary from plain white enriched or whole-grain to muffins, griddle cakes, waffles, or sweet rolls, as the occasion warrants. A breakfast may be light or heavy depending upon the individual's activity and preferences.

Lunch is often neglected. Thousands of workers depend on the lunch counter in a drugstore for their lunches. All too commonly the pattern is a sandwich, a piece of pie, and a glass of carbonated beverage or a cup of coffee. Sometimes the pattern can be improved by the selection of milk, salads, and ice cream. Occasionally food choice for the worker is so limited that there is

little one can do to improve the lunch pattern other than carrying a lunch. This is not feasible for the man or woman who lives in a room and has no facilities for food preparation. When the choice of foods is restricted at lunch, it is essential that basic foods (a salad, or milk, or citrus fruit, etc.) be included in morning and evening meals. (See Figure 17–5.)

In recent years a great deal of emphasis has been placed on hot school lunches. Undoubtedly hot food is an aid to food acceptability, but hot foods per se do not change nutritive values. A packed school lunch may be just as adequate nutritionally; but if it is much less attractive to the child, it may not be eaten.

Perhaps even more neglected than the school child and the worker are the homemaker and preschool children. Lunch may simply be a means to use leftovers or a day-to-day monotony of sandwiches or canned foods because the homemaker does not take the time for adequate preparation. Luncheons c



FIG. 17–5. A popular lunchtime combination—soup and sandwich. Round out the menu with fruit and milk. (*Courtesy, Campbell Soup Company.*)

suppers can be inexpensive, easy to prepare, tasty, and nutritionally adequate with a little foresight and planning. The following menus illustrate good luncheons, both hot and cold.

Spanish omelet
Buttered green cabbage
Fresh fruit cup
Cookie
Milk

Sandwich:
Chopped egg, celery, mayonnaise
on
Whole-wheat bread
Carrot and cucumber sticks
Potato chips
Fresh plums
Spice cup cake
Milk

Salad bowl with mixed greens, diced ham, cheese, tomato wedges
French dressing
Whole-wheat muffin with butter and jelly
Pumpkin pie
Milk

Dinner patterns are many. The chief meal of the day may be served at noon or at night, depending upon family custom. In terms of minerals and vitamins it must make up any lack that may have occurred in the other meals. The American custom of making the dinner meal much larger than the other two, however, is not a good practice. When one meal provides a large share of the day's carbohydrate and calories, the normal metabolic mechanisms are overloaded. As a result, alternate metabolic pathways may be used. These alternate paths favor the synthesis of adipose tissue and of cholesterol, both of which are likely to be undesirable. (See Figure 17–6.)

Meat, fish, fowl, or occasionally a cheese, egg, or legume dish comprises the main dish at dinner. Potatoes or a starchy food and a green or yellow vegetable are generally served with the meat. If no salad has been included in the luncheon, it should be given here. The dessert may consist of puddings, cake, ice cream, pastries, or fruit. Milk should again be given to the children. For more elaborate meals one may also include an appetizer such as a clear soup or fruit cup.

MEAL PATTERN FOR DINNER	SAMPLE MENU
Meat, fish, or poultry	Broiled salmon
Potato or substitute	Creamed whole potato
Vegetable, green or yellow	Fresh peas
Salad, if none at lunch	Lettuce, grapefruit, and celery salad
Bread, whole-grain or enriched	French dressing
Butter or fortified margarine	Parker House rolls
Dessert	Vanilla ice cream
Beverage	Coffee
	Milk for children



FIG. 17–6. This colorful meal is rich in all nutrients and balances the day's meals. Dessert might be cake or pastry, but for those who need to watch their weight, fruit or gelatin dessert would be a better choice. (*Courtesy, U.S. Department of Agriculture.*)

Dinner is often a good time to balance the calories for the day. The active person may eat heartily of potatoes, rolls, desserts as well as of meat, vegetables, and milk, while the individual who needs to watch calories can eat meat, vegetables, and milk and more sparingly of the calorie-rich foods. The calorie intake each day should be such that it balances with a normal weight for one's height and body build.

Snacks are often useful. There can be no rigid rule concerning between-meal eating. Active children often benefit by having a midmorning or mid-afternoon snack, providing that it is of such a nature that the appetite at mealtime is not lessened. Workers in industry, nurses, students, and others experience a "lift" with a snack. This does not infer a continuous pattern of nibbling and raiding the refrigerator at any and all times.

It is the quality of the snack that is important. Concentrated sweets and carbonated beverages may contain little other than carbohydrate and may destroy mealtime appetite; but fruits, fruit juices, milk, or a sandwich depending upon the individual's activity and the interval between meals, carry many valuable nutrients. Between-meal snacks, properly chosen, may actually

aid some persons to maintain weight by reducing the tendency to overeating at mealtime.

MASTER FOOD PLANS

Nutritionists, nurses, home economists, and social workers are frequently called upon to help families plan for the kinds and amounts of foods for adequate nutrition. Although the Four Food Groups are a guide for planning nutritionally adequate menus, they do not serve as an adequate basis for setting up the total plan for a week. The Consumer and Food Economics Research Division of the U.S. Department of Agriculture has developed plans at five cost levels for 20 age-sex categories: low cost; low cost especially adapted for use in the Southeastern states; moderate cost; liberal cost; and economy plan for temporary use when funds are limited.

These plans have been set up on the basis of actual food buying practices at various economic levels and are sufficiently flexible for considerable variety in menu planning. The amounts of food listed for each age category will provide the Recommended Dietary Allowances.

Two of the plans are presented in Tables 17–1 and 17–2. The low-cost plan has more flour, cereals, baked goods, potatoes, dry peas and beans. The moderate-cost and liberal plans allow more meat, eggs, fruit, and vegetables other than potatoes All three plans include generous amounts of milk. Within each plan more or less expensive selections can be made. The moderate-cost plan will cost roughly 25 to 35 per cent more than the low-cost plan, while the liberal plan will cost an additional 10 to 20 per cent, or even more.

What's in each food group. The common foods in each of the 11 groups are given below.[2]

1. MILK, CHEESE, ICE CREAM

Milk—whole, skim, buttermilk, dry, evaporated, condensed.
Cheese, ice cream.

Quantities suggested in the food plans are in terms of quarts of milk. When using cheese or ice cream, count the quantities used as about equal to these amounts of milk:

1 pound cheese, Cheddar type	= 3 quarts milk
12 ounces cheese, cottage	= 1 cup milk
4 ounces cheese, cream	= ¼ cup milk
1 quart ice cream	= 2 cups milk

2. MEAT, POULTRY, FISH

Beef, veal, lamb, pork, including bacon and salt pork; variety meats such as liver, heart, tongue· luncheon meats; poultry; fish, and shellfish.

Assume that not more than ⅓ pound of bacon and salt pork is bought for each 5 pounds other meat, poultry, and fish.

3. EGGS

4. DRY BEANS AND PEAS, NUTS

Dry beans of all kinds, dry peas, lentils; soybeans and soya products; peanuts and peanut butter; other nuts.

5. FLOUR, CEREALS, BAKED GOODS (Whole-grain, enriched, restored)

Flour or meal made from any grain—wheat, buckwheat, rye, corn; cereals, including ready-to-eat cereals; rice, hominy, noodles, macaroni, spaghetti; bread, cake, other baked goods.

Amounts suggested in the master food plans are in terms of pounds of flour and cereal. Bread and other baked goods average about two-thirds flour by weight. Therefore, count 1 pound of bread and other baked goods as ⅔ pound of flour.

6. CITRUS FRUIT, TOMATOES

Grapefruit, lemons, limes, oranges, tangerines, tomatoes.

7. DARK GREEN AND DEEP-YELLOW VEGETABLES

Broccoli, chard, collards, kale, green peppers, spinach, and other dark greens; carrots, pumpkin, yellow winter squash, sweet potatoes.

8. POTATOES

9. OTHER VEGETABLES AND FRUITS

Asparagus, beets, Brussels sprouts, cabbage, cauliflower, celery, corn, cucumbers, green Lima beans, snap beans, lettuce, okra, onions, parsnips, peas, rutabagas, sauerkraut, summer squash, turnips.

Apples, bananas, berries, cherries, dates, figs, grapes, peaches, pears, plums, prunes, raisins, rhubarb.

All other vegetables and fruits not included in other groups.

10. FATS, OILS

Butter, margarine, mayonnaise, salad dressing, salad and cooking oil, fat drippings, lard and other shortening, suet.

11. SUGAR, SYRUP, PRESERVES

Sugar (beet and cane)—granulated, powdered, brown, maple; molasses, syrup, honey; jams, jellies, preserves.

How to use the food plans. To use these plans, four steps are required:

1. List the quantities of food required in 1 week from each food group for each member of the family. Total the amounts for the family. These totals serve as a guide for the family from week to week.
2. Plan menus for the week, keeping the amounts of the 11 food groups in mind.
3. Prepare the market order, listing the kinds and amounts of foods required for the 11 food groups.

Table 17–1. Low-Cost Family Food Plan—Revised 1964*

Sex-Age Group[1]	Weekly Quantities of Food[2] for Each Member of Family																			
	Milk, Cheese, Ice Cream[3]		Meat, Poultry, Fish[4]		Eggs	Dry Beans, Peas, Nuts		Flour, Cereals, Baked Goods[5]		Citrus Fruit, Tomatoes		Dark-Green and Deep-Yellow Vegetables		Potatoes		Other Vegetables and Fruits		Fats, Oils		Sugars, Sweets	
	Qt		Lb	Oz	No.	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz
Children																					
7 months to 1 year	4		1	4	5	0	0	1	0	1	8	0	4	0	8	1	0	0	1	0	2
1 to 3 years	4		1	12	5	0	1	1	8	1	8	0	4	0	12	2	4	0	4	0	4
3 to 6 years	4		2	0	5	0	2	2	0	1	12	0	4	1	4	3	4	0	6	0	6
6 to 9 years	4		2	4	6	0	4	2	12	2	0	0	8	2	4	4	4	0	8	0	10
Girls																					
9 to 12 years	5½		2	8	7	0	6	2	8	2	4	0	12	2	4	5	0	0	8	0	10
12 to 15 years	7		2	8	7	0	6	2	12	2	4	1	0	2	8	5	0	0	8	0	12
15 to 20 years	7		2	12	7	0	6	2	8	2	4	1	4	2	4	4	12	0	6	0	10
Boys																					
9 to 12 years	5½		2	8	6	0	6	3	0	2	0	0	12	2	8	5	0	0	8	0	12
12 to 15 years	7		2	8	6	0	6	4	4	2	0	0	12	3	4	5	4	0	12	0	12
15 to 20 years	7		3	8	6	0	6	4	12	2	0	0	12	4	4	5	8	0	14	0	14

Sex-Age Group[1]	Weekly Quantities of Food[2] for Each Member of Family																			
	Milk, Cheese, Ice Cream[3]	Meat, Poultry, Fish[4]		Eggs	Dry Beans, Peas, Nuts		Flour, Cereals, Baked Goods[5]		Citrus Fruit, Tomatoes		Dark-Green and Deep-Yellow Vegetables		Potatoes		Other Vegetables and Fruits		Fats, Oils		Sugars, Sweets	
	Qt	Lb	Oz	No.	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz
Women																				
20 to 35 years	3½	3	4	7	0	6	2	8	1	12	1	8	2	0	5	0	0	6	0	10
35 to 55 years	3½	3	4	7	0	6	2	4	1	12	1	8	1	8	4	8	0	4	0	10
55 to 75 years	3½	2	8	5	0	4	2	0	2	0	1	0	1	4	3	12	0	4	0	6
75 years and over	3½	2	4	5	0	4	1	8	2	0	1	0	1	4	3	0	0	4	0	4
Pregnant[6]	5½	3	12	7	0	6	2	12	3	4	2	0	1	8	5	8	0	6	0	6
Lactating[6]	8	3	12	7	0	6	3	12	3	4	1	8	3	4	5	8	0	10	0	10
Men																				
20 to 35 years	3½	3	8	6	0	6	4	4	1	12	0	12	3	4	5	8	0	12	1	0
35 to 55 years	3½	3	4	6	0	6	3	12	1	12	0	12	3	0	5	0	0	10	0	12
55 to 75 years	3½	3	0	6	0	4	2	12	1	12	0	12	2	4	4	8	0	10	0	10
75 years and over	3½	2	12	6	0	4	2	8	1	8	0	12	2	0	4	4	0	8	0	8

[1] Age groups include the persons of the first age listed up to but not including those of the second age listed.
[2] Food as purchased or brought into the kitchen from garden or farm.
[3] Fluid whole milk, or its calcium equivalent in cheese, evaporated milk, dry milk, or ice cream.
[4] Bacon and salt pork should not exceed 1/3 pound for each 5 pounds of meat group.
[5] Weight in terms of flour and cereal. Count 1 1/2 pounds bread as 1 pound flour.
[6] Three additional quarts of milk are suggested for pregnant and lactating teen-agers.

* *Family Food Plans 1964.* Consumer and Food Economics Research Division, U.S. Department of Agriculture, Hyattsville, Maryland, 1964.

Table 17–2. Moderate-Cost Family Food Plan—Revised 1964*

Sex-Age Group[1]	Weekly Quantities of Food[2] for Each Member of Family																			
	Milk, Cheese, Ice Cream[3]	*Meat, Poultry, Fish*[4]		*Eggs*	*Dry Beans, Peas, Nuts*		*Flour, Cereals, Baked Goods*[5]		*Citrus Fruit, Tomatoes*		*Dark-Green and Deep-Yellow Vegetables*		*Potatoes*		*Other Vegetables and Fruits*		*Fats, Oils*		*Sugars, Sweets*	
	Qt	Lb	Oz	No	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz
Children																				
7 months to 1 year	5	1	8	6	0	0	0	14	1	8	0	4	0	8	1	8	0	1	0	2
1 to 3 years	5	2	4	6	0	1	1	4	1	8	0	4	0	12	2	12	0	4	0	4
3 to 6 years	5	2	12	6	0	1	1	12	2	0	0	4	1	0	4	0	0	6	0	8
6 to 9 years	5	3	4	7	0	2	2	8	2	4	0	8	1	12	4	12	0	10	0	14
Girls																				
9 to 12 years	5½	4	4	7	0	4	2	8	2	8	0	12	2	0	5	8	0	8	0	12
12 to 15 years	7	4	8	7	0	4	2	8	2	8	1	0	2	4	5	12	0	12	0	14
15 to 20 years	7	4	8	7	0	4	2	4	2	8	1	4	2	0	5	8	0	8	0	12
Boys																				
9 to 12 years	5½	4	4	7	0	4	2	12	2	4	0	12	2	4	5	8	0	10	0	14
12 to 15 years	7	4	12	7	0	4	4	0	2	4	0	12	3	0	6	0	0	14	1	0
15 to 20 years	7	5	4	7	0	6	4	8	2	8	0	12	4	0	6	8	1	2	1	2

Sex-Age Group[1]	Weekly Quantities of Food[2] for Each Member of Family																			
	Milk, Cheese, Ice Cream[3]		Meat, Poultry, Fish[4]		Eggs	Dry Beans, Peas, Nuts		Flour, Cereals, Baked Goods[5]		Citrus Fruit, Tomatoes		Dark-Green and Deep-Yellow Vegetables		Potatoes		Other Vegetables and Fruits		Fats, Oils		Sugars, Sweets	
	Qt		Lb	Oz	No	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz	Lb	Oz
Women																					
20 to 35 years	3½		4	12	8	0	4	2	4	2	4	1	8	1	8	5	12	0	8	0	14
35 to 55 years	3½		4	12	8	0	4	2	4	2	4	1	8	1	4	5	0	0	6	0	8
55 to 75 years	3½		4	4	6	0	2	1	8	2	4	0	12	1	4	4	4	0	6	0	8
75 years and over	3½		3	8	6	0	2	1	4	2	4	0	12	1	0	3	12	0	4	0	8
Pregnant[6]	5½		5	8	8	0	4	2	12	3	4	2	0	1	8	5	12	0	6	0	8
Lactating[6]	8		5	8	8	0	4	3	12	3	8	1	8	2	12	6	4	0	12	0	12
Men																					
20 to 35 years	3½		5	0	7	0	4	4	0	2	4	0	12	3	0	6	8	1	0	1	4
35 to 55 years	3½		4	12	7	0	4	3	8	2	4	0	12	2	8	5	12	0	14	1	0
55 to 75 years	3½		4	8	7	0	2	2	8	2	4	0	12	2	4	5	8	0	12	0	14
75 years and over	3½		4	8	7	0	2	2	4	2	4	0	12	2	0	5	4	0	8	0	12

[1] Age groups include the persons of the first age listed up to but not including those of the second age listed.
[2] Food as purchased or brought into the kitchen from garden or farm.
[3] Fluid whole milk, or its calcium equivalent in cheese, evaporated milk, dry milk, or ice cream.
[4] Bacon and salt pork should not exceed 1/3 pound for each 5 pounds of meat group.
[5] Weight in terms of flour and cereal. Count 1 1/2 pounds bread as 1 pound flour.
[6] Three additional quarts of milk are suggested for pregnant and lactating teen-agers.

* *Family Food Plans 1964.* Consumer and Food Economics Research Division, U.S. Department of Agriculture, Hyattsville, Maryland, 1964.

4. Compare the amounts of foods required for the menus with the totals from the 11 food groups required by the family. If the amounts required for the menus differ widely from the suggested plan, revise the menus so that the two correspond. After some practice, these plans are very easy to use.

An example of a week's menus and a market order for a family of six, using the low-cost plan is given below.* The family in this example includes a father and mother, both about 40 years of age; a boy, 16 years old; a girl, 14; a girl, 11; and a boy, 8.

After listing the total amounts of foods required from each of the 11 food groups, the menus were planned for the week as follows:

SUNDAY

Grapefruit juice
Wheat griddlecakes with syrup
Milk for children

Roast shoulder of pork with stuffing
Sweet potatoes (roasted in pan with meat)
Green beans Coleslaw
Bread
Apple gingerbread
Milk

Poached or scrambled eggs
Cottage-fried potatoes
Apple-and-celery salad
Toast
Ice cream

MONDAY

Orange juice
Hot wheat cereal with milk
Toast
Milk for children

Egg salad sandwich
Peanut butter and shredded-lettuce sandwich
Gingerbread
Milk

Pork pie with potatoes
(pork left from Sunday roast)
Sour beets and beet greens
Bread
Raisin-rice pudding
Milk for children

TUESDAY

Stewed prunes
Ready-to-eat cereal with milk
Toast
Milk for children

Meat turnover (ground beef)
Potato salad
Vegetable slaw: Cabbage, minced onion, radish slices, and dressing
Peanut butter cookies
Milk

Lima bean–tomato casserole
Spinach
Corn-meal muffins
Sweet-potato custard
Milk for children

WEDNESDAY

Grapefruit juice
French toast Syrup
Milk for children

Cheese and lettuce sandwiches
Beet and green bean salad
Graham crackers
Milk

Spaghetti with meat balls
Salad bowl:
Lettuce, celery, carrot, cabbage
French bread
Baked apple with milk

* *Food for Families with School Children.* Home and Garden Bulletin No. 13, U.S. Department of Agriculture, Washington, D.C., 1960.

THURSDAY

Tomato juice
Hot wheat cereal with milk
Toasted rolls
Milk for children

Lima bean soup
Cottage cheese and lettuce sandwich on raisin bread
Oatmeal cookies
Milk

Oven-fried chicken
Scalloped potatoes Carrots
Orange, chopped prune, and cabbage salad
Bread
Butterscotch pudding

FRIDAY

Stewed prunes
Oatmeal and milk
Toast
Milk for children

Corn and onion soup
Deviled egg sandwich, or deviled egg salad for those at home
Celery
Bread
Orange
Milk

Baked perch fillets
Mashed potatoes
Green peas and onions
Biscuits
Hot apple pie
Milk for children

SATURDAY

Orange juice
Fried corn-meal mush with syrup
Milk for children

Cold chicken
Potato cakes Shredded carrot salad
Pickles
Bread
Oatmeal cookies
Milk

Braised liver
Riced potatoes 5-minute cabbage
Jellied tomato and cottage cheese salad
Bread
Sliced peaches Cookies
Milk for children

The market order for the week's menus is listed below. It coincides closely with the totals for the 11 food groups required by the family according to the revised 1964 low-cost food plan (Table 17–1). See figures in parentheses for totals required from each food group.

Milk, cheese, ice cream
(30.5 quarts)
19 quarts fluid whole milk
1 13-ounce package dry skim milk (to make 4 quarts liquid)
4 14½-ounce cans evaporated milk
¾ pound Cheddar-type cheese
1½ pounds cottage cheese
3 pints ice cream

Meat, poultry, fish
(17 pounds 4 ounces)
5–6 pounds chicken

2–2½ pounds ground beef
5½–6 pounds pork shoulder
1½ pounds liver
2 pounds frozen perch fillets
Eggs (39 eggs)
3½ dozen
Dry beans and peas, nuts
(34 ounces)
1 pound lima beans
1 pound peanut butter
Grain products
(18 pounds 12 ounces)
10 loaves bread (3 whole wheat, 4 enriched, 1 rye, 1 French, 1 raisin)
¾ pound rolled oats
1 pound wheat cereal
½ pound ready-to-eat cereal
4–5 pounds enriched flour
1 pound enriched corn meal
1 pound enriched spaghetti
¼ pound rice
2 boxes graham crackers
1 pound pancake mix
1 14-ounce package gingerbread mix
1 box soda crackers
Citrus fruits, tomatoes
(12 pounds)
3½ pounds oranges
2 6-ounce cans frozen concentrated orange juice
1 No. 2 can tomatoes
1 46-ounce can tomato juice
Dark-green and deep-yellow vegetables
(5 pounds 4 ounces)
2½ pounds carrots
1½ pounds spinach
3–4 pounds sweet potatoes
Potatoes
(15 pounds 12 ounces)
16 pounds potatoes
Other vegetables and fruits
(29 pounds 4 ounces)
2 pounds beets
1 large head cabbage
1 large bunch celery
1 No. 2 can corn
2 medium heads lettuce
1½ pounds onions
2 No. 2 cans peas
1 bunch radishes
2 pounds green snap beans
5 pounds apples
1 No. 2½ can peaches
1½ pounds prunes
¼ pound raisins
Fats, oils
(3 pounds 4 ounces)
1½ pounds butter or margarine
1 pint salad oil
1 pound lard or shortening
Sugar, sweets
3 pounds sugar
1 pound brown sugar
¼ pint molasses

PROBLEMS AND REVIEW

This family group may be used for one or more of the following projects:
Father: 25 pounds underweight; works in a factory; carries lunch to work; age 36 years
Mother: pregnant (seventh month); age 32 years; does all her own housework
Boy: 10 years; in school; very active; comes home at noon for lunch
Girl: 3 years

1. *Problem.* Tabulate the daily nutritional requirements of each member of the family by referring to the table of recommended allowances.
2. *Problem.* Using the moderate-cost food plan, tabulate the amounts of foods from each food group for the entire family.
3. *Problem.* Plan menus for a week on the basis of the moderate-cost plan.
4. *Problem.* Prepare a market list for the menus, being sure that the market order and the food allowances from the 11 food groups correspond.
5. Name five ways in which each of the following foods may be used in meals: eggs, milk, American cheese, potatoes, apples, carrots, beef. Consult any good cookbook or popular magazine for ideas.
6. Select a series of menus from any popular magazine. Check them in terms of nutritive adequacy and note good examples of each of the points in menu planning outlined in this chapter.

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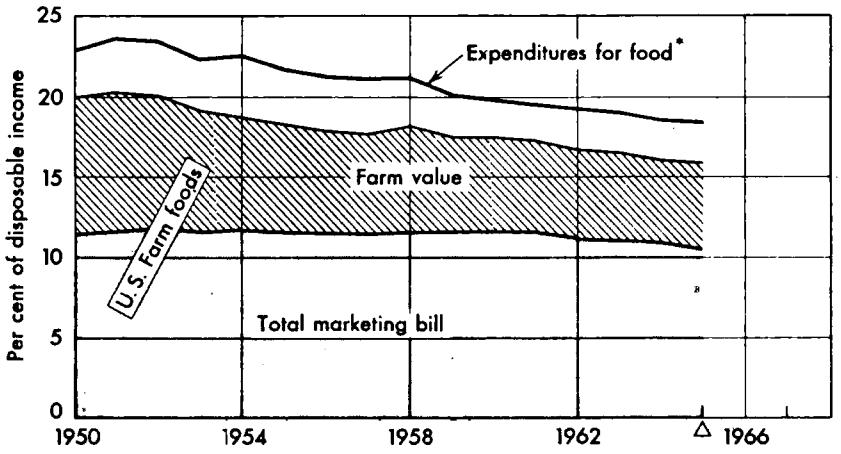
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Chapter 18

QUALITY AND ECONOMY FACTORS IN FOOD SELECTION

Today's homemaker has more money to spend, spends less time in food preparation, and serves better meals than at any time in history. She married at a younger age, has a better education, and enjoys more leisure than did her mother. She lives longer and returns to the work force when her children are in school, if not sooner. All these factors influence the numerous judgments she must make as a shopper, concerning quality, brand, nutritive value, price, convenience, variety, and glamor. During a given year she will purchase about one ton of food for each teen-ager and adult in her family. On this food she will spend, on a national average, about one fifth of the family income. (See Figure 18–1.)



*Personal consumption expenditures for food, less alcoholic beverages (includes imported foods, seafoods, home-produced food, and food furnished to military forces).

△ Preliminary estimates.

FIG. 18–1. Food expenditure relative to income. Note that the marketing bill accounts for about three fifths of the total cost of food. (*Courtesy, Economic Research Service, U.S. Department of Agriculture.*)

Today's foods are more wholesome, more nutritious, and lend more variety to the diet than foods at any previous time have. Although food costs are higher than 10 years ago, incomes have risen rapidly; hence one hour of a man's labor today will buy more food than it would have 10 years ago. Food is the largest single item in the budget of most families. Obviously the proportion spent for food varies widely in different circumstances. One can be adequately nourished at many cost levels, but to be so when the income is low requires careful planning, considerable ingenuity, and time to make the less varied diets interesting.

The amount of money required for food for any given family depends on the size of the family, the number of children and their ages, the activities of the various members, special needs for pregnancy and lactation, and possible therapeutic requirements. The cost of food is decidedly influenced by the choice of foods within each group, the amount of preparation the food has undergone before its sale, the type of market, packaging, and so on. (See Figures 18–2 and 18–3.)

Convenience foods. Homemakers today take for granted the built-in services in many foods that have been cleaned, trimmed, and made ready for cooking, such as poultry, washed greens, frozen foods, and others. They purchase many items that require only the opening of a package or a can and the heating of the contents, and others, such as cake or pudding mixes, that need

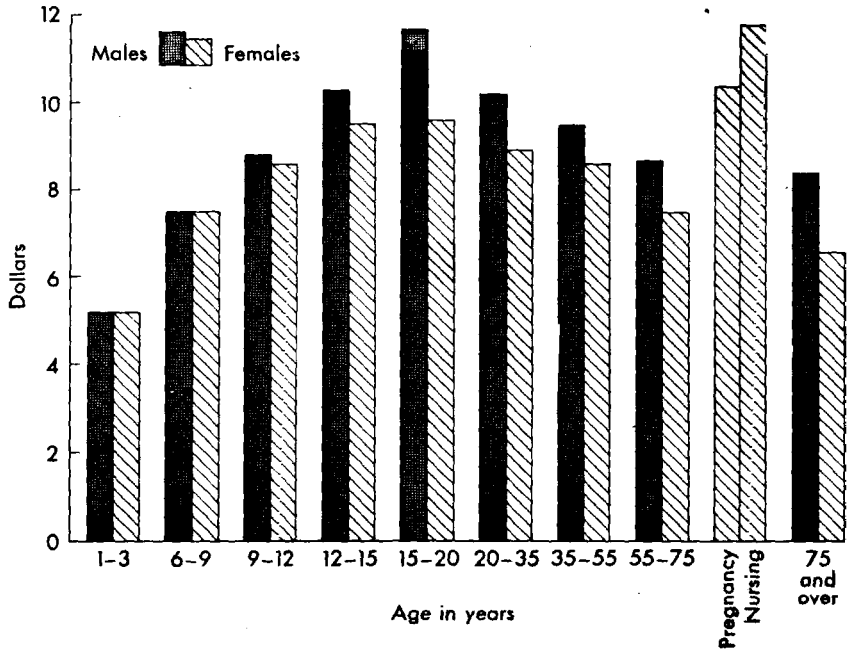


FIG. 18–2. The cost of a week's food (March 1966) using the moderate-cost food plan. (*Data from* Family Economics Review, *U.S. Department of Agriculture, April 1966.*)

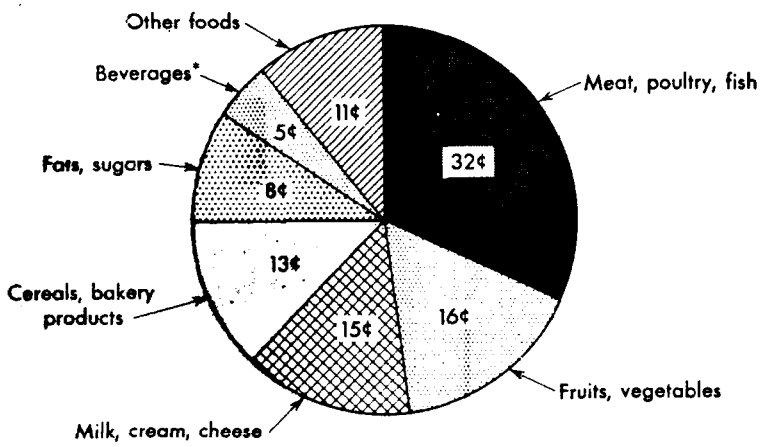


FIG. 18–3. The family food dollar—nonfarm families, 1961–62. The Four Food Groups account for 76 cents of each dollar spent, while fats, sugars, beverages, and other foods account for the remaining 24 cents. (*Courtesy, Agricultural Research Service, U.S. Department of Agriculture.*)

one or two simple steps in mixing before cooking. Among the great variety of convenience foods in today's markets are

Canned foods: fruits, vegetables, seafood, meats, stews, spaghetti, gravy, soups
Dehydrated foods: instantized milk, instant potatoes, instant coffee, soups
Frozen foods: fruits, vegetables, breads and pastries, cakes, ready-to-eat or ready-to-bake poultry, meat, and fish dishes, complete dinners, pizza, Chinese egg rolls, appetizers, and so on.

The great variety of convenience foods makes it difficult for homemakers to determine how costs compare with those for home-prepared foods. A recent study of the Marketing Division of the U.S. Department of Agriculture compared the cost of 158 convenience items and found that almost three fourths of them were more expensive, although the differences for some were not great.[1] In this study, costs were also compared according to the average family purchase pattern. Of $100 spent for food, $14.03 was spent for convenience foods with the convenience foods actually costing $1.07 less than if these items had been prepared in the home. Most of this saving resulted from the inclusion of frozen orange juice in the convenience food group. Other cost-lowering convenience items were canned citrus juices, frozen Lima beans, canned spaghetti, and devil's food cake mix. The relatively larger volume of the low-cost convenience foods thus more than offset the increase in cost of the expensive items.

In another study, by Martin and Robinson,[2] the costs and preparation times

of seven meals prepared with convenience foods were compared with those for seven home-prepared meals. The meals were identical in the foods used and in portion sizes and were of similar nutritive value. The average cost of convenience meals for a family of four was only 23 cents more than that for home-prepared meals, but the average saving of time was 87 minutes. Of the 31 items used in this study, the following convenience foods were less expensive: vegetable and mushroom soups, frozen beef dinner, pork and beans, frozen green beans, and canned fruit cup.

A number of items showed little difference in cost between home-prepared and commercial products: tomato soup, mushroom gravy, beef stew, Boston brown bread, muffins, and vanilla pudding. Among the convenience items that were appreciably more expensive were frozen beef patties, frozen broccoli, stuffed baked potato, packaged cabbage slaw mixed with commercial dressing, packaged salad greens, cheese cake, ready-to-bake rolls, lemon turnover, sponge cake shells. In most instances the foods that show the greatest cost difference are those that are highly perishable and thus have a short shelf life.

Ten recommendations for effecting economy. The quality characteristics for specific food groups must be understood if wise selections are to be made. In general, appreciable savings can be made if the following suggestions are observed in the purchase and use of food.

1. Plan meals for several days at one time. Use the Four Food Groups as the basis for menu planning to assure good nutrition.
2. Read newspapers for reports of the U.S. Department of Agriculture on foods in plentiful supply. When planning menus, take advantage of advertised specials.
3. Use a market list. Be prepared to make substitutions when other foods of equal nutritive value are cheaper. Resist the temptation to purchase many luxury foods now available in markets. Avoid impulse buying.
4. Purchase foods the family will eat. Uneaten foods are no bargain. The wise homemaker, however, introduces new foods from time to time so that her family may learn to enjoy a wide variety.
5. Read labels on packages and cans. Know what the specifications mean. Compare weights and costs of various brands. The private label of a market is often less expensive than nationally advertised brands.
6. Purchase grades according to intended use in the menu.
7. Buy large-size packages only if the price per unit is less, if there is space to properly store the food, and if the food can be used before it spoils.
8. Provide storage conditions that maintain the wholesomeness and nutritive value of the food.
9. Use foods when they are in optimum condition. If there are leftovers, plan for their prompt use, usually within 24 hours.
10. Eat meals at home or carry lunch whenever practical. Meals in restaurants or at lunch counters generally cost more than twice as much as similar food prepared at home.

MILK GROUP

Types of milk. Among the kinds of milk available in the market, those described in the following paragraphs are the most common.

Homogenized milk is fresh milk that has been pasteurized and subjected to a process that breaks up the fat into very fine droplets and mixes them so completely as to make it impossible for the fat to rise as cream. It now accounts for three fourths of all fluid milk sold. This milk has a "richer" taste, but it is not different in food value from plain milk. It gives a softer curd and is more easily digested than a firm curd milk.

Skim milk is fresh pasteurized milk from which the fat has been removed. It contains all the nutrients of whole milk except fat and vitamin A.

Two per cent milk is fresh pasteurized milk which contains only 2 per cent fat and up to 10 per cent milk solids to give a richer body and flavor than skim milk.

Fortified milks are those to which one or more nutrients have been added. Vitamin D is added to most evaporated and fresh whole milks to a level of 400 I.U. per quart. Vitamin A is sometimes added to skim milk. Multiple fortified milk incorporates multivitamin preparations including vitamins A, D, and the B complex; it must conform to local or state regulations.

Chocolate milk is whole milk to which chocolate syrup has been added, while chocolate-flavored milk drink is skim or partially skimmed milk to which the chocolate syrup has been added. The nutrients of milk are diluted in proportion to the amount of chocolate syrup used. The syrup adds caloric value without a corresponding addition of protective nutrients. These flavored milks are nutritious and wholesome, but they should not become the sole way in which milk is taken. Some children refuse to take white milk when they become accustomed to the sweetness of these forms of milk.

Cultured milks are prepared from pasteurized milk to which certain desirable microorganisms have been added. They have a nutritive value equal to that of the milk from which they are made. The fermentation of the milk results in a formation of lactic acid from the lactose and some coagulation of casein. Lactic acid, in turn, is believed to encourage a favorable intestinal flora. The consistency of the milk is less fluid, and the flavor is much desired by some people.

The most widely used of the cultured milks is buttermilk, produced by culturing skim milk, partly skimmed milk, or reconstituted nonfat dry milk with *Streptococcus lactis* and incubating it. Salt is usually added to bring out the flavor. *Acidophilus milk*, of very limited distribution, is cultured with *Lactobacillus acidophilus* under standard conditions. *Yogurt* is a pasteurized milk product of custardlike consistency which is fermented by using a mixed culture of organisms. It may be prepared from whole milk or from milk containing additional milk solids.

Evaporated milk is the product obtained from fresh whole milk after a little more than half of the water has been removed. The protein is so changed that a softer, finer curd results. The milk is homogenized, usually fortified with vitamin D, and sterilized. When diluted with water to its original volume, it has a composition like that of whole sweet milk. Evaporated milk is easily digested, free from bacteria until the can is opened, and lends itself particularly well to the preparation of infant formulas.

Condensed milk is prepared by adding sugar to milk and reducing its water content by evaporation. It owes its keeping qualities to its high sugar content (42 per cent) rather than to the application of heat. It has found wide use in the preparation of desserts.

Dried milk results from the removal of 95 to 98 per cent of the water from fresh milk. *Nonfat dry milk* is made from skim milk and accounts for most of the dry milk on the market. Dried milks are made by spraying partially evaporated milk into warm dry air (spray process). The *instantizing* process produces a fine powder that dissolves instantly. One pound of nonfat dry milk is equivalent to about 5 quarts of fresh skim milk and is therefore a concentrated source of protein, calcium, riboflavin, and other nutrients. Dried milks are easily stored and transported for they require no refrigeration. Nonfat dry milk has excellent keeping qualities, but whole dried milk is subject to oxidation and consequent rancidity.

Cream is the fat of milk which has been separated by centrifugation or by gravity. It is sold as light or "coffee" cream, which has a fat content of 18 to 20 per cent, and as heavy or "whipping" cream, which has a fat content of 35 to 40 per cent. *Half-and-half,* often used in high-calorie diets, consists of half milk and half light cream with a final fat content of about 11.5 per cent. *Sour cream* is light cream which has been cultured under controlled conditions.

Cheese is a milk product representing the solids or curd of milk. The curd may be produced by the action of rennet or of lactic acid. As the milk casein coagulates and becomes semisolid, the whey separates out. The difference in varieties of cheese is due to the kind of milk used—cow (most common), goat, or sheep; the method used for curding the milk—rennet or lactic acid; the temperature and humidity for ripening; the amount of salt and seasonings used; the amount of moisture retained; and the type of bacteria or mold used for ripening.

More than 400 varieties of hard, semihard, and soft cheeses are marketed, but American, Cheddar, cottage, cream, and process cheeses account for the bulk of the consumption in this country.

Cheddar cheese may be designated by the location of its manufacture: Wisconsin, New York, Oregon; or by the style of its package: daisy, longhorn, picnic. Cheeses with little curing are mild in flavor and less expensive; those cured for 6 months or longer are mellow to sharp in flavor. Good quality cheese has a smooth, waxy texture, uniform color, and a nutty, slightly acid flavor.

Cheeses that have been aged for 6 months or longer have better cooking qualities.

Process cheese consists of a blending of mild American cheese with other cheeses, followed by pasteurization. An emulsifying agent, such as disodium phosphate or sodium citrate, gives a smooth texture and keeps the fat from separating out. The process cheeses have a consistently uniform flavor and texture, and they keep well; they do not have the fine flavor of an aged Cheddar.

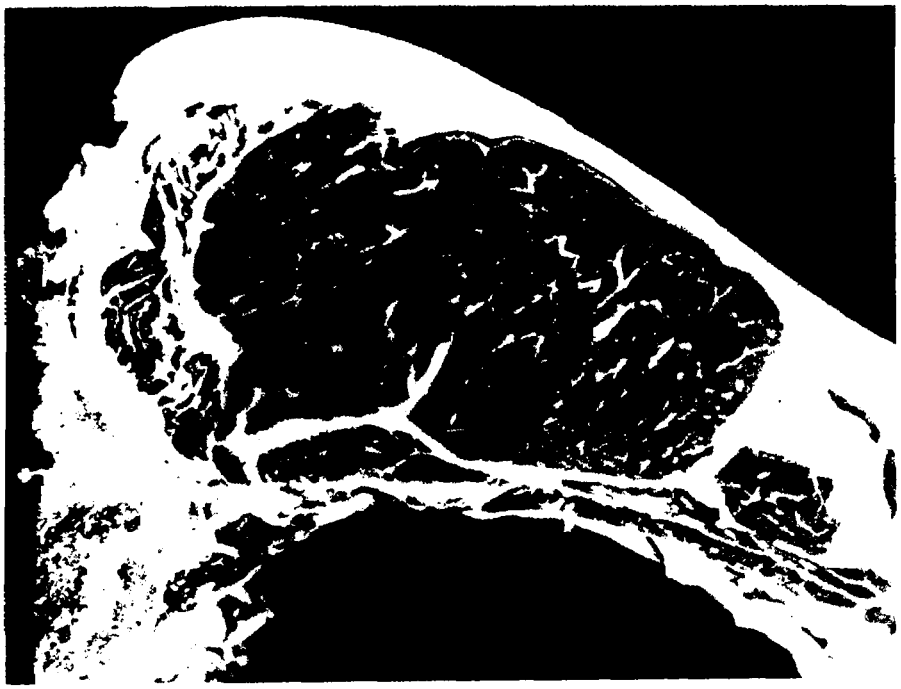
Purchase of milk and cheese. Whole milk purchased in half-gallon or gallon containers in supermarkets is less expensive than milk delivered to the door. Nonfat dry milk costs about one third as much as fresh milk, and its use for cooking can result in worthwhile savings. Many people find that mixing one part reconstituted nonfat milk with one part whole milk is highly acceptable. American, Cheddar, process, and cottage cheeses are economical buys. Among the expensive items in the dairy group are cream, ice cream, aged cheeses, and imported cheeses.

MEAT GROUP

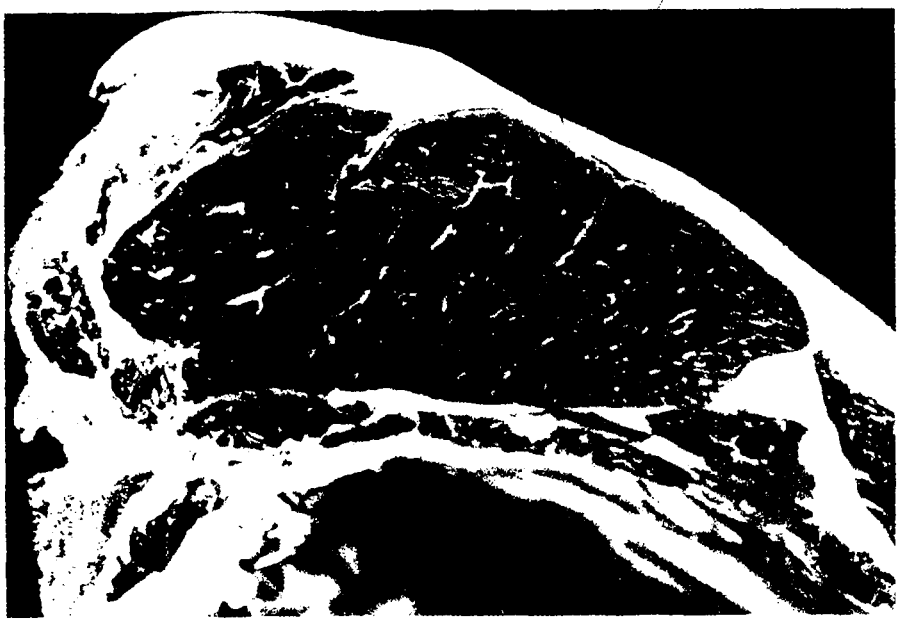
Quality of meat. Meat is selected for its tenderness, juiciness, and flavor. The tenderness of meat is dependent upon the (1) muscular development, (2) part of the animal or cut of meat, (3) age, and (4) amount and kind of connective tissue. Meat cut from resting muscles is more tender than the cuts taken from muscles constantly energized (the flank, for example). Some of the less tender cuts are rich in extractives and, if properly prepared, are both palatable and economical. The meat from cattle and poultry allowed to range is never as tender as that from animals which have been pen fed. The meat of old animals may be tough and stringy, while that of the young animal is tender. Mature animals as a rule show richer fat deposits than the very young animal. The process of ripening brings about enzymatic action which accomplishes chemical and physical changes so that the fibers are more tender.

The standards for various grades of meat established by the U.S. Department of Agriculture are based upon the amount of surface fat and marbling (fat interspersed among the muscle fibers), color, firmness of flesh, texture, and maturity. Prime beef, which is very tender and has a considerable amount of surface fat and generous marbling, is sold chiefly to hotels and restaurants. Many retail markets sell only one grade of meat—choice or good, depending upon location. These grades are less generously marbled with fat than prime meat, but they are juicy and flavorful. Standard beef has very little fat, is less tender, and juicy, but is quite rich in flavor. (See Figure 18–4.)

Table 18–1 shows the U.S. grades of various kinds of meat. No comparable grading standards have been set up by the government for pork



U.S. Choice



U.S. Good

FIG. 18–4. U.S. grades of beef. (*Courtesy, U.S. Department of Agriculture.*)

Table 18–1. Government Grades for Meat

Beef	Veal	Lamb
Prime	Prime	Prime
Choice	Choice	Choice
Good	Good	Good
Standard	Standard	——
Commercial	——	——
Utility	Utility	Utility
Cutter	Cull	Cull
Canner	——	——

Beef is the flesh of cattle over 1 year old. Good quality beef has a bright, cherry red color; a fine grain texture marbled with fat; solid creamy-white layers of fat surrounding the muscle bundles; and porous red bones.

Choice veal is the flesh of a calf 6 weeks to 3 months old. It has a fine grain texture; grayish pink color; clear, hard fat sparsely distributed; and porous red bones.

Lamb is the flesh of sheep 2 to 3 months old, but a well-fed animal may still be classed as lamb, rather than mutton, at 1 year. The flesh is firm and fine grained; pink in color; and the fat is firm, white, and flaky.

Pork includes the flesh of a suckling pig to a mature medium-size pig. Its flesh is fine and firm with a minute layer of fat coating the fibers; the color is grayish pink; the fat is smooth and white; and the bones are soft and tinged with red.

Poultry of best quality has these characteristics: flexible breastbone and well-fleshed breasts; short, fleshy legs; flexible wings which spring back into place when pulled out; fat well distributed but not abundant; dry, firm skin without cuts, tears, or bruises. The class of the bird may be designated as "broiler," "roaster," or "stewing hen."

Selection of meat for economy. Although meat is relatively more costly than some of the other foods, the homemaker can keep costs down by intelligent selection. Prime and choice grades are more expensive per pound than good and standard cuts; they also yield less lean edible portion per pound. When there is a choice of grades available, good or standard grades for many purposes will yield delicious dishes at considerable less cost than prime or choice grades. When comparing costs per pound, one must consider the number of lean, edible portions. For example, one pound of spare ribs will serve only two persons, while one pound of lean round steak will serve three to four.

The cut of meat chosen should be appropriate for a given preparation. The less tender cuts which require moist heat in preparation are less expensive than those cooked by dry heat, such as oven roasts, steaks, and chops. By using flavoring aids—including vegetables, spices, and herbs—many delicious dishes

may be prepared. Any good cookbook can be consulted for the best cuts to purchase for a given preparation. (See also Table 19–1.) The homemaker should learn to recognize the various cuts and be able to select them according to use in the menu. (See Figure 18–5.)

Expenditure for meat can be reduced if the selection is made according to market supply. Pork may be less costly at one time and beef at another. Poultry and fish have been good buys in recent years, although shellfish is a luxury item. If a freezer is available, it may be a good idea to purchase additional cuts when they are on sale.

The supply of meat may be stretched by using it in casseroles, stews, hearty soups, meat loaf, or creamed dishes. Main dishes using eggs, cheese, dry peas and beans, or peanut butter may be substituted occasionally for meat.

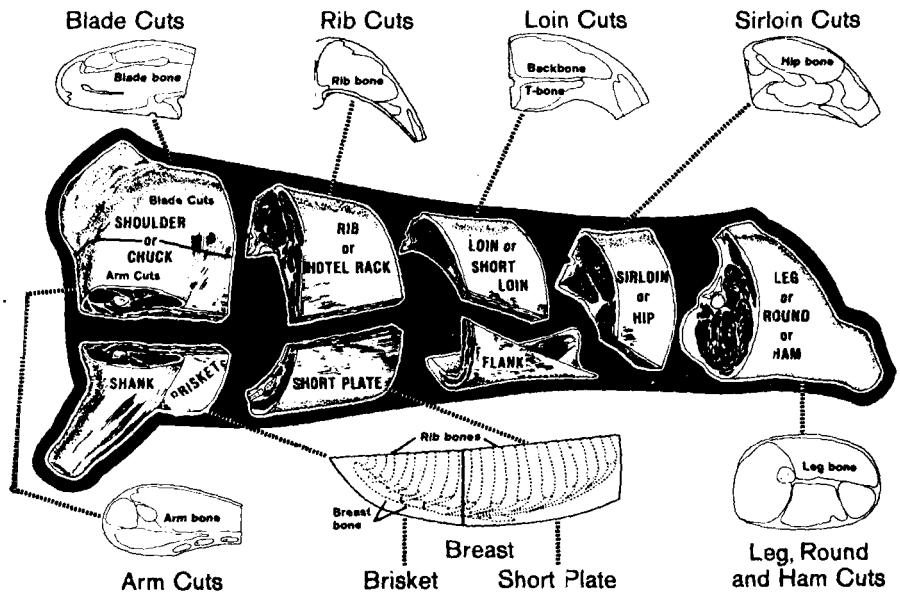


FIG. 18–5. Seven basic cuts of meat. This diagram may be used for beef, lamb, veal, or pork. (*Courtesy, National Live Stock and Meat Board, Chicago.*)

Quality of eggs. A strictly fresh egg has a thick, gelatinous white, a round, firm, upstanding yolk, and gives a delicate flavor. As the egg ages, the yolk and white become more watery so that the egg flattens out over a large surface when broken. Eggs may be graded as AA, the finest quality, new laid, especially good for poached or fried eggs where delicacy of flavor is desirable; A, of excellent quality for all table use and cooking; B, useful for all cooking and some table purposes; C, with thin whites and weakened yolks which break easily, but quite suitable for baking and cooking. (See Figure 18–6.)

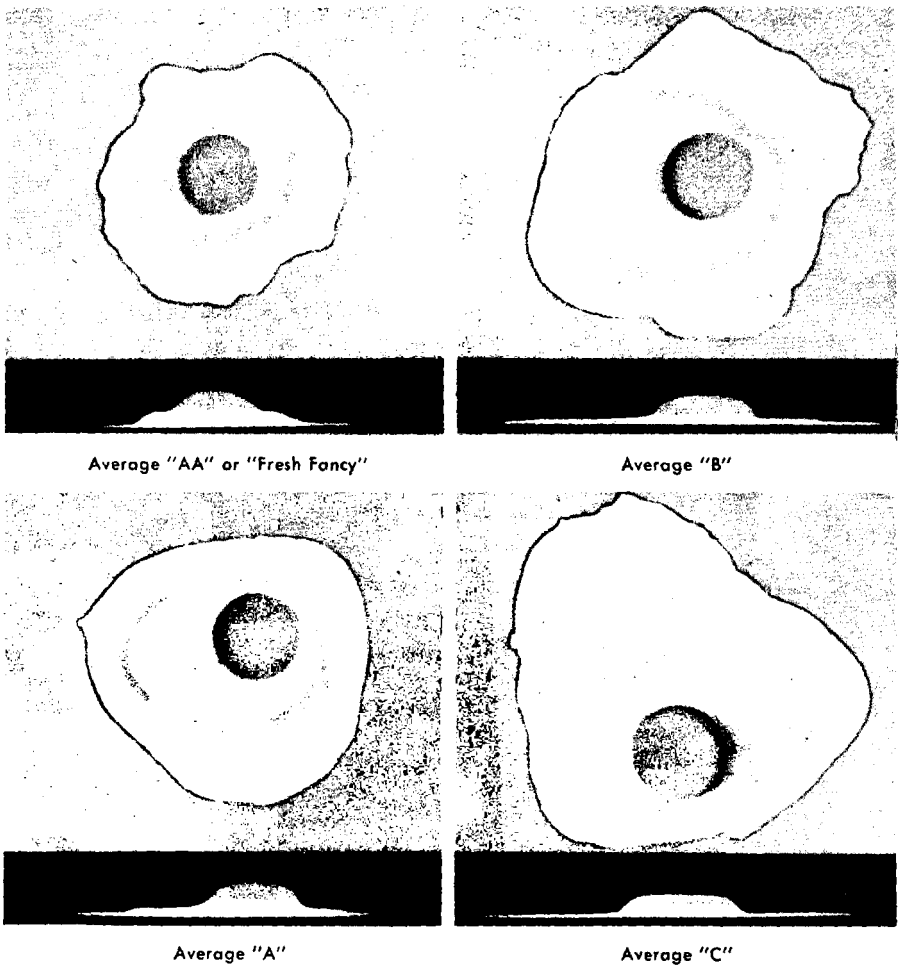


FIG. 18–6. Interior quality of eggs. Note round yolk and thick white of grades AA and A eggs; flat yolk and thin white which spreads out on plate of grades B and C eggs. (*Courtesy, U.S. Department of Agriculture.*)

Selection of eggs for economy. The price of eggs is related to the grade, size, and color. For each size the following minimum weights have been set up:

SIZE	MINIMUM WEIGHT PER DOZEN *ounces*
Jumbo	30
Extra large	27
Large	24
Medium	21
Small	18
Peewee or pullet	15

Small eggs are often a better buy in the fall, while large eggs may cost only a few cents more during the winter and spring months. To determine whether one size egg is a better buy than another, the prices should be compared on the basis of weight. For example, medium eggs cost at least ⅛ less than large eggs of the same grade; small eggs should cost at least ⅙ less than medium eggs, or ¼ less than large eggs. Suppose large eggs are selling for 64 cents a dozen, and medium eggs are 52 cents a dozen. The difference of 12 cents is more than ⅛ of 64 cents, and the medium eggs would be a better buy than the large eggs.

People in some communities prefer brown eggs (Boston, for example), while others prefer white eggs (New York and Philadelphia). The color of the shell has nothing to do with the nutritive values; so there is no merit in paying an additional amount for eggs of one color or another.

VEGETABLE-FRUIT GROUP

Quality of vegetables and fruits. Fresh, canned, frozen, and dehydrated vegetables and fruits provide a broad selection on a year-round basis.

Crisp, ripe, but not overmature vegetables that are firm in texture and free from blemishes should be selected. As vegetables become too mature, the lignocellulose which is formed gives the characteristic stringy or woody texture which cannot be overcome by cookery. Wilted vegetables are lower in carotene and ascorbic acid content than the crisp vegetables. Vegetables deteriorate rapidly in palatability and nutritive value unless proper storage facilities are provided.

Fruits improve in flavor and aroma with ripening. As the fruit ripens, there is an increase in the sugar content and the volatile flavoring compounds, and a decrease in the starch and organic acid. Unripe fruits lack flavor, and the sugar content will not have been fully developed. Some fruits such as peaches and pears bruise so easily that they are customarily picked before fully ripe. They should be allowed to ripen fully at room temperature before refrigeration.

Bananas are high in starch content when green. During the ripening at room temperature, this starch is changed to more digestible sugars. Bananas have the best flavor when the skin shows speckles of brown (not bruised or decayed spots). A tinge of green at the stem end of a banana is an indication that the fruit is not sufficiently ripe for use in its raw form.

Canned fruits and vegetables are usually sold by grade, using the grading of the U.S. Department of Agriculture or, more frequently, similar grade standards maintained by the manufacturer. Grade A products are of excellent quality, uniform in color and size of pieces, practically free of blemishes, and of the proper degree of maturity. When serving fruits or vegetables in a way where size and color are important, this grade is the preferable choice. Grade

B fruits and vegetables are of less uniform color and size of pieces, slightly less tender, and less free of defects. They are just as nutritious as grade A vegetables.

Commercially canned fruits and vegetables closely approximate cooked fresh products in their nutritive values since vacuum closure of the cans reduces the rate of oxidation. There is some unavoidable loss of ascorbic acid and thiamine.

The water-soluble nutrients distribute themselves in canned foods so that the concentration is about equal in the liquid and solid phases. Thus, if the contents are in the proportion of two-thirds solid and one-third liquid, two thirds of the vitamin C, for example, would be in the solids and one third in the liquid. If the liquid is not used, one third of the original vitamin C value would be lost. When vegetables are used, the liquid should be drained off first into a saucepan and reduced in volume by heating before the solids are added.

The consumption of frozen vegetables and fruits is expanding rapidly. The nutritive values of the frozen products are equal to the fresh foods; in fact, frozen fruits and vegetables that have been packed immediately after harvesting may be superior to fresh foods that have been improperly handled from farm to market to consumer. Frozen vegetables and fruits involve little time in food preparation. They require storage at 0° F, and thus a freezer or a separate freezing compartment in the refrigerator is essential if the foods are to be kept for more than a few days. When frozen foods are to be used within a week, it is satisfactory to keep them in the ice-cube section of the refrigerator. The consumer should select frozen foods only in markets which appear to use care in the display of these foods. If foods are stored above the freezing line indicated in the cabinet, or if frozen foods have thawed, they will lose some of the qualities of texture and may even spoil because of the growth of organisms.

Purchase of vegetables and fruits. Fresh fruits and vegetables locally grown and in season are usually less expensive. Apples, cabbage, and root vegetables in fall, citrus fruits in winter, and peaches, tomatoes, and melons in midsummer to fall represent examples of good buys. The cost of canned and frozen products should be compared with the fresh food in terms of edible portions per purchase unit. Fresh peas, for example, will yield about two servings per pound, and even in season are likely to be more expensive than frozen or canned peas.

Canned foods should be selected according to use. For service as dessert, peach halves may be preferred, but pieces will serve as well at less cost in a fruit cup or salad.

Fruits and vegetables are highly perishable, so that they should be used before deterioration takes place. The liberal use of these foods in their raw state ensures maximum nutritive values.

BREAD-CEREAL GROUP

Use of cereals in the diet. Wheat, rice, corn, oats, rye, and barley are the grains most commonly used for food. They are used for flours, of which bread is the single most important product, for breakfast cereals, for pastes, and a number of lesser purposes.

FLOUR. Wheat is superior to other flours in giving a light, porous quality to leavened products and is consequently the grain of first importance in this country. Two proteins in wheat provide for the development of a high gluten content when moisture is added. The elasticity of the gluten permits the ready expansion by gas and consequent lightness of the finished product. The development of gluten depends upon the extent of mixing and the amount and type of liquid used. Long mixing tends to toughen gluten and makes the leavening process more difficult. Gluten develops more quickly in a batter than in a dough. All-purpose flours find widest usefulness for the multiple purposes for which flour is used in the home.

The wheat flour used in the United States is usually a 70 per cent extraction; this means that 70 per cent of the grain, namely the endosperm, is used, while the bran and germ layers are discarded for animal feeds. Practically all of the flour sold in retail markets is now enriched.

The ancient civilizations of the Incas in Peru, the Mayas in Mexico, and the Indians of North America used corn or maize—a food unknown to the Spanish adventurers and the English colonists. Even today corn meal is widely used in the southern states where it is prominent in corn bread as well as in spoon bread and mush, while in the Southwest corn is used for the preparation of tortillas.

Rye and barley flours are used much more extensively in Europe than in America. These flours produce a heavier loaf of bread than that of wheat.

The flours of potato, soybean, oats, rice, banana, and taro find some usefulness in specialty products; they are a great help to the individual who is allergic to wheat.

KINDS OF BREAD. The Food and Drug Administration has established standards of identity for five kinds of bread: white, enriched, milk, raisin, and whole-wheat. Under these regulations specified levels of certain ingredients must be included for bread offered for interstate sale.[3] For numerous other breads on the market—potato, corn, wheat-and-soya, gluten, lysine-enriched and many others—no standards of identity have been developed. However, interstate trade requires that the ingredients of such breads be listed on the label in the order of the amounts used in the formula.

About 85 per cent of all white bread and rolls sold to the American public are enriched. The B vitamins and iron are included at levels to equal whole-wheat bread (see Figure 14–6).

Whole-wheat flour is the only flour that may be used in bread labeled as "whole wheat," "graham," or "entire wheat" bread. This bread accounts for only a small proportion of bread sold in America today. Nutritively speaking, whole-wheat and enriched breads are so similar that one can be guided by taste preferences and cost of the loaf in making one's selection. On the other hand, many people buy breads labeled as "cracked wheat," "wheaten," "wheat," and "rye" in the mistaken belief that they are made with the whole grain. These breads, in fact, are made with white flour and varying proportions of cracked wheat, whole-wheat, or rye flours, as the case may be.

Numerous specialty breads are available in bakeries and supermarkets. When a comparison of nutritive values is made, it is important to evaluate various breads in terms of the weight. On a weight-for-weight basis, the caloric value of white, rye, whole-wheat, protein, and other specialty breads is so similar that there is no need to consider them separately.[4] The use of soy flour, wheat germ, molasses, and other ingredients may increase the nutritive value of the loaf of bread, but how important these additions are depends upon the amounts used in the formula and the amounts contributed to the daily nutrient intake.

BREAKFAST CEREALS. Whether hot or cold, enriched or whole-grain, from wheat, corn, rice, or oats, cereals are a mainstay of the breakfast. They may vary widely in mineral and vitamin content according to the grain used and the minerals and vitamins added, but when one chooses to eat a variety of cereals, one can be certain of high nutritive contributions.

Not only do breakfast cereals find wide usefulness as a main food for breakfast, but they may also be used in place of part of the flour in quick breads and yeast breads, as an ingredient in many desserts, as extenders for main dishes such as meat loaf, and as crumb toppings for casserole dishes. Cereals may be served for lunch as well as for breakfast. Fried mush and Philadelphia scrapple are popular for lunch or even dinner.

While ready-to-serve cereals may be purchased in individual-serving-size packages, it is more economical to purchase the largest size package if the contents can be used in a reasonable length of time. During damp weather the crispness of the cereals may be restored by placing them in a shallow pan and heating them in the oven for a few minutes.

The uncooked oat and wheat cereals are usually more economical than ready-to-serve cereals. Almost all cereals are now of the quick-cooking variety and do not require long cooking periods even when they are to be used for infant feeding. This is made possible through the use of a harmless salt such as disodium phosphate which is added during manufacture in order to bring about quicker gelatinization of the starch. Instead of using a salt, some quick-cooking cereals have been finely divided during manufacture to hasten the cooking process.

PASTES. A special kind of hard wheat flour—durum—is used in the manufacture of an almost endless variety of pastes, known as *pasta* to the Italian.

Macaroni, spaghetti, and vermicelli will be most familiar to the reader. Noodles, which are made with egg, are also included with the pastes. These flour products are used in numerous dishes either as side dishes for the main meal or as a main dish when combined with cheese, meat, fish, or poultry.

RICE. About 95 per cent of the world's rice is grown in the Orient where it is the staple article of diet. Rice was first introduced into South Carolina in 1685 and has since become an important crop in Louisiana, Texas, Arkansas, and California.

White rice (polished) is preferred all over the world to the brown (unpolished) rice. Because it is a staple food for so many of the world's people, enrichment is a major goal in world nutrition. Rice may be enriched by coating the kernels with a mixture of the nutrients, in which case the rice should not be washed prior to cooking nor should an excessive amount of water be used so that the vitamins are dissolved out in water which is discarded. Another process has been developed whereby the rice is parboiled or steamed so that the thiamine is distributed throughout the kernel with only a slight loss taking place during washing and cooking. Precooked rice, now available in many markets, requires the addition of hot water and a short period of standing before it is ready to be served.

Wild rice is harvested in northern Minnesota and Wisconsin but is not a true rice. Although it is prized for its flavor and texture, it is so expensive that its use is limited to gourmet cookery.

OTHER FOODS

From Figure 18–3 it becomes evident that about one fourth of the food expenditure is for fats, sweets, beverages, and foods other than those included in the Four Food Groups. In the selection of fats, margarines are considerably less costly than butter. Hydrogenated fats, lard, and oils are suitable for cooking and frying. Of the oils, corn and cottonseed possess the advantages of being high in linoleic acid and inexpensive. Olive oil, prized for its fine flavor, is not a good source of linoleic acid and its cost is greater than that of other oils. Safflower and sesame seed oils are presently more expensive, although they are excellent sources of linoleic acid.

Cane and beet sugars, corn syrup, and corn sugar are inexpensive sources of calories. When sugar is colored, as for cookie decoration, or when it is mixed with cinnamon in shakers, the cost increases greatly; such modifications are easily accomplished within the home. Confectioners and brown sugars are slightly more expensive than granulated sugar. Honey, maple syrup, maple sugar, candies, and cake icings are among the more costly items in the sweets category.

Coffee, tea, cocoa, and carbonated beverages are included in the budget allotment for beverages. It goes without saying that a high consumption of

carbonated beverages adds greatly to the grocery bill while yielding no nutritional values other than calories.

Spices, herbs, pickles, and relishes add interest and variety to meals. Some preserves, pickles, and relishes, however, are expensive. Fancy cookies, cakes, pretzels, and many tempting snack items should have but a limited place in the budget lest they crowd out more nutritious foods.

PROBLEMS AND REVIEW

1. Prepare a chart that shows the kinds of milk available in a supermarket near your home. Include the following information: size of container; price; principal characteristics of each kind. Write a summary of your study.
2. *Problem.* Assuming that a given family requires 3 quarts of milk per day, calculate the cost of milk for one month, using current prices and purchasing the milk in these ways: (1) as fresh, grade-A homogenized milk; (2) as fresh milk for half of the supply and nonfat dry milk equivalent to half of the supply.
3. Determine the kinds of cheeses available in your market. Have you tasted all of these at one time or another? What are their characteristics?
4. What factors determine the grading of eggs? What changes occur in eggs with age?
5. Obtain the prices of various grades and sizes of eggs in local markets and discuss the relative economy of each.
6. List the factors that determine the quality of meat.
7. Why are not all so-called cheap cuts of meat economical?
8. *Problem.* Complete the following table:

	Cost per pound	Protein per Pound as Purchased, Grams	Cost per 100 Grams Protein
Lamb chop		83	
Lamb neck		66	
Pork shoulder		59	
Pork loin chop		70	
Beef rib roast		69	
Beef round		88	
Frankfurter		65	
Frying chicken		69	

9. *Problem.* Calculate the cost of 25 mg ascorbic acid from each of five fresh fruits available in your market.
10. *Problem.* Compare the cost of three brands of canned peaches, canned peas, canned tomatoes. Note labeling information concerning grade. How do you account for the differences?
11. *Problem.* Calculate the number of servings of each of the following cereals you can purchase for 10 cents: oatmeal, puffed wheat, corn flakes, enriched farina, bran flakes. Assume 1 ounce for each serving.
12. Give three examples of whole-grain cereals, refined cereals, enriched cereals.
13. Evaluate five kinds of bread available in your market by comparing label information and cost.

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Chapter 19

BASIC PRINCIPLES AND PRACTICES IN FOOD PREPARATION

Importance of quality standards in food preparation. The nutrition of the individual is profoundly influenced by the quality of the food preparation. Highly nutritious foods can be seriously reduced in nutritive values, most especially in the levels of soluble vitamins, when improper methods of preparation are used. When the food resources of a family or of a community are limited, such losses can be of major consequence. Good cookery encourages high acceptance of food, while poor cookery leads to excessive plate waste. Many a vegetable, rich in minerals and vitamins, has been left on the plate because it was neglected or abused in its preparation. Generally speaking, food preparation that leads to the highest level of acceptability is also characterized by the highest level of nutrient retention.

The manufacture and home preparation of food are based upon a highly complex food science, which has involved the knowledge and skills of the chemist, biologist, food technologist, and dietitian. Nevertheless, preparation within the home can be efficient and satisfying if a few basic rules are remembered. The principles of preparation are based upon the physical and chemical characteristics of the various food groups, which range from those foods high in sugars, starches, and cellulose to those high in proteins and fats. The environmental factors must be considered, such as heat, light, air, water, and the particular combinations of ingredients used in preparation.

Food preparation is much more than a science. It is an art for it is linked with the total cultural pattern of people. Food preparation requires a sense of discrimination in the blending of flavors, as well as of textures, colors, and shapes. Food preparation, like any skill, requires a considerable amount of practice in order to achieve a high quality of product with efficient use of time, money, and materials.

Methods of cookery. Foods may be cooked by moist heat, by dry heat, or by frying. Cookery by moist heat includes boiling, stewing, braising, and steaming.

Boiling is cooking in water at 212° F or 100° C. The bubbles break rapidly on the surface of the water.

Simmering is cooking at a temperature below the boiling point—approximately 200° F or 93° C. The bubbles of steam rise slowly to the surface of the vessel.

Stewing is cooking for a long time at about 200° F. It is used for less tender cuts of meat. The liquid is sometimes thickened.

Braising is cooking over direct heat or in an oven in a small amount of liquid at a low temperature with the pan tightly covered.

Steaming is cooking by the heat of direct steam or in a steam-jacketed vessel such as a double boiler or bain-marie. The pressure cooker employs increased pressure of steam, thus raising the temperature and shortening the cooking time.

Cooking by dry heat includes broiling, pan broiling, baking, and roasting.

Broiling is cooking by direct heat from a gas flame, electric wires, or live coals. It is usually used for tender cuts of meat, and the temperature is high enough quickly to sear the surface.

Pan broiling is cooking in a hot metal pan on the top of the stove with just enough fat to keep the food from sticking; fat is poured off as it accumulates.

Baking is cooking in an oven using an open or covered pan. The oven *roasting* of meats is really a baking process. The most commonly used oven temperatures are as follows:

Slow = 250° to 350° F
Moderate = 350° to 400° F
Hot = 400° to 450° F
Very hot = 450° to 500° F

Frying is cooking by immersion in hot fat at 350° to 400° F.

Sautéing is cooking in a small amount of fat in a frying pan, the food being turned frequently.

Fricasseeing is cooking in a small amount of fat and then serving with a sauce.

Although electronic ovens are not part of the kitchen equipment in most homes, microwave cooking is gradually gaining in popularity because of the dramatic reductions in cooking time which is one half to one tenth that needed by conventional methods. The food to be cooked is placed in an electronic oven where it is exposed to the penetration of microwaves produced by a magnetron tube. The absorbed microwaves cause agitation of molecules within the food so that heat is generated. Foods are cooked in china, pyrex, ceramic, or paper dishes since these materials permit the microwaves to pass through to be absorbed by the food. Metal utensils are not used since they reflect the microwaves and cause damage to the magnetron.

Only small quantities of food may be cooked at one time. One important disadvantage of microwave cookery is that foods do not brown. Meats, especially, are an unattractive gray color unless subsequently browned. Cakes must be carefully watched since there is a tendency to overbake them, thus resulting in a dry product. The flavor, color, and nutritive values of vegetables compare favorably with other methods of cooking.

EFFECTS OF COOKERY UPON FOOD QUALITIES

Some raw foods, especially fruits and vegetables are delightful and necessary constituents of the daily diet. Nevertheless, most foods must be cooked to make them acceptable for human beings.

Digestibility. One of the most important reasons for cooking food is to enhance the digestibility. Cooking softens the connective tissue of meat and the coarse fibers of fruits and vegetables so that the digestive period is shortened and the gastrointestinal tract is less subject to irritation. Cooking also bursts the starch granule of vegetables and cereals so that starch digestion is more rapid and complete.

Microbiologic changes. The cooking of food is important to destroy microorganisms and parasites that may be present, but the limitation of cookery should also be recognized. The safety of pork, often infested with Trichinella, is assured only when the meat is cooked until no tinge of pink remains in the meat. Some foods are not cooked at sufficiently high temperatures to destroy all microorganisms, or the toxins produced by them, and illness could result. Thus, cooking of food should never be used as an excuse for poor practices in food handling prior to cookery.

Enzymatic effects. All plant and animal cells contain enzymes which are released when the cell walls are ruptured as in peeling, cutting, chopping, or grinding food. Subsequently, rapid changes take place in the physical and chemical qualities of the food. Since enzymes are protein in nature, they will be inactivated when the protein is denatured by heating. The activity of enzymes may be retarded with an increase in the acidity of the food mixture. For example, because of enzyme action, peaches darken rapidly when they are sliced and exposed to the air; however, if the peaches are cooked, no such darkening takes place because the enzymes have been inactivated. If some ascorbic acid or lemon juice is sprinkled over the raw peach slices, darkening can be delayed.

Color changes. Foods undergo many color changes during cookery, some of which enhance the desirability of the product while others do not. The color of vegetables and fruits especially is influenced by the pH of the cooking medium. The green pigments in plants change to an olive green and finally brown if subjected to long cooking, especially in an acid medium. If the water is slightly alkaline, the green color is maintained, hence the practice by some

of adding a pinch of baking soda to the cooking water for green vegetables. Unfortunately, such addition of alkali is destructive of vitamin C and thiamine, and also results in a product that tends to be mushy.

Some authorities advocate that vegetables containing chlorophyll be cooked in an uncovered saucepan for better color, while others leave the pan uncovered for the first few minutes of cooking. Some white vegetables such as cauliflower, onions, potatoes, become yellow if cooked in water that is alkaline but remain white if a small amount of an acid (cream of tartar) is added.

Red pigments as in fruits—strawberries, plums, raspberries—bleach out into the cooking fluid, and the food itself sometimes appears pale. The color remains red in a slightly acid medium but turns blue in an alkaline medium. The vinegar in pickled beets or with red cabbage helps to retain the attractive red color.

The red color of meat changes to pink, gray, or brown upon exposure to heat. Beef is the only meat served with tinges of red, varying from the bright red of rare beef to the faint pink of fairly well-done meat. Veal, pork, and chicken are cooked until well done with the color being gray to white.

The attractive brown crusts of breads and cakes results from the linkage of certain amino acids in the flour with a sugar when subjected to high heat. This is referred to as the browning reaction. The brown color is also achieved in part by the dextrinization of starch on the surface of the food.

Texture changes. The texture of foods is importantly modified in food preparation. If meat needs to be chewed a great deal before it is swallowed, it is said to be tough. Since proteins become tough when cooked too long or at too high temperatures, it is apparent that the texture would be adversely affected. Meats that contain much connective tissue are tough when cooked by dry heat, but they will be tender if cooked with moist heat. The marination of meat with vinegar, wine, tomato juice, or French dressing prior to cooking has a tenderizing effect upon the meat and connective tissue fibers, and is often recommended for less tender cuts of meat.

The texture of cereals, fruits, and vegetables is related to the structural fibers. The cellulose is quickly softened by cooking, and some cellulose, in fact, may disintegrate. However, in the case of vegetables no amount of cooking will result in a tender product if the vegetable was overmature when prepared for cooking.

Protein denaturation. Perhaps you have seen a notation on the menu card in some restaurants which states that the tenderness of a steak cannot be guaranteed if it is cooked to the "well done" stage. Such a statement illustrates the principle of protein cookery. Proteins coagulate at relatively low cooking temperatures and are toughened when the temperature is too high or the time is prolonged. Thus, directions for the preparing of protein dishes usually specify "moderately low oven temperature," "cook in a double boiler," "cook at simmering, not boiling temperature," as the case may be. Coagulation of proteins occurs at a lower temperature when salt or acid is added to the food.

The temperature at which coagulation occurs is increased in the presence of sugar.

Starch gelatinization is the important action in cereal cookery. When starch is heated in water, there is rapid penetration of the starch granule with water. Since large quantities of water are enmeshed, the effect is thickening. Maximum gelatinization occurs only at boiling temperatures. Slow stirring as gelatinization is taking place helps to prevent lumping. However, excessive mechanical agitation can cause rupture of the starch granules so that the mixture becomes sticky.

The ability of starch to absorb water is seen in the large increase in volume of oatmeal, rice, macaroni, noodles, and spaghetti when they are cooked. Likewise, a small amount of cornstarch or somewhat larger amounts of flour have great thickening power for the preparation of puddings.

Vitamin retention. Carotenes in vegetables and vitamin A in eggs, milk, and organ meats are not adversely affected by the cookery of foods. Ascorbic acid and thiamine are the vitamins most readily destroyed by cooking procedures. Therefore, if attention is given to the preservation of these nutritive values, there is assurance that other vitamins are also retained.

MEAT. Extensive research has been carried on to determine the effect of cooking meat by various methods. Braising and stewing resulted in greater losses of all the B vitamins than did broiling, roasting, and pan frying. This is explained in part by the solubility of these vitamins in water and emphasizes the necessity for using liquids and drippings from meat cookery in either gravies, sauces, or soups. Losses were much higher in the instance of thiamine than they were for riboflavin and niacin. In the latter vitamins the losses could be explained almost entirely on the basis of extraction into drippings.

When meats were roasted or broiled they retained 65 and 70 per cent of the thiamine, respectively; pan-fried meats still contained 90 per cent of the initial thiamine. On the other hand, stewed meats retained only 25 per cent of the thiamine, while an additional 25 per cent was present in the liquid. (See Figure 19–1.)

VEGETABLES. As much as 90 per cent of the ascorbic acid is retained if a vegetable such as cabbage is cooked in a small amount of water for the proper length of time. If a vegetable is cooked in a large amount of water, as little as 50 per cent of the vitamin will be retained.

Potatoes baked in the skin retain practically all of the ascorbic acid and lose only small amounts when boiled in their skins. When they are mashed, about 50 per cent of the vitamin has been lost.

COOKERY OF PROTEIN FOODS

Milk. When milk is heated some of the lactalbumin sticks to the bottom and sides of the pan so that scorching occurs readily. A scum forms on the surface of the heated milk which makes it difficult for steam to escape and

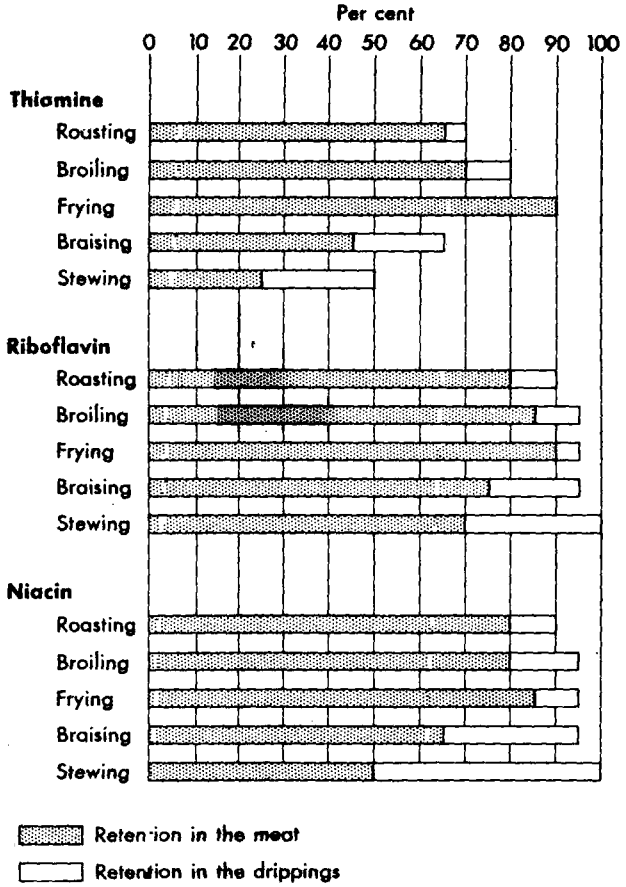
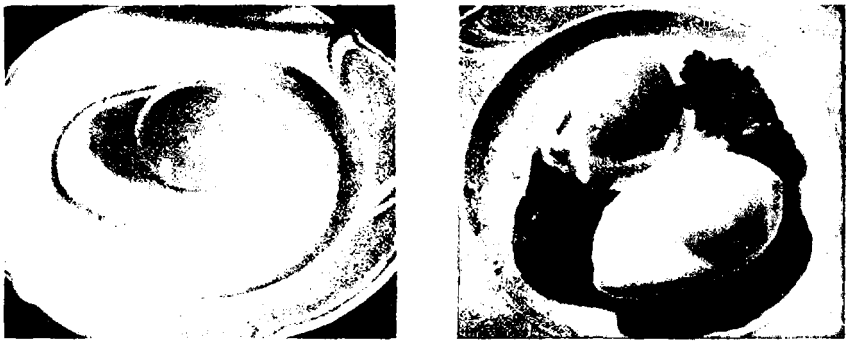


FIG. 19–1. Vitamin retention in cooking meat by various methods. (*Courtesy, National Live Stock and Meat Board, Chicago.*)

causes milk to boil over easily. These problems can be reduced by stirring milk while it is heating or by heating it in a double boiler.

Cheese. Cheese softens and melts at low temperatures but rapidly becomes rubbery and stringy when it is cooked too long or at too high a temperature. The fat tends to separate out from the other constituents. The use of sauces or a mixture of cheese with other ingredients reduces the tendency to stringiness and the separation of fat. Processed cheese blends well with other ingredients and is less likely to be stringy and tough.

Eggs. Egg white is largely composed of albumen which begins to coagulate at 140° F (changes from the raw state to a tender jellylike substance) and solidifies at a temperature of 147 to 149° F. When the temperature is increased to the boiling point (212° F), the albumen becomes tough and unpalatable. The yolk of the egg coagulates at a slightly higher temperature than the white. (See Figure 19–2).



A B

FIG. 19–2. (*A*) Egg of best quality. Note round upstanding yolk, thick white, and small area covered. (*B*) Eggs of best quality poach well. (*Courtesy, the Poultry and Egg National Board, Chicago.*)

Salt and dilute acid such as vinegar hasten coagulation, and one or the other is sometimes added to water in which eggs are poached. The presence of sugar, as in custards, elevates the coagulation temperature somewhat and is thus favorable in helping to avoid curdling.

A simmering temperature should be used for soft-cooked, hard-cooked, and poached eggs. A slow oven should be used for baked custards and soufflés. It is helpful to place such dishes in a pan of hot water rather than to set them directly on the oven shelf. A double boiler is essential in the preparation of soft custards. Overcooking in all instances must be avoided, since it results in toughening of the product and also in curdling, as in scrambled eggs and custards.

Meat. The proteins of muscle fibers are coagulated by heat at temperatures much below the boiling point of water; boiling toughens albumin and hardens the globulin.

The proteins of connective tissue are insoluble and are of two kinds, collagen and elastin. Collagen is the chief constituent of white connective tissue which binds the muscle fibers to each other and to the bones. It is changed to gelatin when subjected to moist heat for a prolonged cooking time but is hardened by dry heat. The change from collagen to gelatin may be hastened by the use of acid; thus, tomato juice as in the preparation of Swiss steak, or vinegar, sometimes used in the marination of meat, helps to give a more tender product in a shorter cooking time.

Elastin, the main component of yellow connective tissue found in the ligaments, walls of the blood vessels, and between the muscle fibers, is not affected by moist heat but is hardened by dry heat.

The length of cooking time is dependent upon the amount of connective tissue present and the toughness of the muscle fiber. Tender cuts of meat require only a short cooking time, but less tender cuts with much connective tissue require longer cookery. Fish contains such a small amount of connective tissue that the cooking time is very short.

Table 19–1. Methods of Cookery for Various Cuts of Meat

	Dry Heat		Moist Heat	
Type	*Broiling*	*Roasting*	*Braising*	*In Liquid*
Beef	Steaks	Loaf	Brisket	(Large cuts and
	club	Rib	Plate	stews)
	hamburg	rolled	Pot roast	Brisket
	loin tip	standing	Shank	Corned beef
	porterhouse	Rump	Short ribs	Flank
	rib		Steaks	Heel of round
	sirloin		arm	Neck
	T-bone		blade	Plate
	tenderloin		flank	Shank
	top round		round	Short ribs
				Stew meat
Veal	Too lean for	Leg	Breast	Breast
	broiling	Loaf	Chops	Flank
		Loin	rib	Heel of round
		Rack	loin	Neck
		Shoulder, bone in	Cubes	Riblets
		or rolled	Steaks	Shank
				Shoulder
				Stew meat
Lamb	Chops	Leg	Breast	Breast
	loin	Loaf	Chops, shoulder	Flank
	rib	Shoulder, bone in	Neck slices	Neck
	shoulder	or rolled	Shank	Riblets
	sirloin			Shank
	Patties			Stew meat
	Steaks			
Pork	Bacon	Boston butt	Chops	Smoked:
	Canadian bacon	Loin	Hocks	ham
	Ham slice	Sirloin	Shoulder steaks	picnic ham
	Smoked shoulder	Spareribs	Spareribs	shank
	slice	Ham, fresh or smoked	Tenderloin	shoulder butt
	Fresh pork should	Picnic ham, fresh		
	not be broiled	or smoked		
		Ham loaf		
Variety	Brains		Brains	Brains
	Kidneys		Heart	Heart
	Liver, lamb or veal		Kidney	Kidney
	Sweetbreads		Liver	Sweetbreads
			Sweetbreads	Tongue

Cooking tender cuts of meat. Roasting, broiling, pan broiling, or frying are used for tender cuts of meat. (See Table 19–1.) A low temperature used throughout the cooking period results in less shrinkage, more juiciness, more attractive appearance, and greater tenderness. Searing is not only unnecessary, but it is undesirable.

ROASTING. Large tender cuts of beef, veal, pork, or lamb are roasted in an uncovered pan with a rack to permit circulation of heat around the meat. The fat side is placed up so that the meat bastes itself. No water is used. The meat may be seasoned with salt and pepper at the beginning of the roasting or later, since salt penetrates only to a depth of about ½ inch. An oven temperature of 300° F is used for all meats except pork which requires a temperature of 350° F. Pork must be cooked so thoroughly that no tinge of pink remains in the meat itself or along the bone. A meat thermometer inserted into the center of the thickest muscle of the roast is the only reliable guide.

BROILING is used for tender chops, steaks, meat patties, ham slices, fish, or poultry. The meat is placed 2 or 3 inches away from the heat and is broiled until the top surface is browned. Thick pieces of meat and poultry are placed further from the heat so that the surface will not become dried out before the center is cooked. Salt and pepper are added to the browned surface of the meat just before turning; to add salt at the beginning would extract considerable amounts of juices and thus retard browning and detract from flavor. If fish, liver, and veal are broiled, they should be brushed with butter, margarine, or oil to prevent dryness.

In *pan broiling* the meat should be cooked without the addition of fat in a heavy uncovered pan. The meat is turned occasionally as it browns. Fat is poured off as it accumulates; otherwise the meat would be fried rather than broiled.

Cooking less tender cuts of meat. Braising, simmering, or stewing are used for less tender cuts of meat. (See Table 19–1.) Long, slow cooking in the presence of moisture is necessary to soften the collagen and convert it to gelatin. Braising is also recommended for liver, and steaks and chops of pork and veal. The meat may be dredged with flour or coated with egg and crumbs, if desired. It is browned in fat, after which liquid is added with salt, pepper, herbs, spices, and vegetables, depending upon the dish which is being prepared. The meat may be cut in small pieces to increase the surface area and to give a highly flavored broth. The flavor is further developed by long, slow cooking over a flame or in an oven. (See Figure 19–3.)

PREPARATION AND COOKERY OF VEGETABLES

Principles of cookery. The cooking of vegetables softens the cellulose and breaks the starch cells so that the carbohydrates are more accessible to the starch-splitting enzymes. The flavor and palatability of many vegetables are improved by cooking. Properly cooked vegetables should be tender yet firm and crisp, rather than hard and tough or soft and soggy. Some color change in green vegetables is unavoidable because heat decomposes the chlorophyll, but this can be kept to a minimum if overcooking is avoided.



FIG. 19–3. Moist heat, as in the preparation of a stew, is used for less tender cuts of meat. With fresh vegetables, such a dinner meal is delicious. (*Courtesy, United Fresh Fruit and Vegetable Association.*)

The carotene of vegetables is not affected by cooking procedures. On the other hand, the manner of cookery can importantly influence the contribution which vegetables make to the dietary level of water-soluble minerals and water-soluble, heat-labile vitamins. Thiamine and ascorbic acid are extremely soluble in water, while riboflavin and niacin are much less so. Vitamin and mineral losses through solubility can be materially lessened by (1) keeping pieces as large as practical in order to avoid excessive surface exposure, (2) cooking with skins on whenever possible, (3) avoiding long soaking in water which is later discarded, (4) using a minimum quantity of water in cookery, and (5) saving water in which vegetables were cooked or canned for use in soups, sauces, or gravies.

Goodly amounts of vitamins and minerals are lost when peelings and skins are discarded, since vitamins and minerals occur in greatest concentration near the skin. Moreover, the exposure to air hastens oxidation, with the result that dicing in small pieces, chopping, grinding, and stirring during cookery greatly hastens destruction.

Some destruction of vitamins during cookery is unavoidable, but this can be kept at a minimum. The water in which vegetables are cooked should be

rapidly boiling before vegetables are added and should be quickly brought to the boiling point again. This facilitates prompt destruction of enzymes which may oxidize the vitamins. Continuous boiling rather than simmering is most effective in giving a tender product in the shortest length of time. This does not mean that excessively high heat, with consequent rapid escape of steam and danger of scorching, is necessary. For most vegetables a tightly covered pot, using a minimum quantity of water, is desirable. Even such strongly flavored vegetables as cabbage may be cooked in this way.

The use of baking soda to retain color and shorten cooking time is destructive of water-soluble vitamins and also modifies flavor if used in excessive amounts. Recent studies indicate that alkali in properly controlled amounts may not be as harmful as formerly believed, and that the decreased loss of vitamins through the shortened cooking time may more than compensate for the destruction effected by the alkali itself. Further studies in this direction will no doubt clarify details of effective procedure.

Methods used for cooking vegetables. Boiling, steaming, and baking are the most commonly used methods of cooking vegetables.

1. BOILING. Many vegetables such as string beans, turnip and mustard greens, spinach, carrots, and green peas may be cooked in a covered vessel with a small amount of water to preserve the flavor, reduce nutrient losses, and keep oxidation at a minimum. Washed greens require no additional water.

2. STEAMING. Spinach, chard, broccoli, and asparagus are especially adapted to this method. A basket to hold the vegetables is placed over a pan of rapidly boiling water. The vessel is tightly closed, thus permitting steam to circulate around the vegetables. Although vegetables retain their shape and nutritive values very well, the cooking time is much longer than by boiling.

3. PRESSURE COOKER. For preservation of flavor, color, and nutritive value the use of a pressure cooker is good. However, the cooking time must be carefully controlled, and the instructions of the manufacturer should be followed carefully since the cooking time is materially shortened and overcooking can readily occur.

4. BAKING, with or without removing the skin. This method retains the nutrients which lie close to the skin, if the vegetables are not pared. Potatoes, eggplant, and squash are well suited to baking.

5. SAUTÉING. Eggplant, green or ripe tomatoes, and cucumbers are cooked to advantage with this method. The slices of vegetable are rolled in crumbs and browned in small amounts of fat. They should be drained to remove excess grease.

6. BROILING. Vegetables may be cooked under an open flame for a short time at high temperature. Tomatoes lend themselves well to broiling.

7. PANNING consists in cooking vegetables in a heavy covered frying pan with a small amount of fat. Finely shredded cabbage, kale, collards, and sliced summer squashes are especially delicious when cooked by this method.

COOKERY OF CEREALS AND PASTES

Cereals. Breakfast cereals are cooked with just enough water to give a smooth, thick consistency. Disodium phosphate added to quick-cooking cereals during manufacture enhances the ability of the granule to take up water and hence the cooking time is reduced. Fine-grain cereals require less cooking time than those of coarser texture.

The dry cereal should be added slowly to rapidly boiling salted water so that boiling does not stop. If very fine cereals are to be cooked, lumping can be avoided by mixing the cereal with a small amount of cold water before adding it to the boiling liquid. It is necessary to stir constantly while cooking over direct heat; however, quick-cooking cereals require cooking for only a few minutes. Well-cooked breakfast cereal is free from lumps, neither too thick nor too thin, and full-flavored.

Rice is preferably cooked with just enough water so that all the water will be absorbed—usually 2 to 2½ times the volume of rice. A minimum of stirring yields fluffy whole grains which remain separated rather than becoming stuck together.

Various paste products—macaroni, spaghetti, noodles—are cooked in a large volume of water until just tender. They need not be fully cooked when they are to be used in dishes requiring further heating. Excessive cooking results in a pasty, gummy, sticky product.

PROBLEMS AND REVIEW

1. What are the effects of each of the following practices in food preparation? (Also indicate which practices are desirable.)
   a. Marinating meat in wine, oil, and herbs for 24 hours.
   b. Adding a little vinegar to the water in which beets are cooked.
   c. Adding a tiny pinch of baking soda to the water in which green beans are cooked.
   d. Adding salt to water before poaching eggs.
   e. Boiling eggs.
   f. Searing a roast at 500° F and then turning heat down to 350° F to complete the roasting.
2. What precautions are necessary to avoid a heavy cheese soufflé with a curdled appearance; a grilled cheese sandwich with a rubbery texture?
3. State the principles that are essential to obtain a baked custard with a smooth velvety texture.
4. *Problem.* List five ways in which each of the following vegetables could be prepared: carrots, cabbage, tomatoes.
5. *Problem.* Outline the steps in the preparation of the following meal so that maximum nutritive values would be retained: pot roast with potatoes, carrots, onions; tossed green salad; baked custard with fresh peach slices. List the principles of cookery involved in this meal preparation.
6. Why is a home-prepared cole slaw likely to be a good source of ascorbic acid, while a commercially prepared one is unreliable for vitamin C?
7. What is meant by denaturation, coagulation, dextrinization, gelatinization, sauteing, simmering?

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UNIT V

Safeguarding the Food Supply

Chapter

20 PRESERVATION AND SANITARY HANDLING OF THE FOOD SUPPLY

21 CONTROLS FOR THE SAFETY AND NUTRITIVE VALUE OF THE FOOD SUPPLY

Chapter 20

PRESERVATION AND SANITARY HANDLING OF THE FOOD SUPPLY

ILLNESS CAUSED BY FOOD

The ancient Egyptians realized that meat of animals that had died a natural death was unfit for human food. Greek records of many centuries ago note that the wife, daughter, and two sons of the Greek poet Euripides died after having eaten poisonous fungi by mistake. For centuries official food tasters were employed to protect kings against poisoning. That an adequate supply of food of high nutritive value is essential for health and well-being of man has been established. It is equally well recognized that food may be an occasional cause of disease.

When one considers the total population of the United States and the amount and variety of foods consumed each day, it becomes evident that the incidence of outbreaks of illness from the food supply as reported to public health authorities is indeed very low. The fact remains, however, that hundreds of thousands of persons annually contract gastrointestinal upsets which last for a day or two and which cause discomfort and absenteeism from work. Many of these outbreaks can be traced to unsanitary practices of food handling in public eating places or in the home. Food handlers from the field to the factory and retail store share the responsibility for a clean, safe, and nutritious food supply.

Illness resulting from the eating of food may be caused by bacterial contamination or parasitic infestation of the food, by the presence of some poisonous chemical in the food, or by sensitivity of the individual to a given food or foods. Only bacterial, parasitic, or chemical contamination will be discussed in this chapter.

Diseases transmitted by foods. Typhoid fever, dysentery, tuberculosis, diphtheria, streptococcic sore throat, and undulant fever are some of the diseases which may be transmitted by contaminated foods and water. Such diseases may result from the ingestion of meat or milk from infected animals or from drinking contaminated water. Because of stringent regulations for the

inspection of animals, pasteurization of milk, and safeguarding of the water supply, these diseases have occurred only rarely in recent years in the United States.

The eating of food contaminated by bacteria carried by insects, flies, roaches, rodents, or food handlers is still a frequent cause of food poisoning. The illness affects the gastrointestinal tract with the usual symptoms being one or more of these: nausea, vomiting, cramps, diarrhea, fever, headache, and sometimes prostration.

BACTERIAL FOOD POISONING includes infections and true poisonings that result from the toxins produced by the bacteria. If the bacteria are present in the food in large numbers, a true infection occurs in the intestine; the bacteria continue to grow in the favorable intestinal environment, with symptoms occurring in 12 to 36 hours after ingestion of the food.

The *Salmonella* group, which includes many species of bacteria, are a common cause of infection. They are present in many animal feeds, in the flesh of animals, in eggs, and may be transmitted by careless food handlers. Poultry, prepared meats, mixes containing dried eggs, and custard-filled bakery products have frequently been found to harbor the bacteria.

Dried eggs are the composite of many broken eggs, a few of which may be contaminated by salmonella. Because of the high incidence of salmonella infections traced to them, it is recommended that foods containing dried eggs be thoroughly cooked in an oven. Cookery in a double boiler or surface unit cookery, as for scrambled eggs, does not provide sufficiently high temperatures to destroy the bacteria.

Clostridium perfringens, the gas gangrene organism, is responsible each year for numerous outbreaks of gastroenteritis.[1] The organism ordinarily inhabits the intestinal tract and in usual numbers does not produce illness; however, when a food is consumed which also has large numbers of the bacteria, illness results.

Cl. perfringens will increase a thousandfold in 3 hours at 90 to 120° F. The spores may survive boiling water for as long as 5 hours; thus, cooked food will not be free of the organism. Although the spores are harmless, every effort should be taken to prevent their germination by maintaining high temperatures for foods that are to be served hot, and by promptly chilling cooked foods that are to be served cold. Oftentimes, foods that are served hot are in fact at just the right temperature for rapid germination of the spores. Likewise, the interior of a large food mass placed in the refrigerator may not reach cold temperatures for several hours, during which time rapid growth has also taken place.

Staphylococci are probably responsible for more food poisoning annually than any other organism. The illness results from the enterotoxin produced by the bacteria in the food, rather than the bacteria. The onset of symptoms is rapid, usually within 1 to 5 hours.

Staphylococci are found in the air and occur especially in infected cuts and

abrasions of the skin, boils, and pimples. They may be present in the nose and throat of food handlers. Rapid growth of the bacteria occurs in contaminated food if it is held at temperatures ranging between 50° and 120° F for 3 to 4 hours. Semisolid foods such as custards, cream fillings in pastries, cream puffs, cream sauces, mayonnaise, chicken and turkey salads, croquettes, potato salad, poultry dressing, ham, ground meat, stews and fish provide the ideal culture media for bacterial growth.

Staphylococci are killed at high temperatures, but the toxin is not inactivated with temperatures ordinarily used in food preparation. The contaminated food usually does not smell, taste, or appear to be spoiled. The best safeguard against staphylococcal food poisoning is prompt refrigeration. Foods that have been cooked should be placed immediately in shallow containers in the refrigerator, rather than being allowed to cool for several hours at room temperatures at which rapid bacterial growth can take place.

Botulism is an extremely rare type of food poisoning, but of such serious consequences that its occurrence is quite newsworthy. A news story in 1959 gave an account of the death of three members of a family and serious illness of three others following the eating of home-canned beets.[2] The presence of *botulin*, a toxin produced by *Clostridium botulinum*, was established as the cause of illness. Another fatal poisoning occurred in 1962 through the ingestion of tuna fish in which botulin had been produced. The vigilance of the Food and Drug Administration in recalling the entire pack of tuna fish from the market eliminated the possible hazard to many others.

Cl. botulinum are found in soils all over the world and consequently infect the vegetables grown thereon. The spores produced by the bacteria are quite heat resistant, and they will germinate rapidly under anaerobic (without oxygen) conditions such as are found in canned foods. As the bacteria grow, they produce a toxin that is extremely deadly—about 65 per cent of instances of ingestion leading to fatality.

Canned foods which contain little or no acid such as meat, beans, asparagus, corn, and peas are very good media for the growth of the bacillus botulinus, while acid-containing foods such as tomatoes and certain fruits are not favorable for growth. The processing of canned vegetables in boiling water is not adequate for destruction of spores, and therefore the use of sterilization with steam under pressure should be urged for the home as well as for commercial establishments.

Botulinus-infected foods do not necessarily taste or smell spoiled, so that home-canned vegetables should always be brought to a vigorous boil before being used since the toxin is inactivated in 10 minutes by heat at 80° C. It goes without saying that any food that shows gas production or change in color or consistency should be destroyed without even tasting it. The contents of any can that has bulging ends should likewise be discarded. It is important that such foods be burned since animals eating them will otherwise be poisoned.

Parasitic infestations of food. Many animal parasites gain admission to the body by means of food. Among them are *Endamoeba histolytica,* which causes amebic dysentery, and various worms such as beef and pork tapeworm, pinworm, and Ascaris. Flies and other insects carry cysts of the ameba from feces and contaminate food and water with which they come in contact. In the United States contaminated water has been, on rare occasions, responsible for epidemic outbreaks of amebic dysentery. Food handlers who harbor the organism may be sources of amebic infection unless great care is taken regarding cleanliness of the hands.

Trichinosis is one of the most serious of worm infestations and results from eating raw or partially cooked pork infected with *Trichinella spiralis.* Various autopsy reports indicate that the incidence in Americans is from 10 to 20 per cent. Trichinella are destroyed by temperatures of at least 160° F, by 30,000 rads of gamma radiation, or by freezing at 0° F for at least 72 hours. Only pork products which have been thoroughly cooked should be eaten. Government inspection of meat does not include examination for Trichinella since it is impractical to do so at the present time. The United States Public Health Service has long recommended that garbage used to feed hogs be cooked, and many local health authorities now require that this be done. This precaution will go a long way in reducing the Trichinella infestation of hogs.

Chemical poisons in plants and fish. Another type of poisoning occurs from the consumption of plants that contain poisonous alkaloids, such as strychnine, atropine, scopolamine, solanine, and others. Varieties of hemlock have been mistaken for parsley, horse-radish, or wild parsnip and eaten in salads or soup only to produce immediate illness which was often fatal. Monkshood, foxglove, and deadly nightshade have from time to time been mistaken for edible plants and caused violent illness.

The increased consumption of mushrooms has led to more frequent poisonings by fungi, for many people are unable to distinguish the very poisonous *Amanita* from the harmless varieties. The ingestion of one type of poisonous mushroom results in mortality of more than half of the victims. This source of poisoning can be eliminated if people will use only the commercially grown mushrooms.

A class of substances of extreme toxicity to cattle, swine, poultry, and laboratory animals are the *aflatoxins* produced by the mold *Aspergillus flavus.*[3,4] Much attention has been focused on peanuts since they are subject to the fungal growth. Practically all of the growth is associated with broken shells and shriveled, discolored, rancid kernels; if these are removed, the remaining nuts are practically free of aflatoxins. According to Milstead,[3] the cooperation of growers, processors, and manufacturers of peanut butter and peanut products has been so good that no contamination of domestically produced products has been encountered.

The eating of certain weeds such as white snakeroot by cows produces the disease "trembles." This disease, also known as milk sickness, is transferred

to man through the milk supply or through the eating of meat from the diseased animal.

The green part of sprouting potatoes contains sufficient solanine to produce pain, vomiting, jaundice, diarrhea, and prostration. Rhubarb leaves contain appreciable quantities of oxalic acid and should not be used in place of other greens since serious illness usually results.

During certain months of the year mussels and clams from the Pacific coast extending from Alaska to California feed on marine organisms which produce a toxic alkaloid similar to strychnine. The eating of these mussels and clams can be fatal.

Chemical poisoning. Lead is a particularly dangerous metal since it accumulates in the body and results in chronic illness characterized by severe anemia and changes in the kidneys and arteries, death occurring in some cases. A minute quantity of lead occurs naturally in food and is ingested daily, but whenever the daily intake is 1 mg or more, the eventual accumulations may become toxic. Food may become contaminated with lead if it is exposed to dust containing lead, or if it is kept in containers in which solders, alloys, or enamel containing lead have been used. Canned foods were formerly subject to lead contamination, but the canning industry has long since devised containers that are entirely safe for food.

Cadmium, zinc, and antimony are readily soluble and will quickly produce illness if ingested. They are not used in the manufacture of utensils or cans.

Accidental poisonings have occurred when chemicals have been mistaken for powdered milk, flour, or baking powder. Some years ago in a state institution 47 deaths resulted when roach powder containing sodium fluoride was mistaken for dry milk powder and used as such.[5] In another instance boric acid was used in place of lactic acid for the preparation of infant formulas. Even common table salt became a deadly poison a few years ago when it was mistaken for sugar in the preparation of infant formulas.

The coloring of pesticides green or some other color unusual to foods could prevent accidental poisonings. It goes without saying that insecticides, lye, moth balls, and numerous other poisons should be placed where small children cannot reach them.

The metals used in cooking utensils and in food containers have been a source of much controversy. Many studies have shown that glass, stainless steel, aluminum, agate, and tin are suitable containers for food since these materials are practically insoluble or, when dissolved to a slight degree, are not harmful to health. Acid foods may dissolve some of the tin from cans so that a change of flavor results from the iron underneath the tin coating, but the ingestion of these foods is not harmful. It is recommended that acid foods be transferred from the can to a covered glass container if the food is to be refrigerated after opening. The intentional use of chemicals in foods is discussed on page 304.

Radioactive fallout. Man has always been exposed to the radiation of naturally occurring radioisotopes in the environment. With the advent of the nuclear bomb the amount of such exposure has increased, although to date the annual exposure of the population from this source is very small when compared to that which occurs naturally. No change in food habits is currently indicated by the amounts of radioactive contamination.

Numerous radionuclides are produced in a nuclear detonation. Some of these enter the atmosphere below 30,000 to 40,000 feet and some enter the stratosphere above 40,000 feet. Particles of radioactive dust and debris settle on the earth's surface sooner or later.

Following a nuclear detonation there are several pathways by which the radionuclides eventually are ingested by man. (See Figure 20–1.) For example, contaminated plants may be eaten by cows; much of the element may be excreted in the urine of the cow, but some will be secreted in the milk which, in turn, is consumed by man. Some of the consumed element will be excreted in the feces of man, but some will be absorbed and will enter the metabolism in a manner similar to that of the element with which it is related. Strontium-90 is related to calcium and is deposited chiefly in the bones; cesium-137, like potassium, is distributed throughout the body in the soft tissues; and within 48 hours of ingestion iodine-131 is accounted for in the thyroid gland and in the urine. Excessive deposits of radioactive elements carry the threat of cancer —of the thyroid with iodine-131, and of the bone with strontium-90.

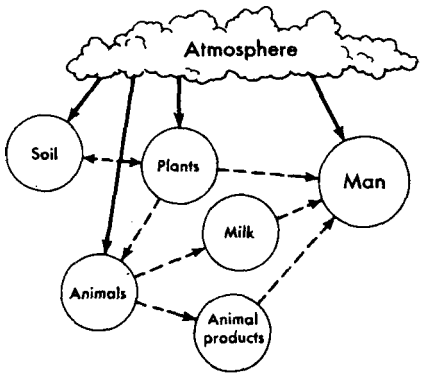


FIG. 20–1. Pathways of radioactive fallout. (*Courtesy, National Dairy Council, Chicago.*)

Several of the radioisotopes are of particular health significance to man. Each element has a specific *physical half-life*. This is the amount of time that elapses before half of the element is decayed. The element thus emits radiations to the external environment with consequent exposure over this period of man, animals, and plants. The *biologic half-life* refers to the length of time before half of the element is excreted from the body. Thus, some elements may be rapidly excreted causing little harm, while others are retained. Stron-

tium-90 and cesium-137 have a physical half-life of 28 years. Strontium-90 is of much more serious biologic consequence since its rate of turnover is slow in the body, whereas cesium-137 has a biologic half-life of about 140 days.

The Federal Radiation Council has established guidelines which define the potential hazards of radiation.[6] The U.S. Public Health Service, Atomic Energy Commission, and U.S. Department of Agriculture are among the groups that periodically analyze foods from all over the country to determine levels of radioactivity. About one third to one half of the dietary strontium-90 is present in milk; however, the high calcium intake helps to ensure a preferential use of calcium rather than strontium by the body. The current levels in foods present no risks whatsoever.

PRESERVATION OF FOODS

Factors contributing to food spoilage. Bacteria, yeasts, and molds grow rapidly at temperatures of 50° to 120° F; within this range the rate of growth increases tenfold for each 10° C (18° F) increase in temperature. Thus, the bacteria produced in a food left at room temperature for 3 or 4 hours can reach astronomical numbers.

Growth of microorganisms is retarded at refrigerator temperatures and is stopped at freezing temperatures. Many molds and some bacteria known as *psychrophils* grow even at refrigerator temperatures, leading to spoilage of food. Pathogenic bacteria do not grow at these temperatures. Many bacteria are not killed by freezing—an important fact to remember when frozen foods are thawed and allowed to stand at room temperatures. (See Figure 20–2.)

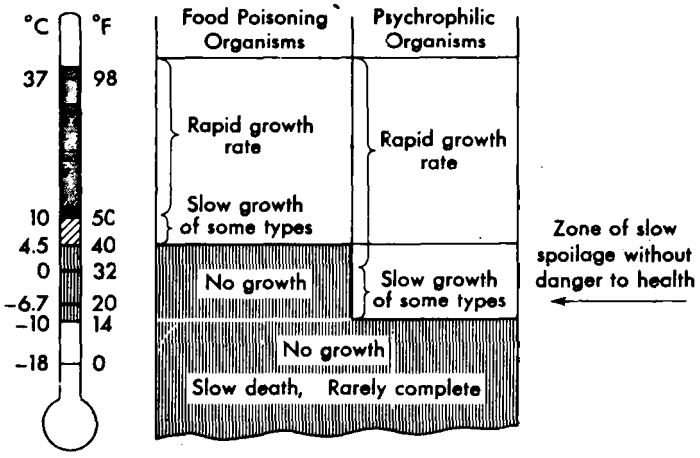


FIG. 20–2. Low temperature limits on growth of food poisoning and psychrophilic organisms. (*Courtesy, Dr. Horace K. Burr and the* Journal of the American Medical Association, *October 29, 1960 pp. 1178–1180.*)

Some bacteria known as *thermophils* thrive at relatively high temperatures. They are responsible for the "flat sour" which occurs in some home-canned foods.

Many bacteria produce spores that are very resistant to heat. In fact, several hours of boiling may not destroy them. Under favorable conditions such spores will germinate rapidly.

Chemical changes in foods are the result of the influences of air, heat, light, and moisture, with the rate doubling for each 10° C rise in temperature. All chemical reactions are accelerated by the enzymes present in plant and animal tissues. Oxidation produces a number of undesirable results, such as rancidity in fats and loss of ascorbic acid. Sunlight is especially destructive of riboflavin and vitamin B_6. Soluble nutrients may be lost in discarded liquids. The darkening of cut nonacid fruits, the oxidation of ascorbic acid, the spoilage of meat are examples of deterioration hastened by enzyme action.

Food preservation, whether it entails keeping a food for a day or two in the refrigerator, or a year or so in the can or freezer, must meet these objectives: (1) safety from contamination by pathogenic organisms or toxicity through chemicals; and (2) maintenance of optimum qualities of color, texture, flavor, and nutritive value. Foods may be preserved through the application of heat or cold, by the removal of water, by the use of chemicals, or by irradiation. Microorganisms are destroyed by some methods, while their growth is inhibited by others.

Safe milk. Of all foods, milk is perhaps most susceptible to contamination. Pasteurization is the most effective measure which can be taken to protect the milk supply, although the inspection of the cows, barns, and milk handlers is also desirable. More than 90 per cent of all milk consumed in the United States is now pasteurized.

There are two methods for pasteurizing milk: (1) in the *holding* process milk is heated to at least 143° F and kept at that temperature for at least 30 minutes; or (2) in the *high-temperature short-time* method the milk is heated to at least 160° F and kept at that temperature for at least 15 seconds.

Milk may be sterilized by boiling it for a specified time as in the preparation of infant formulas or by heat as in the processing of evaporated milk. Pasteurization does not appreciably change the color or the flavor of milk, but sterilization deepens the color and gives to the milk a slightly caramelized flavor.

Certified milk is produced and marketed under very strict supervision of local medical boards. At the time of delivery to the consumer it must contain fewer than 10,000 bacteria per milliliter when raw, and less than 500 bacteria per milliliter when pasteurized. It is used primarily for the feeding of infants. While some of it may be sold raw, most cities now require that it be pasteurized.

Cheese, butter, and ice cream may harbor pathogenic organisms, and the milk used for the preparation of these foods is usually handled with the same sanitary precautions, including pasteurization.

Cooking. Boiling temperature (212° F), if maintained sufficiently long for heat to completely penetrate the food, will quickly kill bacteria, but spores of bacteria such as those of the botulinus or of molds are not always destroyed. When temperatures above the boiling point—that is, with the aid of pressure cookers—are employed, these spores are also destroyed. Bacteria may not be killed when low-heat cookery is employed as in the preparation of custards, or where heat penetrates very slowly food masses such as casserole dishes and roasts. Such foods are particularly likely to cause poisoning if they have been carelessly handled prior to cookery.

Canning. Commercial firms now employ standard methods for canning each food. Sterilization is brought about by means of steam under pressure. By means of agitation of the cans during processing, heat penetration of the can contents is accelerated and the heating time is shortened with a great improvement in flavor and in color.

High-temperature, short-time processing is a new development in canning. At temperatures of 275 to 350° F a product may be sterilized in a few seconds, whereas minutes or even hours were earlier required. *Aseptic* canning is an application of the high-temperature processing. The product is first sterilized in a matter of seconds, cooled, and filled aseptically into presterilized containers in a sterile atmosphere. The method has been used for fluid products such as soups, sauces, fruit juices, milk, and baby foods and appears to be applicable to other foods in small pieces. The resultant product is of better color and flavor, and retains more of the heat-labile vitamins.

Some nutritive losses, especially of heat-labile vitamins, occur during canning, but the newer techniques have reduced these losses considerably. The manner of storage is probably the major factor in nutrient retention or loss. As much as 25 per cent of ascorbic acid and thiamine may be lost from fruits and vegetables stored for a year at 80° F, but with storage at 65° F these losses may be reduced to 10 per cent. Meats, likewise, lose 20 to 30 per cent of their thiamine content after 6 months storage at 70° F, but the riboflavin content is not adversely affected. Carotene losses in fruits and vegetables are small even after months of storage. Water-soluble nutrients distribute themselves evenly throughout the solids and liquid; thus, if the solids constitute two thirds of the total, one third of these water-soluble nutrients will be lost if the liquid is not used.

HOME CANNING. When foods are canned in the home, a pressure canner should always be used for low-acid foods, including most vegetables, poultry, and meat, in order that bacteria and their heat-resistant spores may be destroyed. Fruits and tomatoes, being acid foods, may be safely canned at boiling temperatures. The packing of food into jars and heating for stipulated lengths of time in a water bath is preferable to the open-kettle method of packing hot food into jars without further heating.

Cold storage. Modern refrigeration has been largely responsible for the tremendous variety of foods available all over the country, in season and out.

By means of it foods can be kept for long periods of time in commercial cold-storage rooms at the proper humidity, or may be transported from coast to coast without danger of loss from spoilage or freezing, or may be kept in the home refrigerator to reduce the number of trips the homemaker makes to the market.

Fruits and vegetables are kept just above the point at which they will freeze, this being in most instances 31 to 33° F. Butter and meats may be kept at much lower temperatures.

Cool storage is being gradually extended to canned and dehydrated foods to retain optimum color, flavor, and nutritive values since many chemical reactions occur twice as rapidly at 68° F as at 50° F and four times as rapidly at 85° F as at 50° F.

Freezing. In the quick freezing of foods, first developed as a practical method of processing some 30 years ago, bacteria are unable to grow and enzymes are inactivated. Today an almost endless variety of frozen foods is available—fruits, vegetables, juices, meats, poultry, fish, pies, cakes, cookies, rolls, stews, casseroles, and complete dinners. The per capita consumption of frozen foods is about 50 pounds per year, with 19 pounds of this being fruit juices. One third of all seafood and one fifth of all poultry purchased is in the frozen state. Prepared foods representing several hundred products have shown a rapid increase in sales.

Foods to be frozen must be carefully selected for quality, maturity, and highest sanitary standards. No frozen product is ever any better than the raw materials from which it was frozen. Because ready-to-eat foods involve mixtures and are subject to more handling prior to freezing, special care must be taken to enforce the most rigid sanitary practices. Some foods such as raw salad vegetables and tomatoes cannot be frozen satisfactorily because of texture changes. Fruits are softened by the freezing process.

Before freezing, vegetables are blanched to inactivate the oxidative enzymes. The darkening of fruits may be prevented by immersion in a sugar syrup or by using ascorbic acid. Foods are packaged in such a way that air is excluded as much as possible. Polyethylene bags and containers, and moisture-vapor-proof wrappings including heavy foil, heavily waxed papers, and cellophane are used. Small packages are placed in direct contact with the freezing units so that the entire mass can be quickly penetrated and rapidly frozen. Rapid freezing at temperatures as low as −30° F to −35° F results in minimum damage to the cell walls of the product.

For optimum retention of flavor, texture, and nutritive value, foods should be preferably stored at temperatures below 0° F. Ascorbic acid losses are greater than those for other nutrients. Orange juice held at 32° F for a year loses no more than 5 per cent of its ascorbic acid, but nonacid foods lose appreciable amounts at 0° F and much lesser amounts at −10° F to −20° F. Frozen foods should be kept for only a few days in the usual freezing compartment of a refrigerator.

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Frozen foods should be used promptly upon thawing. If allowed to stand for some time subsequent to thawing, microorganisms multiply, and changes occur in consistency and flavor. Foods which have been thawed should never be frozen again because further deterioration will take place. Fruits retain the best color if they are thawed in the container before it is opened. Most vegetables are cooked by dropping the frozen vegetable directly into a small quantity of boiling water and rapidly returning it to the boiling point. Corn on the cob should be thawed before it is cooked. Meats may be cooked while still frozen or may be thawed prior to cooking; the former procedure requires a considerable increase in the cooking time.

DEHYDROFREEZING, a relatively new process, consists in evaporating about half the water, and then freezing the product. It has been applied particularly to fruits and vegetables. The costs of packaging, shipping, and storage are thus reduced. Water is added to reconstitute the food when it is cooked.

FREEZE-DRYING consists in placing the frozen food under a vacuum to remove the water and packaging in the presence of an inert gas such as nitrogen. The product retains its original volume and shape and rehydrates readily. Seafoods, beef, pork, chicken, soups, and several food mixtures have been found acceptable in taste tests conducted by the U.S. Department of Agriculture.[7] They rated somewhat lower than frozen or canned foods but possessed the advantages of long shelf life, storage, refrigeration, and light weight. The process is currently quite costly and only limited supplies are available in the general market.

Dehydration. Drying of foods is an effective means of avoiding spoilage since microorganisms cannot grow in the absence of water. Dried foods possess the special advantages of light weight and small volume, and are easily transported and stored. The dehydration of certain fruits such as prunes, peaches, apricots, apples, figs, dates, and raisins as well as the legumes has been practiced for centuries. Every market today features numerous dried foods: nonfat dry milk; quick bread, yeast bread, cake, cookie, and pudding mixes; dehydrated soups; instant coffee; instant mashed potatoes; citrus juice powders; precooked rice and beans; cereals; and many others. Dried whole eggs and egg whites are used extensively in the baking industry.

Chemical preservation. Sugar is employed in high concentrations for the preparation of jams, jellies, and preserves. The water is made unavailable to the microorganisms, and hence spoilage will not occur. However, molds will grow on the surface of these foods if sterility is not maintained. Sodium chloride and vinegar are also good preservative agents as employed in brining and pickling.

The number of chemicals that may be used for preservation is now strictly limited by government regulations. Benzoic acid or sodium benzoate may be used up to a concentration of 0.1 per cent if labels specifically indicate its use. Sulfur dioxide may be used in the drying of apples to lessen darkening. Meats may be cured with smoke that contains phenols. Older methods of curing

meat employed considerable amounts of salt so that preservation was possible at ordinary room temperature. Recent processes employ less salt and more uniform though shorter curing periods, but it is important to emphasize that hams so cured are perishable and require refrigeration. Failure to refrigerate hams has caused a number of outbreaks of food poisoning in recent years. Spices such as cloves and cinnamon have been much overrated for their preservative properties, since concentrations sufficient to inhibit bacterial growth would render food inedible. See also food additives on page 304.

Antibiotics in food preservation. The uncontrolled use of antibiotics in foods or as drugs is a potential hazard to approximately 10 per cent of the population who react unfavorably to contact with them with symptoms ranging from a mild skin rash to fatal anaphylactic shock.[8] The repeated ingestion of antibiotics may produce an immunity in other individuals so that they do not respond to therapeutic doses required in the treatment of disease conditions. It is, therefore, a prime requirement that the food supply that may have had any contact with antibiotics contain no residues when eaten.

Antibiotics are used in food production. The farmer adds antibiotics to feeds to stimulate the growth of swine and poultry, or he may employ antibiotics to prevent and treat illness in animals. Crops are sometimes sprayed with antibiotics. Since no residues of the antibiotics are present in the foods as eaten, these practices constitute no health hazard. One possible source of antibiotic residues has been milk from cows which have been treated for mastitis. Regulations of the Food and Drug Administration now specify that milk obtained for 3 days following treatment for mastitis with antibiotic drugs must not be used for human consumption.

The shelf life of poultry and fish treated with an antibiotic is increased two to three times because of the reduced growth of microorganisms. Chlortetracycline (Aureomycin) and oxytetracycline (Terramycin) have been used in the cooling water for dressed poultry, allowing a maximum residue of 7 ppm in the uncooked poultry. Likewise, these antibiotics may be used in the ice slush for packing raw fish and shellfish, the maximum of residue allowed in the uncooked fish being 5 ppm. The cooking of poultry and fish destroys the antibiotic residues at these levels of use. With improved methods of food handling the Food and Drug Administration has recommended that the use of antibiotics to prolong shelf life be prohibited.

Preservation of foods by irradiation. One of the potential peacetime uses of atomic energy is in the radiation preservation (cold sterilization) of foods. Microorganisms can be destroyed by using gamma rays or high-speed electrons, both types of radiation being referred to as ionizing radiations. The unit of radiation is the "rep" (roentgen equivalent physical), one rep being defined as the absorption of 93 ergs of energy per gram of material, water being the reference substance. Irradiation does not make the food radioactive. No irradiated foods are presently available for public consumption, nor does the Food and Drug Administration permit the sale of such foods. Long-term experiments

with animals must be conducted to eliminate the possibility of toxicologic and carcinogenic manifestations, although there is no evidence of such danger at present. Under carefully controlled conditions shorter tests have also been conducted on human volunteers by the Quartermaster Food and Container Institute for the Armed Forces.

Small doses of irradiation—less than 100,000 rep—will destroy the insects which may infest flour, cereals, and spices, inhibit the sprouting of potatoes and onions, delay the ripening of fruit, and destroy the Trichinae of pork. Such doses of irradiation do not have adverse effects on acceptability of the product.

At somewhat higher levels of irradiation, that is, 100,000 to 1,000,000 rep, most microorganisms are destroyed but the product is not sterile. Fruits and vegetables may be kept for a longer time; and meats, poultry, and fish may be kept under refrigeration for appreciable lengths of time without deterioration. Radiopasteurization with doses of less than 500,000 rep holds promise of market application in the not-too-distant future.

To effect sterilization, that is, complete destruction of bacteria, 4.8 to 6.0 million rep are required, the spores of *Clostridium botulinum* being especially resistant. The inactivation of enzymes requires such high levels that it appears some heat treatment, such as blanching prior to radiation, is the only practical solution. At high dosages of radiation such as required for sterilization, adverse changes occur in color, flavor, and texture so that many products are no longer acceptable. Moreover, modifications of nutritive value also occur. Vitamins A and E, ascorbic acid, and thiamine are especially sensitive.

FOOD ADDITIVES

A casual inspection of the labels that appear on food packages in any American home will reveal the presence of several dozen chemicals in a reasonable variety of foods. An additive is any substance not normally present in the food in question and which is added, either deliberately or incidentally, in order that some quality of the food may be improved. A chemical additive is a substance for which the exact chemical nature is known.

Intentional additives. Chemicals are intentionally added to foods by the processor in order to enhance some quality of a food such as texture, color, flavor, nutritive value, or keeping properties to gain better consumer acceptance. Table 20–1 illustrates some of the functions of additives, and gives a few examples of chemicals together with typical foods to which they may be added. Many chemicals serve more than one function. For example, ascorbic acid might be added to prevent the darkening of a fruit, but an excess might also increase the net ascorbic acid intake.

Incidental additives. A food may contain minute traces of a chemical as a result of contact with a substance used in its production, processing, or packaging. Since its presence serves no useful purpose in the final food product, such a chemical is considered to be an incidental additive. For example, food

Table 20–1. Typical Uses of Some Intentional Additives

Function	Chemical Compound	Examples of Food
Improve nutrition	Mineral salts, vitamins	See page 320
Preservative	Sodium chloride	Pickles, salted meats
	Sodium benzoate	Dried codfish; maraschino cherries
	Chlortetracycline	Antibiotic dip for dressed poultry
(inhibit mold)	Calcium propionate	Bread, rolls
(fungistat)	Sorbic acid	Cheese
Antioxidant	Ascorbic acid	Frozen peaches
	Butylated hydroxyanisole (BHA)	Lard, potato chips, meat pies, cereals, crackers
	Lecithin	Margarine, candy
	Sulfur dioxide	Dried fruits
	Tocopherol (vitamin E)	Candy, oils
Texture	Alum	Firm pickles
(anticaking agents, retain moisture, emulsifiers, give body, thickening, jelling, binding)	Disodium orthophosphate	Evaporated milk, cheese
	Mono- and diglycerides	Margarine, chocolate
	Sodium alginate	Cream cheese, ice cream
	Pectin	Jelly, French dressing
Buffers, acids, alkalies	Acetic acid	Cheese, catsup, corn syrup
	Sodium hydroxide	Pretzel glaze
	Baking powder, baking soda	
Coloring	Annatto; carotene	Butter, margarine
	Certified food colors	Baked goods, soft drinks
Flavoring (over 300 compounds in use)	Aromatic chemicals, essential oils, spices	
	Monosodium glutamate	Meat, seasoning salts
Nonnutritive sweeteners	Calcium and sodium cyclamate; saccharin	Dietetic foods
Yeast food; dough conditioner	Calcium phosphate; calcium lactate	Bread
Whipping agent	Carbon dioxide	Whipped cream in pressurized can

may pick up a material from a wrapper or a container, either by dissolving it out or by abrasion from the container into the food. Detergents used for cleaning dishes or food equipment, likewise, could be such an incidental source.

Of greatest concern are the pesticides which are used in crop production in order to avoid destruction by insects, viruses, fungi, or other plant perils. Residues of some of these pesticides sometimes may be present on fruits and vegetables even after careful washing of the foods. It is self-evident that these chemicals are toxic to some forms of life or they would not have their protective properties for the crop. Just what hazard they pose for man is a fundamental question. Since the minimum lethal dose of these chemicals for various species of animals is well known and the products must be used according to specified concentrations, likelihood of acute toxicity to man is remote. More difficult to determine is the effect of build-up in the body when foods that contain such residues are eaten day after day for long periods of time—even

a lifetime. Toxicologic studies on animals throughout their life cycles, including the effects on reproduction and the next generation, are continuously being conducted to minimize such hazards.

CARING FOR FOODS AFTER THEIR PURCHASE

Storage of food requires as much care as its purchase in the market if the goals of nutrition, high eating quality, wholesomeness, and economy are to be achieved.

Storage at room temperature. Cereals, flours, packaged mixes, nonfat dry milk, sugars, and other dry foods have a long shelf life at room temperatures if the containers in which they are kept are tightly closed. Canned foods retain higher levels of vitamin C and thiamine if they are stored at cool temperatures.

Root vegetables and tubers including potatoes, sweet potatoes, mature onions, carrots, beets, turnips keep well in a dark room at cool temperatures, but in many homes where room temperatures average 70° or more, only a week's supply should be purchased at one time.

Bananas and unripe tomatoes should be ripened at room temperature. Citrus fruits may be kept at room temperatures for as long as a week.

Refrigerator storage. Highly perishable protein foods should be stored in the coldest part of the refrigerator. Ground meat, organ meats, and fish should be used within 24 hours, while larger pieces of meat will keep for several days. The polyethylene store wrappings around meat should be loosened at the end if the meat is not used within a day. Cured and smoked hams and other cured meats require refrigeration.

Milk should be stored in the bottle or carton in which it was delivered, always keeping the bottle tightly covered. Ordinarily it will be used within 4 or 5 days, although today's market milk is so carefully processed that it keeps well for several days longer.

Soft cheeses deteriorate rapidly and should be used within a few days. Hard cheeses should be wrapped in plastic or foil excluding as much air as possible. Mold which sometimes appears on the surface of hard cheese may be scraped away with little effect on the cheese. If Cheddar cheese becomes hardened, it may be grated for use in soups, cream sauces, and such dishes.

Many fruits and vegetables are kept crisp by placing them in the hydrator. Berries are especially perishable and should not be washed until just before their use.

Table 20–2 illustrates the best placement of foods in the refrigerator and indicates the limits of storage time for maximum quality of food.

Freezer storage. Frozen foods may be kept for varying periods of time at 0° F but should be used within a week if storage is in the freezing compartment of a refrigerator. Foods are of best quality if they are used soon after being stored. Maximum storage times for some high-quality foods are indicated in Table 20–3.

Table 20–2. Guide to Refrigerator Storage*

Foods and Storage Space	Storage Time
Coldest Part of Refrigerator	
Loosely wrapped	
Roasts, steaks, chops	3 to 5 days
Ground meats, variety meats, poultry, fish	1 to 2 days
Tightly covered	
Milk, cream, cottage cheese, cream cheese	3 to 5 days
Hard cheese	*Several* weeks
Other Parts of Refrigerator	
Tightly covered	
Butter, margarine	2 weeks
Opened canned foods, fresh or reconstituted juice	
Nuts	
Mayonnaise and other salad dressings (after opening jar)	
Peanut butter (*after opening jar*)	
Covered: eggs	1 week
Uncovered	
Ripe fruits; apples	1 week
Berries, cherries	1 to 2 days
Apricots, grapes, pears, peaches, plums, rhubarb	3 to 5 days
Some fresh vegetables	
Ripe tomatoes, corn in husk, Lima beans and peas in pods	
Crisper *and/or* Plastic Bag	
Most fresh vegetables	
Leafy green vegetables, asparagus, Brussels sprouts, cauliflower, summer squash, beets, broccoli, cabbage, carrots, celery, cucumbers, green onions, peppers, radishes, snap beans	

* *Consumers All.* Yearbook of Agriculture, 1965. U.S. Department of Agriculture.

Table 20–3. Maximum Storage Time for Some Frozen Foods (at 0°F)

	Months		Months
Beef or lamb roasts, steaks, chops	12	Cooked fish and shell fish	3
Pork or veal roast	8	Oysters	1
Poultry, cut-up	6	Fruits	12
Chicken, whole	3	Fruit juices	12
Ground meat	3	Vegetables	8–10
Cooked meat, frozen dinners	3	Pie, unbaked	8
Sausage, ham	2	Cakes	2–3
Fish, shrimp, clams, raw	2–4	Bread, rolls, pastry	2–3
		Frozen desserts	1

SAFE FOOD PRACTICES

The National Sanitation Foundation has adopted a slogan "Sanitation is a way of life." It is not difficult to formulate standards to be observed in the preparation and serving of foods both in public eating places and in the home, but it is quite another matter to educate the food handler to apply given rules intelligently. Routine medical examination of the food handler is no guarantee that the individual will remain free from disease until time for the next examination. Moreover, thorough examinations are expensive and may require time-consuming laboratory tests. However, communities should maintain adequate regulation of known carriers of disease such as typhoid, dysentery, tuberculosis, and diphtheria.

One of the best guarantees for sanitary food practices is to employ intelligent individuals with high standards of personal cleanliness who are willing to cooperate in the best sanitary procedures. In all respects, education of the food handler with regard to (1) personal cleanliness, (2) correct use of equipment with regard to sanitization, and (3) proper refrigeration of food is the best guarantee for safeguarding the food supply. Some cities provide courses for food handlers which cover these points. The following rules illustrate the application of the principles of safe food practices.

Personal hygiene

1. Do not permit individuals with colds, sore throat, or diarrhea to handle food until they have recovered.
2. Do not permit anyone with boils, pimples, or carbuncles on hands or face to handle food or tableware.
3. Avoid sneezing or coughing near foods.
4. Always wash hands after using the toilet, scratching the head or other part of the body, or blowing the nose. Suitable hand-washing facilities, including warm water, soap, and towels, should be conveniently available to the food handler.
5. Avoid indiscriminate handling of foods with fingers. The proper use of tongs and other serving utensils should be taught to all food handlers.
6. Do not return tasting spoon to food without washing it.

Food selection and storage

1. Select foods from plants or markets that maintain high standards of sanitation.
2. Protect foods at home or in the market from flies, insects, rodents, or contamination by unnecessary handling, sneezing, or coughing. The wide use of cellophane or plastic wrappers is a boon to safeguarding foods.
3. Keep the refrigerator temperature at 40° to 45° F.
4. Permit adequate circulation of air around foods in the refrigerator.
5. Refrigerate cooked foods as soon as possible after cooking. With present-

day mechanical refrigeration, foods need not be cooled before putting them into the refrigerator.

6. Keep cream-filled bakery products, sandwich spreads, and salads under constant refrigeration.

7. Purchase only pasteurized milk. Use freshly ground meat within 24 hours after purchase.

8. Use a pressure cooker for canning all nonacid vegetables, meats, and poultry. Boil home-canned nonacid vegetables and meat for 6 to 8 minutes before use.

9. Discard without tasting all foods from tin cans which bulge or from glass jars which spurt upon being opened.

10. Use frozen foods promptly after thawing.

11. Carefully label insect powders and other chemicals. Do not keep them near foods. Keep them out of the reach of small children.

Care of equipment

1. Clean all kitchen equipment thoroughly after each use. Meat choppers and mechanical mixers require special attention.

2. Public health regulations require that dishes in public eating places should be washed at least 20 seconds at 140° F in a mechanical washer and then rinsed at 170° F for at least 10 seconds. When hand washing is used, the dishes should remain in rinse water at 170° F for at least 30 seconds. Detergents or soap powders should be used as directed by the manufacturer and their concentration maintained throughout the wash period.

3. Instruct all food handlers in the proper use of all equipment.

REVIEW

1. List several ways in which bacterial diseases may be transmitted by foods.
2. Give two examples of bacterial infections transmitted by foods; two examples of bacterial poisoning.
3. What organisms are responsible for most cases of summer food poisoning?
4. Explain what is meant by botulism. Which types of food are most apt to contain botulinus toxin? What measures are necessary to eliminate the possibility of botulinus poisoning?
5. Formulate several rules which might be enforced in the prevention of food-borne diseases.
6. Describe the effects of Trichinella infestation. How can it be avoided?
7. Lead and arsenic are especially poisonous to man. In what ways do they sometimes contaminate food supplies?
8. Name several plants that are poisonous to man. What type of chemical compound produces this poisoning?
9. What are the causes of food spoilage?
10. Why are commercially canned foods likely to be superior in their vitamin content to home-canned foods?
11. Which method of canning is preferable for home use? Why?
12. Discuss the uses of cold storage for various foods.
13. Why do dehydrated foods keep so well?
14. What losses of nutritive value occur in dehydration?
15. Name five chemical agents frequently used for preservation.

16. What are the time and temperature requirements for the pasteurization of milk?

17. What is the nature of each of these in food preservation: irradiation, aseptic canning, dehydrofreezing, antibiotics? What advantages and disadvantages may be claimed for each?

18. What is a chemical additive? List several uses of additives and give examples of foods in which they are used.

19. Read the labels of a variety of packaged foods and list the additives. Try to determine the reason for each additive. What objections can you see to the use of additives? Would it be advisable to avoid the use of all additives? Explain your answer fully.

20. What is strontium-90? cesium-137? and iodine-131? Of what significance are they to the health of man?

21. Why is a liberal intake of milk likely to be protective against the effects of strontium-90?

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Chapter 21

CONTROLS FOR THE SAFETY AND NUTRITIVE VALUE OF THE FOOD SUPPLY

You shall not eat anything that dies of itself.

Deuteronomy 14:21

You shall not have in your bag two kinds of weights, a large and a small. You shall not have in your house two kinds of measures, a large and a small. A full and just weight you shall have, a full and just measure you shall have.

Deuteronomy 25:13–15

These Biblical quotations are but two of the many laws concerning the use of food set down by Moses and others. Although examples may be found throughout history of efforts to exercise some controls over the food supply, the major advances have come in the present century.

FEDERAL LEGISLATION

Need for food laws. The growth of an urban society and the revolutionary developments in science and technology have necessitated numerous controls to protect the consumer. In the early days of this nation the consumer, for the most part, was also the producer. He grew the crops, raised the cattle, preserved the food by methods then available, and cooked the food in his own home. By and large, those not engaged in agriculture purchased food from sellers who were known on a personal basis. Even in colonial history, however, one can find examples of laws designed to protect the consumer against fraud.

With the industrial development and movement to cities people became dependent upon growers, manufacturers, and distributors for the food supply. Not all practices were honest. In fact, the conditions for sanitation in food processing and marketing by the end of the nineteenth century were often described as appalling. Far too common were fraudulent practices whereby the products were diluted with some cheap and unsafe ingredient so that a greater profit could be realized. Over these unsavory practices the consumer had little control.

life with sufficient circulating hemoglobin, it is essential that iron salts be prescribed to supplement the diet.

In some women the gastric acidity is reduced during pregnancy and a macrocytic anemia characterized by low cell count, increase in cell size, and low hemoglobin level results. This anemia is corrected by folic acid therapy.

Toxemia. By toxemia is meant that combination of symptoms which may include edema, hypertension, albuminuria, and, if allowed to progress, convulsions. The importance of a good diet in reducing the incidence of toxemia has already been discussed (p. 328). Some toxemias are undoubtedly occasioned by kidney or circulatory disease already present in the woman. When toxemia does occur, the dietary management must be related to the etiology as well as to the symptoms which may be present.

Of paramount importance is an adequate protein intake (85 to 100 gm or more) to alleviate the hypoproteinemia which is almost invariably present and which may be primarily responsible for the edema. So long as the non-protein level of the blood is not elevated a high protein intake will not be harmful to the kidney; the additional amino acids made available are incorporated into tissue construction and thus do not add to the load for excretion.

Restriction of sodium is sometimes employed for the control of edema. The concurrent need for a high-protein and high-calcium intake makes it impractical to enforce marked restriction since milk and meat are important sources of sodium. On the basis of animal experiments Pike[9] has suggested that sodium restriction during pregnancy may be undesirable.

LACTATION

Nutritive requirements. McGanity and his associates[7] found that women who had high intakes of calcium, phosphorus, and riboflavin from their diets nursed their babies more frequently than did women who drank less than 3 glasses of milk daily and who had calcium supplements. When one considers the nutritive value of human milk, and that the nursing mother will produce 20 to 30 ounces each day, it becomes apparent that the requirements for protein, minerals, vitamins, and calories are even greater than they were during pregnancy. The recommended allowances for the various nutrients have been listed in Table 22–1.

The need for protein is greatest when lactation has reached its maximum, but it is a need which should be anticipated and planned for during pregnancy. The mechanics of converting food into milk protein is only about 50 per cent efficient, and thus about 2 gm of food protein are required to produce 1 gm of milk protein. This conversion takes place when there is a suitable mixture of all of the essential amino acids, and therefore the proteins of milk, eggs, meat, poultry, fish should have priority.

Approximately 120 calories are required for each 100 ml of milk, and thus the daily production of 850 ml of milk (30 ounces) would necessitate an additional 1000 calories in the diet.

Even liberal intakes of calcium may not be successful in completely counteracting a negative calcium balance. Consequently, a high level of calcium intake and the building of considerable reserves throughout pregnancy cannot be overemphasized. The baby is born with a relatively larger reserve of iron since milk is not a good source of iron. A good allowance of iron in the mother's diet during lactation does not convey additional iron to the infant. Nevertheless iron-rich foods are essential for the mother's own health, while supplements are included early in the infant's diet.

Selecting the daily diet. The pattern of diet used during pregnancy (p. 334) may be used during lactation, provided the following additions are made: (1) one pint of milk; (2) foods as desired to provide the additional calories. Weight gain, beyond that desirable for body build should be avoided. When the baby is weaned, the mother must reduce her food intake in order that obesity may be avoided.

The choice of foods during lactation may be wide. There are no foods that require restriction, except where distress may occur in individual cases following the taking of a particular food such as strongly flavored vegetables or highly seasoned or spicy foods. Successful lactation is dependent not only upon an adequate diet, but also upon sufficient rest for the mother, freedom from anxiety, and a desire to nurse the baby.

PROBLEMS AND REVIEW

1. What evidence exists that diet is of importance in the development of the fetus and the health of the mother?
2. What physiologic changes occur during the course of pregnancy?
3. Name the hormones which are especially important in controlling the changes occurring during pregnancy? What is the effect of an excess production?
4. In what way do the nutritional practices of teen-age girls affect the outcome of pregnancy?
5. What weight increases are recommended for each trimester? What are the dangers of excess weight gain? Of underweight or insufficient weight gain?
6. What foods are especially important for their protein content in the diet during pregnancy and lactation?
7. What mineral elements require especial attention during pregnancy? What changes occur in the rate of absorption of calcium and iron?
8. Discuss the need for an increased vitamin intake. What foods would you recommend for this?
9. Mrs. A. does not like milk and is taking calcium gluconate to correct calcium deficiency. Why is this less desirable than taking milk? List ways by which she could incorporate milk into her diet.
10. What recommendations can you make to a woman with complaints of nausea, vomiting, and gastric distress?
11. What instructions are in order for the woman who complains of constipation?
12. What is meant by the "physiologic anemia of pregnancy"? What are the hazards of iron deficiency anemia? What measures are essential for its prevention and treatment?

13. A woman secretes 800 ml milk daily. What amount of protein is here represented? What allowances must be made in the diet for protein?

14. *Problem.* Plan a low-cost diet for a woman of moderate activity during the second half of pregnancy. Calculate the nutrients in this diet and compare them with the recommended allowances.

15. *Problem.* Modify the diet in Problem 14 for a woman who is lactating.

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Chapter 23

NUTRITION DURING INFANCY

Growth and development of the infant. Each infant's growth and development are determined by the quality of the nutrition of his mother during pregnancy, by the adequacy of the formula and supplements offered throughout infancy, and by the characteristics acquired from his ancestors. Each infant is individual, and he best serves as his own control in the measurement of progress. Although it is often useful to make comparisons with stated norms, such as height and weight, it is also dangerous to expect every infant to conform exactly to such norms. No single criterion of physical status is indicative of the quality of nutrition, but a series of measurements over a period of time are likely to be reliable indicators. During the first year the infant will grow and develop more rapidly than at any other time of life. At a weekly gain ranging from 5 to 8 ounces he will double his birth weight in the first 5 months. The weekly gain slows down to 4 to 5 ounces for the remainder of the year, and he will have tripled his birth weight by the time he is 10 to 12 months old.

The baby will increase his birth length of 20 to 22 inches by another 9 to 10 inches during the first year. At birth he has a large head in proportion to the rest of his body, but his short arms and legs will grow especially rapidly in the next 12 months.

The gastrointestinal system of the full-term infant is able to digest protein, emulsified fats, and simple carbohydrates, but starches and most fats are poorly tolerated until some months later when the digestive enzyme production is more fully developed.

The infant's body contains a much higher proportion of water than that of older children and adults; the muscles are poorly developed and the amount of subcutaneous fat is limited. Since the skin surface area is high in proportion to the total body weight, the loss of body water and of body heat is also relatively high. The skeleton contains a high percentage of water and cartilage, and will be only gradually mineralized throughout childhood and adolescence.

At birth the infant of a well-nourished mother has a hemoglobin level of 17 to 20 gm per 100 ml. This level is gradually lowered as the infant grows and

his blood circulation expands, but the levels will remain satisfactory until about the third month when iron-rich foods should be introduced.

Several criteria may be applied to determine whether an infant is well nourished, namely: steady gain in height and weight, but some weekly fluctuations are to be expected; sleeps well, is vigorous, and happy; firm muscles and a moderate amount of subcutaneous fat are developed; teeth begin to erupt within 5 to 6 months, and from six to twelve teeth have come through by the end of the year; and elimination is normal for the type of feeding. The breast-fed baby usually has two to three soft, yellow stools each day, while the formula-fed infant has one to two yellow, somewhat firmer stools.

BREAST FEEDING

Approximately 87 per cent of all mothers can supply their infants with enough milk to justify the continuation of nursing if there is proper management.[1] In this country, however, less than one fourth of all mothers breast-feed their babies. If breast feeding is to be successful, the advantages must be sold to the mother early in pregnancy. An adequate diet, exercise, rest, and freedom from anxiety are important during the prenatal period as well as during lactation (Chap. 22). The sucking of a hungry baby stimulates the mother's breast to produce milk and should be started during the first 24 to 48 hours of the baby's life.

Advantages of breast feeding. Human milk is the natural food for the infant. Breast feeding gives a safe and protected feeling to the infant, and a sense of satisfaction to the mother. In lower economic groups breast-fed infants have a consistently lower mortality rate, probably because there is no problem of sanitation. As a rule, there are fewer and less serious illnesses and feeding problems among breast-fed infants; constipation also occurs less frequently. On a practical basis breast feeding eliminates preparation of a feeding; the milk is available at proper temperature; and errors in calculation and in formula preparation are avoided.

Contraindications to breast feeding. If the mother can supply less than half of the infant's needs, breast feeding is usually not practical. It must be discontinued when (1) chronic illnesses are present in the mother, such as cardiac disease, tuberculosis, severe anemia, nephritis, epilepsy, insanity, and chronic fevers; (2) another pregnancy ensues; (3) it is necessary for the mother to return to employment outside the home; or (4) the infant is weak or unable to nurse because of cleft palate or harelip. Temporary cessation is also indicated when the mother acquires an acute infection which the infant has not yet acquired; in such a situation the mother's breasts should be completely pumped at regular intervals so that the milk supply will not dwindle.

Colostrum. The clear, yellowish secretion from the breast during the first few days after delivery is not mature milk, but a substance richer in protein

and in vitamin A than the milk secreted later. The levels of carbohydrate, fat, niacin, pantothenic acid, biotin, and riboflavin are low initially and reach mature milk levels by the tenth day. Both colostrum and mature milk contain the same levels of ascorbic acid.

The infant receives only 10 to 40 ml of colostrum during the first 2 to 3 days, but by the end of the first week the supply of milk will usually satisfy the full nutrient needs. While the nutritive contribution of colostrum seems to be small, the secretion apparently confers an immunity to certain infections during the first few months and aids in the development of the digestive enzymes.

Intervals of feeding. To feed the infant whenever he cries or to adhere to a rigid time schedule are equally bad, and it is now realized that the intervals of feeding may be reasonably flexible. Healthy infants will establish, after a few weeks, schedules of their own which are reasonably regular from day to day if they are fed when they indicate that they are hungry. Self-demand feeding is not successful, however, for premature infants or those who are weak and sickly.

The success of self-demand feeding depends also upon the mother's ability to determine when the child is hungry. The infant who cries at intervals much shorter than 3 hours may be underfed, may have swallowed too much air at the previous feeding, or may be crying because of other discomforts.

The very young infant may require as many as 10 or 12 feedings at first, but he soon establishes a rhythm of feeding which falls into approximately 3- to 4-hour intervals. After the second month, the night feeding usually may be discontinued. By the end of the fourth or fifth month, the infant sleeps through the night and will no longer require a feeding around 10 P.M.

Adequacy of feeding. About 2.5 ounces of human milk per pound of body weight result in satisfactory weight gain. The baby is getting enough milk if he is satisfied at the end of a 15- to 20-minute feeding, if he falls asleep promptly and sleeps quietly for several hours thereafter, and if he makes satisfactory gains from week to week. The infant should be weighed once a week in the same amount of clothing each time.

Insufficient milk intake is indicated when the infant is not satisfied at the completion of the feeding, when he is restless and fails to fall asleep quickly after nursing, when he awakens frequently if he does go to sleep, and when his gains are not satisfactory. In such cases, the physician may advise adding a supplementary food, or replacing one or more of the breast feedings with bottle feedings.

Even human milk is low in some nutrients required by the growing baby so that it is necessary to supplement the diet of the breast-fed infant according to the routine suggested in Table 23–4.

Weaning the baby. As a rule, weaning is started during the fifth to the ninth month by substituting a cup feeding for the breast at any convenient interval. When the baby has become accustomed to this—after about 4 to 5

days—the second cup feeding is offered and so continued in this way until the baby is entirely weaned. Weaning usually requires a period of 2 to 3 weeks. The transfer from breast to cup should be gradual.

If breast feeding must be terminated at an earlier age, it is usually necessary to substitute bottle feeding, and subsequently to proceed with weaning to the cup. Breast feeding after 9 months has no special advantages for the infant, and may lead to serious depletion of the mother.

FORMULA FEEDING

Comparison of human and cow's milk. The most widely used substitute for human milk is properly modified cow's milk. Goat's milk is used in some countries for infant feeding, and occasionally in this country when the infant is allergic to cow's milk. Milk of other mammals such as the water buffalo, llama, camel, and sheep is used in countries where such milk is available. Table 23–1 gives a comparison of human and cow's milk.

Table 23–1. Composition of Human, Cow's, and Goat's Milk*

	Human†	Cow's	Goat's		Human	Cow's	Goat's
Energy, calories	77	66	67	Vitamin A, I.U.	240	150	160
Protein, gm	1.1	3.5	3.2	Thiamine, mg	0.01	0.03	0.04
Fat, gm	4.0	3.7	4.0	Riboflavin, mg	.04	.17	.11
Carbohydrate, gm	9.5	4.9	4.6	Niacin, mg	.2	.1	.3
Calcium, mg	33	117	129	Ascorbic acid, mg	5	1	1
Phosphorus, mg	14	92	106				
Iron, mg	0.1	tr	.1				

* Watt, B. K., and Merrill, A. L.: Composition of Foods—Raw, Processed, Prepared. Handbook No. 8, U.S. Department of Agriculture, 1964, p. 39.

† U.S. samples.

About half of the protein in human milk is in the form of lactalbumin, which can be quickly digested, whereas only about one fifth of the protein of cow's milk is in this form. Human milk forms fine flocculent curds, while cow's milk forms larger, tougher curds.

The full-term infant utilizes well the fat from both cow's milk and human milk. Cow's milk, however, contains a larger proportion of the volatile, short-chain fatty acids (such as butyric acid), which are somewhat more irritating than the long-chain fatty acids (such as oleic acid) found in human milk.

Human milk contains much more lactose than cow's milk. Both kinds of milk provide approximately 20 calories per ounce. The concentrations of calcium and phosphorus in human milk are much lower than those of cow's milk. The two milks vary widely in their vitamin content. Neither milk contains adequate levels of iron and vitamin D for the infant's needs of the first year.

Nutritional requirements. The Food and Nutrition Board has recognized that human milk is the best food for infants, and will meet the nutritive requirements early in life. Recommended allowances, summarized in Table 23–2, have been stated in terms of nutrients provided by cow's milk and by supplements.

Table 23–2. Recommended Allowances for Normal Infants During the First Year*

Nutrient	0–1 Year *Per Kilogram Body Weight*	0–1 Year *Per Pound Body Weight*	How the Requirement Is Met
Calories†	130–100	59–45	Chiefly milk, 1½–2 oz. per pound; sugar in formula; supplements in increasing amounts
Protein†	3.0–2.0 gm	1.4–0.9 gm	Chiefly milk; egg yolk; meat; cereal
ron	1.0 mg	0.5 mg	Egg yolk, meat, fruits and vegetables
	Total daily need		
Calcium†	700 mg		Milk
Vitamin A	1500 I.U.		Whole milk, fish-liver oil
Vitamin D	400 I.U.		Fish-liver oil or concentrate
Thiamine†	0.4 mg		Milk, egg yolk, enriched cereals, fruit, meat, vegetables
Riboflavin†	0.6 mg		
Niacin†	6 mg		
Ascorbic acid	30 mg		Orange or tomato juice; ascorbic acid supplement

* *Recommended Dietary Allowances, 1964,* 6th ed. Food and Nutrition Board, National Research Council, 1964.

† Calorie and protein allowances decrease proportionately from birth to the end of the first year, while calcium, thiamine, riboflavin, and niacin allowances increase to the levels listed.

ENERGY. The caloric requirement of the infant is high in terms of his body weight because the proportionately larger skin surface leads to large heat loss, the rapid rate of growth represents a considerable storage of energy, and the activity of the infant is great. Since the activity of the infant varies even more widely than that of the adult, the stated allowances can serve only as an approximation. Some infants who are relatively inactive might show excessive weight gains if they received the recommended energy allowances, while others who are very energetic might require more calories than the levels recommended. The healthy baby, given an appropriate formula without having it forced upon him, regulates his appetite according to his needs surprisingly well.

PROTEIN. An allowance of 2.0 to 3.0 gm protein per kg body weight represents a level two to three times as high as that of the adult, and is somewhat greater than that provided by human milk. The Food and Nutrition Board

recognizes that lower levels may well be satisfactory when cow's milk is used, but substantial data are not yet available to establish this.

FAT. Whole cow's milk contains satisfactory levels of the essential fatty acids, linoleic acid and arachidonic acid, required by the infant. Low-fat milks used for a short period of time present no problem since the infant has generous reserves of the essential fatty acids. When low-fat milks are used for a prolonged period of time, or when milk substitutes are used because of allergy, consideration must be given to the inclusion of the essential fatty acids.[2] Vegetable oils such as corn, soybean, and cottonseed oils are good sources.

WATER. The daily fluid needs of the infant are approximately 2.5 ounces per pound of body weight. The water balance is more easily disturbed than that of the adult because of the large fluid losses through the skin and respiration, and because of the needs for elimination.

MINERALS AND VITAMINS. Breast-fed infants have satisfactory mineralization of bones on much lower levels of calcium than the 700 mg recommended for the artificially fed infant by the end of the first year. The circulating hemoglobin of the well-nourished infant is ample during the first three months, after which foods providing iron should be added so that the infant receives about 1.0 mg iron per kilogram body weight.

The requirements for B-complex vitamins are based upon the calorie intake; per 1000 calories these needs are: thiamine 0.4 mg; riboflavin, 0.6 mg; and niacin, 6.6 mg equivalents. About 400 mcg vitamin B_6 should be provided. All of these vitamin requirements are met by the infant's formula and the gradual addition of supplements. The enriched cereals introduced early are important for these vitamins.

The dangers of toxicity of vitamins A and D must be kept in mind. Usually the concentrates prescribed are rich sources of both vitamins. The adverse effects of vitamin A are noted when very large amounts are ingested over a prolonged period of time (see p. 146), but the safe margin of intake for vitamin D is apparently narrower than was once stated. The vitamin-D needs are met with a daily intake of 400 I.U., and levels of 1500 to 1800 I.U. may depress growth.[3] The importance of regulation of the dosage of concentrates can scarcely be overemphasized.

Planning the formula. The type of milk, amount of milk, kind and amount of carbohydrate, and the fluid requirement must be considered in planning the formula.

TYPES OF MILK. The milk selected should be one which is suited to the infant's needs, readily available, inexpensive, and safe. Fresh pasteurized, evaporated, and dried cow's milks are all used frequently. The milk is modified by dilution, homogenization, heating, or acidulation to produce a finer, smoother curd which is more readily digested by the infant.

Evaporated milk is used for a large proportion of all infant formulas because it is inexpensive, readily available, and stored without refrigeration until

the can is opened. It contains fat in a finely divided form, produces a fine, soft curd, and is fortified with 400 I.U. vitamin D per tall can.

Plain or homogenized fresh milk may be used. The latter has a more finely divided fat and forms softer curds than plain milk.

Dried milk may be obtained as whole, skim, or protein milk. It does not require refrigeration, but once the can has been opened the milk powder should be kept in a cool place in a container with a tight lid. By correct dilution the milk may approximate fresh liquid milk, or it may be prepared in a more concentrated form.

Acid-milk formulas prepared from fresh or evaporated milk are occasionally prescribed. Certain advantages are claimed for these formulas: (1) the curd formed is fine and smooth; (2) less dilution is required so that infants with a small capacity may be more readily nourished; (3) the tendency to vomit is reduced; (4) the acid counteracts the neutralizing effect of cow's milk, and calcium and iron may be more completely absorbed.

Numerous commercial milk and milk substitute formulas have been developed to meet the particular needs of an infant. One may now purchase premodified formulas in powdered or concentrated liquid form which require only the addition of sterile water before feeding the baby. Formulas packaged in disposable bottles are another convenience innovation. Although such preparations are being widely used by many mothers, they are still too expensive for the low-income family.

Commercial formulas also include those which have been modified in fat content and increased in protein content. Infants who are allergic to milk may be nourished satisfactorily with formulas prepared from protein hydrolysates, soybeans, and meat bases. The vegetable-protein mixtures initiated in Central America[4] provide another approach for the feeding of infants with milk allergies.

AMOUNT OF MILK. About 1.5 to 2 ounces of fresh whole milk per pound of body weight is suitable for the healthy infant.

SUGAR. Most of the day's caloric needs are met by milk. Since cow's milk is diluted, sugar is added to complete the caloric requirement. Sucrose and corn syrup are inexpensive, easily digested, and lend themselves readily to formula preparation, although they possess the slight disadvantage of sweetness. Lactose, the sugar of milk, is expensive and is seldom used in infant feeding. Dextrinized products such as Dextri-maltose are less sweet and are sometimes prescribed.

During the first 2 weeks the amount of sugar added may be ½ ounce; thereafter, 1 ounce is sufficient until the sixth or seventh month when sugar is eliminated from the formula. As other foods are added to the diet, the sugar in the formula may be reduced or discontinued.

LIQUID. A baby will usually take 2 or 3 ounces more of fluid in a single feeding than his age in months. More than 7 ounces at one feeding is usually undesirable before the infant is 7 months old. Feedings larger than 8 ounces

are not needed after 6 months since the infant will be taking other foods as well. The total fluid requirement of the infant is met by offering water between feedings, and by fruit juices.

INTERVALS OF FEEDING. As with breast feeding, the number of feedings and the amount taken at each feeding should be flexible. Formula-fed infants should not, as a rule, be fed at less than 3-hour intervals since cow's milk remains for a longer time in the stomach than breast milk.

CALCULATION OF THE FORMULA. An example of the calculation of a formula is given below.

Infant, 5 months old, weighs 14 pounds
Number of feedings . . . . . 5 (assuming approximately 4-hour intervals)
Size of feedings: age in months plus 2 . . . . . 5 + 2 = 7 ounces
Daily total: 5 × 7 ounces = 35 ounces
Whole milk: 14 × 1.75 ounces = 24.5 ounces
Water: 35 − 24.5 = 10.5 ounces
Sugar: 1 ounce

This formula provides 490 calories from milk and 120 calories from sugar, or a daily intake of about 44 calories per pound of body weight. Food supplements given at this age will further increase the caloric intake. The formula contains 24.5 gm protein or about 1.7 gm protein per pound of body weight.

Technique of feeding. The feeding should always be given at body temperature. Remove the bottle from the refrigerator, and stand it in a deep saucepan full of warm water. Heat the water rapidly, and shake the bottle several times to assure that the mixture is uniformly heated. It takes only a few minutes to reach the desired temperature of 100° F. To test the temperature of the milk, invert the bottle and allow a few drops of formula to fall on the inner surface of the forearm; it is the correct temperature when the heat is barely felt.

The mother or other individual feeding the baby should sit in a comfortable chair, and should hold the infant in a semireclining position. In this way the infant is given the sense of security and love which is so important. The baby should not be propped up with his bottle.

The hole in the nipple should not be too large since the rapid taking of the formula together with the swallowing of much air will cause discomfort and perhaps regurgitation. On the other hand, a very small hole in the nipple will necessitate too long a period of feeding; a not overstrong baby may become exhausted before obtaining enough food.

The baby should not be forced to empty the bottle at each feeding. Any formula remaining in the bottle must be discarded.

If the nipple is filled with fluid, and not air, during the feeding, less air will be swallowed. Even so, it is necessary that the baby be allowed to belch. He should be held over the shoulder, or allowed to sit upright on one's lap, and patted gently on the back. This "bubbling" should be done midway and at the

end of each feeding—more frequently during the early part of the feeding, if necessary.

FORMULAS FOR THE PREMATURE INFANT

Nutritive requirements. The premature infant is born with poorly developed muscle tissues, very little body fat, low stores of iron, and an inadequately mineralized skeleton. Regulation of the body temperature is difficult because of the very high surface area and the incomplete development of the sweat glands. The digestive ability is limited since the stomach can hold little food at the time, and the digestive enzymes are not sufficiently developed for satisfactory digestion and absorption of fat.

Very small infants are unable to suck, while somewhat larger infants may be overfatigued if sucking is prolonged. Feeding by medicine dropper or by gavage may be necessary.

The first need is for fluid, and in most instances, with a graduated program, the baby will be receiving his full nutritive requirements by the end of the first week to 10 days. The following allowances have been recommended for some of the nutrients:

Calories: 55 to 60 per pound
Protein: 2.0 to 2.7 gm per pound[5]
Vitamin A: 2500 I.U.
Vitamin D: 400 I.U.
Ascorbic acid: 30–50 mg

Intervals of feeding. Since very small babies can take only limited amounts of fluid, they are preferably fed at 2-hour intervals for the first few days; thereafter, 3-hour intervals may be used.

Choice of formula. Human milk, evaporated milk, or partially skimmed milk formulas are used. Human milk, however, contains insufficient protein, calcium, and phosphorus for the rate of growth required of the premature infant; it may be fortified by using skimmed cow's milk. Under careful supervision, better gains are obtained with mixtures of partially skimmed cow's milk or evaporated milk because of the somewhat greater protein and mineral content. Feeding mixtures which may be employed are illustrated in Table 23–3.

Amount of feeding. The first feedings for the small infant should be only ½ teaspoonful at a time, with slightly larger amounts for larger babies. When it is clearly evident that the infant can tolerate the initial amount given, the feedings are increased by ½ to 1 teaspoonful. It is advisable to make increases at every other feeding rather than at every feeding.

Suggested daily program. FIRST 12 HOURS: Nothing by mouth.

SECOND 12 HOURS. A 5 per cent solution of glucose or lactose is given at

Table 23–3. Feeding Mixtures Designed to Give 120 Calories per Kilogram (55 Calories per Pound)*

	Per Kilogram	Per Pound	Grams/Kilogram			Percentage of Total Calories		
			Protein	Fat	Carbohydrate	Protein	Fat	Carbohydrate
Human milk	180 ml	2½ oz	2.2	6.7	12.9	7	50	43
Evaporated milk	70 ml	1 oz	4.8	5.5	12.9	16	41	43
Carbohydrate	6 gm	3 gm						
Water to make	150 ml	2¼ oz						
Half-skim milk powder	18 gm	1 tbsp	6.0	2.2	19.4	20	16	64
Carbohydrate	11 gm	5 gm						
Water to make	150 ml	2¼ oz						

* Gordon, H. H., *et al.*: "Feeding of Premature Infants. A Comparison of Human and Cow's Milk," *Am. J. Dis. Child.*, 73: 442, 1947.

2- to 3-hour intervals, beginning with ½-teaspoonful amounts, and increasing the feedings by ½ teaspoonful at alternate feedings.

THIRD 12 HOURS. One of the formulas listed in Table 23–3 is prepared and diluted with an equal amount of 5 per cent glucose solution. One-half-teaspoonful amounts of the diluted formula are given at the first feeding. This is alternated with the glucose solution throughout the next 12 hours. The amount of formula is increased at alternate intervals.

FOURTH 12 HOURS. Feedings of the formula are now given every 2 to 3 hours, the amount being increased at alternate intervals as tolerated.

THIRD DAY AND THEREAFTER. By the fourth or fifth day most babies can take the formula in the full concentration outlined above, and by the end of a week to 10 days they can take the fully prescribed amounts of formula to meet their nutritive needs. One should not increase both the concentration and volume at any single feeding. The formula must be adjusted every few days to correspond to the baby's weight.

Ascorbic acid in gradually increasing amounts up to 50 mg is given by the end of the second or third week. Orange juice is not given until the baby is several weeks to 1 or 2 months old.

The infant should receive 400 I.U. of vitamin D daily by the end of the second or third week, preferably as a water-soluble preparation.

PREPARATION OF THE FORMULA

Equipment needed. The usual equipment includes:

Bottles, 8 oz graduated, of heat-resistant glass or plastic which can be boiled; wide-mouth bottles are easier to clean; provide one for each feeding plus 2 or 3 extra for water and orange juice

Nipples, one for each feeding, plus extra for orange juice and water
Bottle caps, glass, metal, plastic, or paper
Bottle sterilizer or large kettle with wire rack to hold bottles
Saucepan or pitcher with pouring lip, 2–3 quart size, for mixing formula
Standard measuring cup with pouring lip, graduated in ounces
Standard measuring spoons
Long-handled spoon
Funnel
Bottle brush with stiff bristles and long handle
Tongs are convenient
Jar for used nipples
Fine strainer
Can opener if evaporated milk is used

Care of equipment. Before starting to make the formula the hands should be scrubbed thoroughly and the work area should be scrupulously clean. Persons with a skin disease should not be permitted to prepare feedings.

Immediately after each feeding rinse the bottle and nipple with cold water. Fill the bottle with cold water and allow to stand. Scrub all bottles at one time with detergent and water, using a long-handled brush which will reach into the corners of the bottles. Rinse bottles thoroughly in warm water. Scrub nipples inside and out with water and rinse. Test each nipple to be sure that the hole has not become plugged.

Terminal sterilization. Measure the required amount of sugar, leveling off the spoon with a knife, and put into a large pitcher or saucepan. Add measured amounts of milk and water and mix well. Pour formula into bottles according to the amount required for each feeding. Put nipples on bottles and test the flow of milk. Cover loosely with nipple covers.

Place bottles on rack in sterilizer. Include one or two extra bottles of drinking water. Pour water into the sterilizer until water comes halfway up on the bottles.

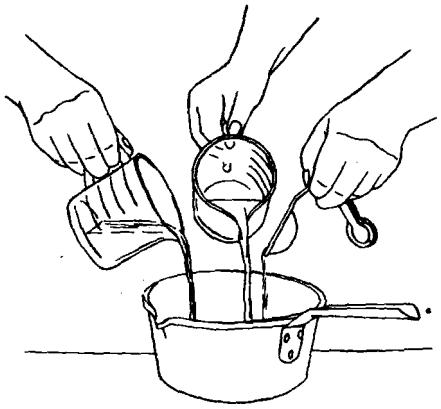
Cover the sterilizer. Bring water to a boil and continue boiling gently for 25 minutes. Remove sterilizer from heat and let stand until bottles are cool enough to handle. Press nipple covers down firmly. Cool bottles to room temperature and then place in the refrigerator.

Standard clean technique. Place clean bottles upside down in the wire rack. Lower rack into pot containing 2 inches of water. Place nipples in jar with metal top in which holes have been punched. Place bottle caps, nipples, funnel, and strainer in sterilizer with the bottles. Cover the pot and allow to boil for at least 5 minutes after steam begins to escape in appreciable amounts.

MIXING THE FORMULA. Into the saucepan measure the required amount of sugar with a tablespoon, leveling off the top with a knife. Measure the specified amount of water with a measuring cup and add to the sugar. Allow a little extra water to take care of the loss in evaporation—usually ½ to 1 ounce. Invert the milk bottle several times to ensure uniform mixture, and hold it under running water before removing the cap. After wiping the cap, add the amount of milk specified in the formula prescription to the water and sugar.



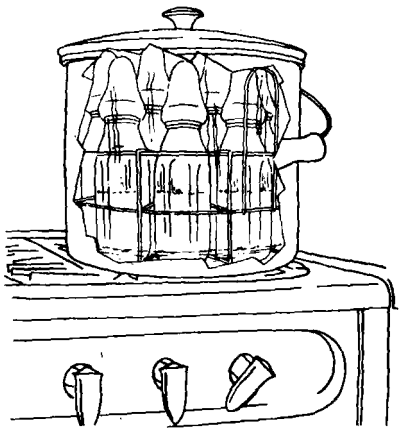
A. Scrub bottles, nipples, and equipment.



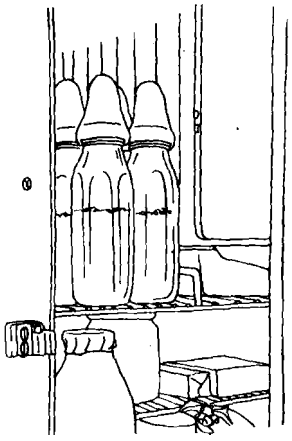
B. Measure and mix milk, sugar, and water in pan with pouring lip.



C. Pour mixture into bottles.



D. Place bottles on rack in sterilizer. Boil gently for 25 minutes.



E. Store capped bottles in refrigerator.

FIG. 23–1. Steps in preparation and terminal sterilization of infant's formula. (*Courtesy, Children's Bureau, U.S. Department of Health, Education, and Welfare.*)

Mix well and boil gently for 5 minutes, stirring constantly. Allow to cool for a few minutes, stirring from time to time to keep scum from forming.

FILLING THE BOTTLES. Lift the sterilized bottles from the pot without touching the mouth of the bottle. Insert the funnel into the neck of the bottle, and put the strainer in place over the funnel. Pour the exact amount of milk required for each feeding into the hot bottles. Place a nipple on each bottle, being careful not to touch the part which goes into the baby's mouth. Cover nipple with metal or glass cap. Cool the bottles rapidly under running water, using care to avoid contamination of nipples with the water. Store in the refrigerator until needed.

Evaporated-milk formula. Evaporated milk may be substituted for fresh cow's milk if properly diluted. For example, if the formula calls for 20 ounces of fresh cow's milk and 10 ounces of water, one would use 10 ounces of evaporated milk and 20 ounces of water. Before the can of milk is opened, the top should be scrubbed with soapy water and rinsed well with hot water. The procedure for preparation of the formula is the same as that for fresh-milk formulas.

Dried-milk formulas. If a dried-milk product is used, measure the required amount of water into a saucepan. Then measure the dried milk with a dry tablespoon, leveling each spoonful with a knife. Sprinkle the dry powder on the surface of the water and beat thoroughly with an egg beater until well mixed. Add sugar, mix well, and then proceed as for fresh-milk formulas, using either terminal sterilization or clean technique.

Acid-milk formulas. The use of lactic acid or lactic acid-producing bacteria to acidify milk produces a milk having a fine curd. Lactic acid is diluted by adding 6 ml of 85 per cent U.S.P. lactic acid to 1 ounce of boiled water. The diluted solution is poured slowly with constant stirring into 1 quart milk which has been boiled and cooled. The necessary amount of sugar is then mixed with the acid milk. No further heating or dilution is necessary. There are several brands of dried acid milk on the market which may be substituted for the acid milk prepared at home.

SUPPLEMENTARY FOODS DURING THE FIRST YEAR

Supplements of vitamin D and of ascorbic acid are provided after the second or third week of life. Practices vary widely concerning the time when solid foods are introduced. Many infants are now given some solid food as early as six weeks, while others are fed the first solid foods at about three months or so. No clear advantage can be ascribed to one or the other, since babies thrive on either.

Introduction of new foods. A number of practical suggestions are offered for the introduction of new foods.

1. Introduce only one new food at a time. Allow the infant to become familiar with that food before trying to give another.

2. Give very small amounts of any new food—teaspoonfuls or even less—at the beginning.

3. Use a very thin consistency when starting solid foods. Gradually the consistency is made more solid as the infant learns how to use his tongue in propelling the food back. A small spoon is put into the baby's mouth so that the food is placed on the middle of the tongue and swallowing is more readily accomplished. The fact that a baby spits out his first feedings of solid food may indicate that he hasn't yet learned the tongue movements rather than that he doesn't like the food.

4. Never force an infant to eat more of a food than he takes willingly.

5. If, after several trials, it is apparent that a baby has an acute dislike for a food, omit that item for a week or two and then try it again. If the dislike persists it is better to forget about that food for a while and substitute another.

6. Food should be slightly seasoned with salt. Other seasonings are avoided.

7. Use foods of smooth consistency at first—strained fruits, vegetables, and meats.

8. When the baby is able to chew, gradually substitute finely chopped fruits and vegetables for puréed foods—usually at 8 to 9 months.

9. Infants may object to taking some foods by themselves but will take them willingly if they are mixed with another food. For example, egg may be mixed with formula, cereal, or vegetable; again, vegetables may sometimes be made into a soup with a little milk until the baby becomes accustomed to the new flavor.

10. Variety in choice of foods is important. The baby, like older persons, may tire of the repetition of certain foods, especially cereals and vegetables.

11. The mother or anyone feeding the infant must be careful to avoid showing in any way a dislike for a food which is being given.

Sequence of additions. No uniformity of opinion exists concerning the time and sequence at which supplements are added. Some pediatricians introduce cereals, egg yolk, strained meats, fruits, and vegetables very early. In many infants the swallowing reflex is not fully established until the third or fourth month, and too early feeding, especially if forced, could lead to resistance and rebellion later on. The outline in Table 23–4 for feeding during the first year is typical of many.

Vitamins. Cod-liver oil, concentrated fish oils such as percomorph or haliver oil, or water-miscible preparations of vitamin D are started during the second or third week of life. A teaspoonful of one preparation may be required to provide the necessary amount of vitamin D, while only a few drops of a concentrate may suffice. Since vitamin D and the vitamin A also present in most preparations are both toxic, great care must be taken to see that the exact dosages prescribed are used.

Supplements for ascorbic acid are usually begun during the second or third week of life. One teaspoonful of strained orange juice (fresh, canned, or frozen) is diluted with an equal amount of boiled water and given at first. The amount is gradually increased until the baby is taking 3 ounces of juice

Table 23–4. Typical Feeding Schedules for Normal Babies During the First Year*

Hour	Food	1 Month	3 Months	6 Months	10–12 Months
6 A.M.	Formula†	3–4 oz	5–6 oz	7–8 oz	6 A.M.
8 A.M.	Orange juice Vitamin D‡	1 oz 400 I.U.	3 oz 400 I.U.	3 oz 400 I.U.	Orange juice, 3 oz Zwieback, ½ piece
10 A.M.	Formula Cereal	3–4 oz	5–6 oz ¼–2 tbsp	7–8 oz 2–4 tbsp	Breakfast, 7:30 A.M. Cereal, 2–5 tbsp Milk, 8 oz Chopped fruit, 1–2 tbsp Vitamin D, 400 I.U.
2 P.M.	Formula Egg yolk Vegetable	3–4 oz	5–6 oz	7–8 oz 1 yolk 2–3 tbsp	
6 P.M.	Formula Cereal Fruit	3–4 oz	5–6 oz	7–8 oz 2–4 tbsp ¼–2 tbsp	Dinner, 11:30–12 Meat, ½–1 oz, *or* Egg, 1 whole Potato, 2–4 tbsp Chopped vegetable, 2–4 tbsp Milk, 8 oz
10 P.M.	Formula	3–4 oz	5–6 oz	Discontinued	
2 A.M.	Formula	3–4 oz	Discontinued		Supper, 5:30 P.M. Cereal or potato, 2–5 tbsp Milk, 8 oz Chopped fruit, 1–2 tbsp Toast or zwieback

* *Feeding intervals, amounts of food, and age at which supplements are given are subject to individual variation.*

† Formula or breast milk; plain milk after 7 to 9 months.

‡ The appropriate concentrate for vitamin D is prescribed by the physician. Note exact measurements carefully.

a day by the age of 3 months. Grapefruit or tomato juice may be used, but the latter must be given in twice as great amounts to provide equivalent vitamin C. The mother must be cautioned not to boil the juices.

Some pediatricians give 25 mg ascorbic acid in ½ ounce of water from the first week of life, and defer giving orange juice until about 1 month of age or later.

Cereal foods. Cereals are often the first semisolid foods given to the baby, at approximately 2 to 4 months. Specially formulated dry infant cereal foods possess the distinct advantage of enrichment with iron, thus bolstering the iron intake when body reserves have reached a low point. These cereal foods are mixed with a portion of the warm formula to the desired consistency.

Cooked cereals given to the rest of the family may also be used for the baby if they have been thoroughly cooked, are well strained, and are diluted with part of the formula. Cooking directions appear on the containers in which the cereal is purchased.

Crisp toast, zwieback, and graham crackers may be given when the teeth begin to appear, about 5 to 8 months.

Egg yolk. The rich source of iron and of B-complex vitamins, as well as vitamin A, are reasons favoring the introduction of egg yolk at the third to the fifth month. Hard-cooked egg yolk may be mashed with a fork and mixed with part of the formula, cereal, or vegetable. Only ¼-teaspoonful amounts should be given initially since some infants may be allergic to the egg protein. Soft custard is also a suitable way in which to introduce the egg yolk. Egg white, which leads to allergic manifestations more frequently, is not given until the infant is at least 8 to 10 months old and it then is introduced with extreme caution.

Fruits. Ripe banana and strained orange or grapefruit juice are the only raw fruits permitted during the first year. Cooked or canned prunes, pears, applesauce, peaches, and apricots are the fruits with which an infant first becomes acquainted, usually by the third to fourth month. These fruits are strained for the first few months they are offered, but they may be chopped by the end of the first year. Most babies accept fruits very well.

Vegetables. Strained carrots, green beans, spinach, squash, peas, asparagus, and tomatoes are all suitable for the infant from the fourth month or earlier. They are conveniently purchased in small cans, or the vegetables may be cooked at home until very soft, lightly seasoned with salt, and pressed through a sieve. The first feeding of less than 1 teaspoon is gradually increased to 3 or 4 tablespoons daily by the end of the year. Chopped vegetables are substituted for strained vegetables at 10 to 12 months. Baked or mashed potato may be included occasionally by the seventh month.

Meats. Canned strained baby meats may be used as early as the second month, although they are more usually introduced at the fifth to the seventh month. When the baby is accustomed to strained meats and meat soups, he may be given ground meat including beef, lamb, lean pork, thoroughly boned fish, chicken, and liver. The baby who is teething often enjoys a piece of crisp bacon.

Other foods. In some areas such as the Southwest, a variety of beans are widely used. They are a good source of protein, iron, and B-complex vitamins, and may be cooked and sieved for the infant. The infant may be given simple puddings toward the end of the first year. It is desirable that the amounts of sugar used in the preparation of fruits and puddings be kept small so that the infant does not develop a special craving for sweets.

ESTABLISHMENT OF GOOD FOOD HABITS

Most of the feeding problems of children begin during the first few months or years of life. Spock[6] calls attention to one of the early problems, namely, the loss of appetite and even refusal of food, as being traceable to overfeeding

by the overanxious mother who has been sent home from the hospital with a formula a little too large. When the baby takes enough of the formula to satisfy him he promptly goes to sleep; the mother looks with alarm at the amount left in the bottle and, fearing the baby has not taken enough, proceeds to waken him. Although he cries in protest, she slips the nipple into his mouth and stirs it vigorously in an attempt to get him to suck. Spock says that the rapidly increasing appetite at this time helps the baby to catch up with his formula before the mother has taken away his appetite entirely. If the mother is instructed in the proper care and handling of the feeding as well as other problems of infancy during her stay in the hospital, it is possible that many objectionable situations may be avoided.

Toward the end of the first year and during the second year the baby will show a marked drop in appetite. He starts to refuse foods he formerly liked, and he may eat much less than he did. This is occasioned in part by the growing individuality and the negativistic attitude which appear at this age; it is also explained by the slower growth rate at the end of the first year and during the next few years. If the mother would have the baby retain good food habits, she will permit the baby to adjust the amounts of food he will take. It may be necessary to omit certain formerly liked items of food for a while or to serve them in an entirely new manner.

One of the most harmful practices is that of trying to make the feeding pattern of a baby and his physical development correspond exactly to a textbook description or to match or surpass the accomplishments of a neighbor's child. Each baby is an individual; some learn slowly and others rapidly; some are more active than others, and so on. The fact that one baby may eat vegetables well at 4 months of age is no indication that another baby will not make equal progress even though he learns to eat vegetables in only small amounts at 6 to 7 months! Likewise, some babies will happily adjust from bottle to cup at 9 months while others may not do so until they are almost a year old. Parents and others who are responsible for the feeding of children should remember this individuality and the need for flexibility concerning the intervals of feeding, the amounts of food that may be taken, the age at which new foods are given, and the response which may be expected.

The attitude of the parents has much to do with the establishment of good eating habits. Learning to eat food that is different in texture and flavor, trying to hold a cup and bring it to the mouth without spilling, or putting food onto a spoon and eating it are new and interesting experiences for the baby. He may wish to handle the food to see what it feels like, or he may prefer to use his fingers in eating. Then again, he may delight in throwing the food about him or onto the floor. The mother must be very patient at these times lest she be tempted to say "Don't do that!" and thus create antagonisms in the child. Equally harmful is the overattentive attitude in which the mother or other bystander laughs at the "cute" tricks of the baby, thus encouraging repetition of the action. The best way to overcome an undesirable practice before it

becomes habit is to ignore, by look, word, or deed, such action on the part of the child. Approval, given at the right time, will quickly teach a baby to repeat favorable behavior.

Learning to like new foods may depend on the manner in which they are started. (See suggestions on p. 352.) It is best to introduce new foods at the beginning of the feeding when the baby's appetite is still on edge. One cannot overemphasize the importance of gradually accustoming the baby to new tastes with no attempt at using force or bribery. The parent must avoid showing any concern when a food is not taken but should be ready to praise when a new food has been taken well. The very smooth strained foods should not be continued too long since it may be difficult to adjust the baby to chopped or coarser foods.

Even babies react to the general atmosphere about them. They must be comfortable if they are to enjoy their food. They will eat better if the mother is unhurried, calm, and pleasant but not overtalkative.

PROBLEMS AND REVIEW

1. For what reasons is breast feeding preferred to artificial feeding? Under what circumstances would it be contraindicated?
2. Even though human milk is the ideal food for infants, it does not always provide adequate amounts of ascorbic acid and is especially low in vitamin D. How are the infant's needs for these vitamins met?
3. Weaning should be a gradual transition from the breast to the bottle or cup. When is it usually started? What procedure will ensure satisfactory weaning?
4. Cow's milk is the best substitute for human milk. In what respects does cow's milk differ from human milk?
5. Fresh, evaporated, and dried milks may be used for the preparation of formulas. What advantages may be claimed for each type of milk?
6. Human milk and whole cow's milk both contain about 20 calories per ounce. Why is water added to the cow's milk formula for the young infant? How is the caloric level of 20 calories per ounce maintained?
7. The normal rate of gain during the first half year is 5 to 8 ounces. What explanation may be given for a 4-month-old baby who has shown only 6 ounces gain in 4 weeks?
8. *Problems.* Calculate a formula for an infant 4 months of age who weighs 12 pounds. Describe in detail how you would instruct a mother in the preparation of this formula. What changes would be necessary if you were using evaporated milk? Dried milk? Include directions for terminal sterilization of the formula. Why is this preferred to clean technique?
9. Supplements must be added to the infant's formula at various intervals throughout the first year in order to supply the necessary nutrients and to accustom the infant to a solid diet. What supplementary foods are usually included, and at what age is it advisable to start each? What nutrients are especially important in each of these?
10. What recommendations could you give to a mother who is beginning the use of supplementary foods for her infant so that satisfactory food habits are established?
11. Egg white is customarily omitted from the young infant's diet. Why?
12. *Problem.* Outline the day's diet for an infant of 7 months. Include a calculation of the formula.
13. *Problem.* How do the nutritive requirements of premature infants differ from those born at full term? Describe a feeding program during the first week of life for a premature infant who weighs 3½ pounds.
14. What recommendations could you give for the preparation of a formula when no refrigeration is available?

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Chapter 24

NUTRITION FOR CHILDREN AND TEEN-AGERS

Growth and development. The term *growth* refers to an increase in size because of cell multiplication; the term *development* denotes an increase in the complexity of function. The size of a person is limited by his heredity, but nutrition and other environmental factors determine whether a child will realize his full potential.

The toddler gains 8 to 10 pounds during the second year, thus quadrupling his birth weight. Thereafter, the yearly gains are approximately 4 to 7 pounds up to the preadolescent period. For a year or two before and during adolescence an accelerated rate of growth again takes place. The maximum gain in weight and in height occurs in girls at 11 to 13 years and in boys at 13 to 15 years. Girls are taller and heavier than boys at 11 to 12 years, but thereafter the boys catch up with and exceed the girls. Weight gain is generally more rapid in the fall and early winter, while the greatest gains in height usually occur in the late winter and spring.

The number, size, and composition of the bones change from birth to maturity. The skeleton has usually reached its full size at 17 years in girls, and at 20 years in boys. The water content of the bones gradually diminishes as the mineralization increases. For several years following the attainment of full size, bone mineralization continues, providing that the diet remains good. This helps to ensure bones less liable to injury under physical stress, and is also a distinct advantage to the girl in preparation for motherhood.

Criteria of good nutritional status. A full assessment of the nutritional status of the child can be made only by specialists qualified to give comprehensive physical and dental examinations, to make biochemical studies of the blood and urine, and to evaluate patterns of growth and measurements of body size. Longitudinal-type grids (Wetzel grid) or percentile curves (Stuart-Meredith curves) are replacing the height-weight tables for the assessment of growth. These guides permit evaluation of the child from time to time and also provide a basis for comparison with other children. X-rays of the bones of the hands and wrist are often used to study ossification.

Certain physical and behavioral characteristics may be noted by the mother, teacher, or nurse which would indicate that some children should be studied more carefully with respect to the adequacy of their nutrition. The well-nourished child may be expected to exhibit these characteristics:

Sense of well-being: alert; interested in activities usual for the age; vigorous; happy.
Vitality: endurance during activity; quick recovery from fatigue; looks rested; does not fall asleep in school; sleeps well at night.
Weight: normal for height, age, and body build.
Posture: erect; arms and legs straight; abdomen pulled in; chest out.
Teeth: straight, without crowding in well-shaped jaw.
Gums: firm, pink; no signs of bleeding.
Skin: smooth, slightly moist; healthy glow; reddish-pink mucous membranes.
Eyes: clear, bright; no circles of fatigue around them.
Hair: lustrous; healthy scalp.
Muscles: well-developed; firm.
Nervous control: good attention span for his age; gets along well with others; does not cry easily; not irritable and restless.
Gastrointestinal factors: good appetite; normal, regular elimination.

Nutritional status of children. Many dietary surveys and studies of nutritional status of children have been conducted for all age categories. Beal and her associates at the Child Research Center in Denver[1] and Burke and her coworkers at the Center for Research in Child Health and Development in Boston[2] show that children of a given age set up their individual patterns of growth which may vary widely, just as their intakes of nutrients vary. These studies are of special significance since each child is observed over a span of years, and thus in a sense serves as his own control.

Stature is considered to be an important index of nutritional status because it is an indication of how well the individual has been able to achieve his genetic potential. The individual who is short may never have received the essential nutrients in sufficient quantity for the best development of his body, while the tall individual gives indication of full development. Mitchell[3] has reported on the changes in stature which occurred in boys and girls in Japan over a ten-year period following the war as compared with a similar group prior to the war. As a direct outcome of an improved diet the stature of the boys and girls following the war was significantly greater; the protein content of the diet was believed to be especially important in bringing about this increase.

Nutritional status studies were conducted from 1947 to 1958 by more than 200 investigators in 39 states on approximately 4000 children 5 to 12 years old and an equal number of adolescents 13 to 20 years.[4] (See Figure 24–1.) At all ages the nutrient intakes by boys were somewhat better than by girls. Elementary school children more nearly met the recommended allowances than did teen-agers. In fact, no segment of the population established as poor a nutrient intake as did the adolescent girl.

Up to the age of 12 years, boys and girls had mean intakes of all nutrients in excess of the recommended allowances, except that the calcium intake

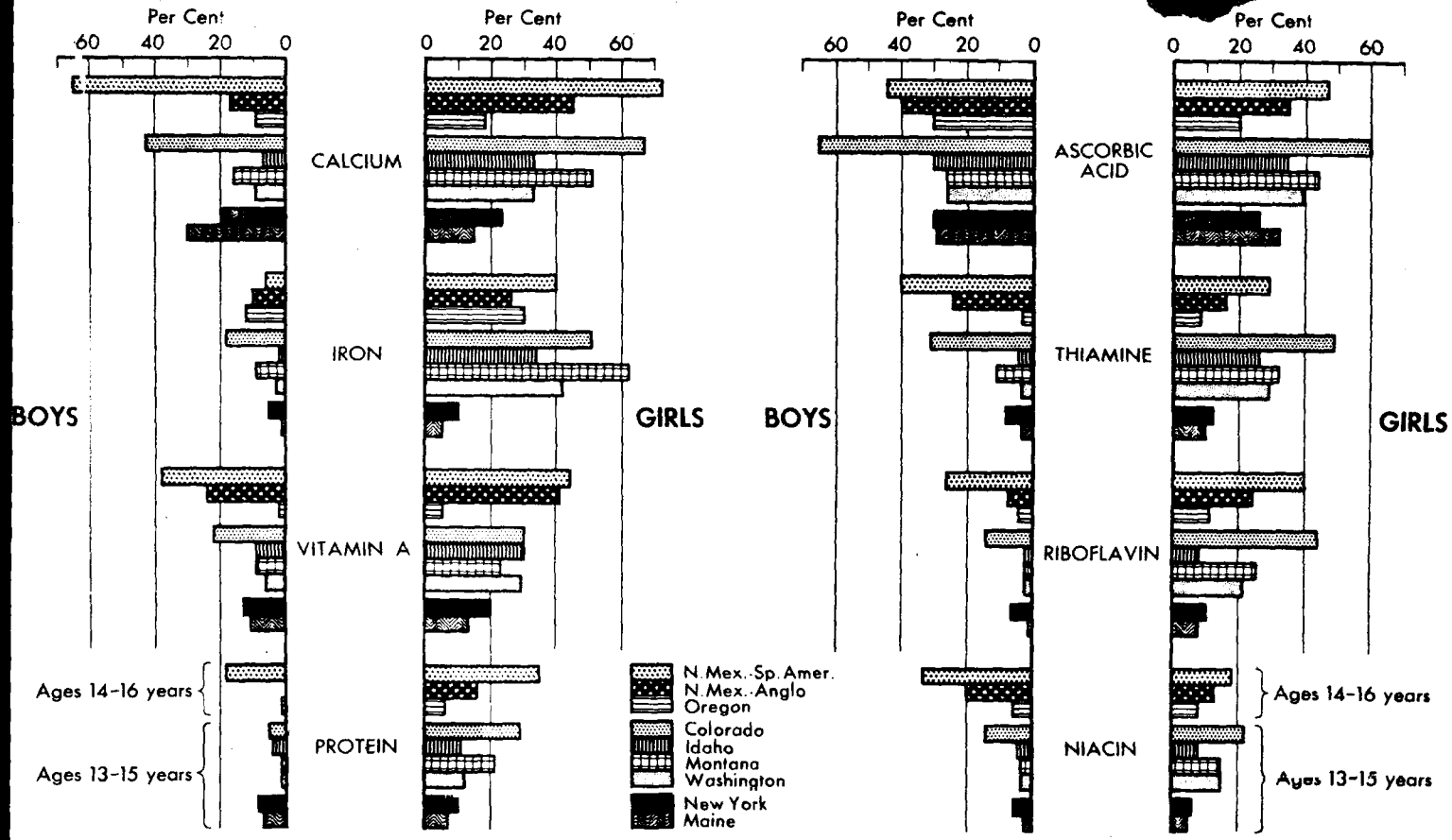


FIG. 24–1. Percentage of boys and girls 13 to 16 years in six western and two northeastern states who ate less than two thirds the recommended amounts of mentioned nutrients. (*Courtesy, California Agricultural Experiment Station.*)

was slightly low for the girls. For boys of 13 to 20 years, mean intakes of all nutrients except vitamin C were more than adequate. The mean intakes of girls, 13 years and over, equaled or exceeded the recommended allowances only for vitamin A, riboflavin, and niacin. The intakes of calcium, ascorbic acid, and thiamine were seriously inadequate, while the intake of protein was moderately low. Regional differences and the effects of income were noted in the studies. The investigators emphasized that intakes of nutrients below recommended allowances are not necessarily indicative of poor nutritional status in children since it is well recognized that the allowances provide a generous margin of safety for most people.

The overall nutritional status of the child in the United States may be characterized as good. Nevertheless, individual children in all communities, for one another, do not have the full benefits of good nutrition. In the cotudies cited above, some correlation was found between the dietary he blood levels of ascorbic acid and vitamin A, and between the in and iron and the blood hemoglobin levels. They also found d eye changes, such as inflammation of the eyes and reddened sociated with low vitamin-A and-C levels of the blood.

FIG. 24–2. MAINTAIN NORMAL WEIGHT is a frequently recurring problem. vegetable-prot studies indicated that overweight and underweight occurred Nations Childre ency in boys and girls prior to adolescence. During adolesnore often overweight and boys were more frequently underof overweight or thinness increasing with age. Studies on overwe e shown that the caloric intake, surprisingly, is not as great as that of girls of normal weight; however, the activity of the overweight girls has been less.[5,8]

DENTAL DECAY is probably the most prevalent disease in the country, although a full rationale for its prevention is still lacking. Unquestionably, fluoridation of water supplies (see Chapter 9) and a fully adequate diet, including vitamin D supplementation, afford protection against caries incidence. On the other hand, sticky carbohydrates in contact with the tooth surfaces provide the favorable environment for the growth of decay-producing bacteria.

STRESSES of various kinds may have an adverse effect on nutrition. The incidence of tuberculosis is higher than it should be in the adolescent years and in early adulthood, and is believed to occur more frequently in those who have had inadequate diets, especially with respect to protein and calcium. A large proportion of infants are born to young women who have not yet completed their own body growth and maturation. The stress of pregnancy can have serious effects on the girl who has had a poor intake of protein, calcium, and iron during the preceding years. Johnston[7] has called attention to the frequency with which slipping of the upper femoral epiphysis takes place in rapidly growing adolescent girls.

Common dietary errors. The mean intakes of nutrients by children of all ages do not give any indication of the numbers who receive less than the

recommended levels. Ascorbic acid, calcium, iron, and vitamin A are the nutrients which are most frequently provided in less than recommended amounts in the diets of children. These lacks occur with unsatisfactory intakes of milk, fruit (especially those rich in ascorbic acid), and vegetables (especially those which are green leafy or deep yellow). A number of poor dietary habits contribute to these deficiencies:

Poor breakfasts or none at all: lack of appetite; getting up too late; no one to prepare breakfast; monotony of breakfast foods; no protein at breakfast, meaning that the distribution of good quality protein is poor even though the day's total may be satisfactory; too little fruit, meaning that ascorbic acid often is not obtained.

Poor lunches: failure to participate in school lunch program; poor box lunches; spending lunch money for snacks or other items; unsatisfactory management of school lunch program with resultant poor menus, poor food preparation, excessive plate waste.

Snacks: account for as much as ¼ of calories without providing significant amounts of protein, minerals, and vitamins; often eaten too near to mealtime thus spoiling the appetite.

Overuse of milk, especially by younger children: other foods are not eaten so that the intake of iron and certain vitamins may be low.

Self-imposed dieting, especially by teen-age girls: caloric restriction but no consideration given to protein, minerals, and vitamins.

Irregular eating habits: few meals with the family group; no adult supervision in eating; children often prepare own meals without guidance.

NUTRITIONAL REQUIREMENTS

The recommended allowances for children of all ages (Table 4–1) are proportionately higher than those for adults.

Energy. Body size, age, and activity influence the caloric requirement of the child. The very young child has a high basal metabolic rate incident to intensive cellular activity and to a proportionately high surface area. Year by year the rate of metabolism decreases, then accelerates somewhat during adolescence, after which it again declines to the adult level. The basal metabolism of boys is higher than that of girls owing to the greater muscle mass. Superimposed upon the basal metabolic rate are relatively large requirements for growth and for activity.

The requirements of individual children vary widely, and the recommen allowances can only serve as a guide. The 1- to 3-year-old needs abou calories daily, the 6- to 9-year-old should have 2100 calories whi much as his mother is likely to need, and the 15- to 18-year-old b 3400 calories. Boys engaged in competitive athletics or heav have considerably more calories if they are to grow satisfacto Hunscher[8] have shown that a deficit of as little as 10 calo

body weight resulted in failure to grow and depression of nitrogen retention even though the protein intake had been satisfactory.

Protein. A liberal allowance of protein is desirable throughout childhood in order to provide for increase in muscle mass, for the formation of the matrix of skeletal tissues, and for protection against infection—especially tuberculosis. (See Figure 24–2.) The total daily protein allowance for children 9 to 12 years, for example, equals that for their parents, while adolescent boys and girls require more. Based on body weight, the allowance decreases from 2.5 gm per kilogram for the 1- to 3-year-old to 1.4 gm per kilogram for the teen-ager. About 12 to 15 per cent of the calories should normally be obtained from protein.

Since the requirement for essential amino acids (see Table 5–1) is proportionately greater for children than for adults, one half to two thirds of the protein should be selected from complete protein foods.



nice to be healthy. A nurse in Guatemala gives small patients more of mixture that helped them recover from kwashiorkor. (*Courtesy, United Fund.*)

Meal patterns. The Four Food Groups constitute a sound basis for planning the daily meals. Children of this age should consume each day:

- 4 cups of cow's milk
- 2 ounces chopped meat, fish, or poultry
- 1 cup orange juice or other source of ascorbic acid
- 2 tablespoons other fruit such as banana, peaches, pears, apple, apricot, prunes
- 2 tablespoons vegetables, including deep yellow and dark-green leafy
- 1 potato
- 1 raw vegetable such as carrot sticks, cabbage slices, lettuce, tomato
- ⅓ to ⅔ cup enriched dry or cooked cereal
- 1–3 slices enriched or whole-grain bread
- 400 I.U vitamin D, either as fortified milk or as a concentrate

The following meal patterns for a child from one to six* show that little adjustment needs to be made from the adult menu.

BREAKFAST	LUNCH OR SUPPER	DINNER
Fruit or juice	Main dish—mainly meat, eggs, fish, poultry, dried beans or peas, cheese, peanut butter	Meat, poultry, or fish
Cereal with milk	Vegetable or salad	Vegetable
Toast	Bread	Relish or salad
Butter or margarine	Butter or margarine	Bread
Milk	Dessert or fruit	Butter or margarine
	Milk	Fruit or pudding
		Milk

SNACKS. Most young children with a limited capacity for food are more likely to obtain all the dietary essentials if they are fed something in the middle of the morning and the afternoon. Moreover, very active children become excessively fatigued and hungry if they are not fed between meals. Snacks should make a liberal contribution to one or more of the nutrient needs. (See Figure 24-3.) Some which are suitable for preschool children are:

- Fruit juices with little or no sugar
- Milk and milk beverages
- Fruit of any kind; raw vegetables
- Small sandwiches; crackers with peanut butter
- Molasses, oatmeal, or peanut butter cookies
- Dry cereal from the box or with milk
- Cheese wedge
- Fruit sherbet or ice cream

Establishing good food habits. Suggestions have been made in the preceding chapter for the establishment of good food habits in the infant. In addition, the following considerations are conducive to the development of good food habits in the preschool child.

* *Your Child from 1 to 6.* Children's Bureau Pub. 30, Welfare Administration, U.S. Department of Health, Education, and Welfare, Washington, D.C., 1963.



FIG. 24–3. Snacks can provide valuable nutrients such as ascorbic acid. (*Courtesy, Sunkist Growers.*)

Meals should be served at regular hours in a pleasant environment. The child should be comfortably seated at a table. Deep dishes permit the child to get his food onto the fork or spoon with greater ease. A fork, such as a salad fork with blunt tines, and a small spoon can be handled comfortably. A small cup or glass should be only partially filled with liquid to minimize spilling; however, the coordination of eye, hand, and mouth is difficult and some spilling is to be expected.

Children enjoy colorful meals just as adults do. Their appetites also vary from day to day, and like adults they react strongly to portions that are too large. It is much better to serve less than the child is likely to eat and to let him ask for more.

Even favorite foods should not be served too often. Breakfasts do not need to be stereotyped. A hamburger or sandwich with an orange cut in sections to be picked up with the fingers is just as satisfactory as a juice, cereal, and egg breakfast.

Fewer difficulties are likely to be encountered if new foods are given at the beginning of the meal when the child is hungry. A food is more likely to be accepted if it is given in a form which can be easily handled, which can be chewed, and if some favorite food is also included in the same meal. The parent should assume that the child will also take some responsibility in accepting the offered food.

Whether or not the preschool child should eat with other members of the family or alone is a matter that each mother must determine for the child's greatest good and the family's convenience. If the father returns from work at such an hour that the evening meal must be late, if the child becomes overexcited about the family doings, or if the child is expected to live up to a code of behavior beyond his young years, it is better that he be allowed to eat before the rest of the family in a pleasant, quiet atmosphere with his mother nearby. Even so, an occasional meal with the family may be a treat for the child and parent if tension can be avoided. Since children are great imitators, they enjoy doing just as Daddy or Mother or the other children are doing.

The child may well learn early in life that he is expected to eat foods prepared for him, but this does not mean that nagging or bribery will accomplish anything. Children, like adults, enjoy attention, and they are quick to realize that food can be a powerful weapon for gaining such attention. It is therefore important to recognize that a display of concern or the use of force in getting a child to drink milk or to take any other food, can have nothing but unfavorable effects. When a child refuses to take a food, the unwanted item should be calmly removed without comment after a reasonable period of time. If the child is refusing to eat because he thereby attracts attention, the mother should make certain that the child receives his full share of affection and companionship at other than mealtimes. By so doing the child will lose interest in using food as a weapon.

DIET FOR THE SCHOOL CHILD

Characteristics of food acceptance. Elementary school children are usually better fed than preschool children or adolescents. Group acceptance is extremely important at this time, and the child needs to be able to keep up with his classmates and to have a sense of accomplishment. When the child goes to school for the first time he makes acquaintance with food patterns that may be different from those he knows at home. He learns that certain foods may be acceptable to the peer group, while other foods from a different cultural pattern may be looked upon with disdain; as a result he may be unwilling to accept these foods at home—good though they may be. On the other hand, within a group he is willing to try foods with which he is unacquainted and which he would not try alone.

School children have relatively few dislikes for food except possibly for vegetables, which are usually not eaten in satisfactory amounts. By the time they reach 8 to 10 years of age the appetite is usually very good. Feeding problems are more likely to result because parents are unduly concerned with behavior at mealtime which does not come up to adult standards. Most children of this age are in a hurry, and don't like to take time for meals. Breakfast, especially, is likely to be skipped. (See Figure 24–4.)



FIG. 24–4. Breakfast—a good start for the school day. (*Courtesy, National Dairy Council.*)

School children may be subject to many stresses which affect the appetite. Communicable diseases occur often in this age group. They reduce the appetite on the one hand, but they increase body needs on the other. Schoolwork, class competition, and emotional stresses in getting along with many children may have adverse effects on appetite, as may also an unbalanced program of activity and rest.

Choice of foods. Table 24–1 lists the kinds and amounts of foods which may be taken in a day by healthy school children. A number of other equally satisfactory patterns could be devised for different cultural groups. A diet for adults which places emphasis first on the inclusion of protein, minerals, and vitamins is also a good one for school children. The amount of milk given to children should be greater than that for the adult. While no foods need to be forbidden to this age group, it is extremely important that high-carbohydrate and high-fat foods not be allowed to replace essential items of the diet.

Food habits. The suggestions concerning good food habits for preschool children also apply to school children. A good school lunch program (see p. 374) may introduce new foods in a setting where the child is anxious to

3. Vegetables and fruits, at least ¾ cup, consisting of 2 or more servings. One serving of full strength juice may be counted as not more than ¼ cup of the requirement.

4. Whole-grain or enriched bread, 1 slice; or muffins, corn bread, biscuits, rolls made of enriched or whole-grain flour.

5. Butter or fortified margarine, 2 teaspoons, as a spread, as a seasoning, or in food preparation.

Under the Special Milk Program, the U.S. Department of Agriculture subsidizes part of the cost of milk to schools, nonprofit child care centers, and summer camps.

Nutritive value of Type A lunch. When foods are served in the amounts specified, and additions are made to satisfy the appetite, the Type A lunch provides, on the average, one third of the recommended allowances for the 10- to 12-year-old child. Larger portions must be provided for older children. Since the child eats but five meals in the school each week, the contribution represents about one fourth of his total nutritive needs.

Some care must be taken in the selection of fruits and vegetables. A vitamin C–rich food should be served daily, and a vitamin A–rich food at least twice a week. Well-managed school lunch programs seldom permit sales of soft drinks, candy, pretzels, and similar carbohydrate-rich foods because they contribute little except calories to the child's nutritional needs, and because the child's money may be used for these empty calories rather than the more nutritious foods. The American Medical Association, the American Dietetic Association, and the National Congress of Parents and Teachers have opposed the sale of candy and soft drinks within the schools.[17,18]

The school lunch and nutrition education. Through the feeding program the pupil is helped to develop a liking for nutritious foods, and to overcome prejudices. (See Figure 24–6.) He is guided in food selection, and he becomes familiar with the essentials of an adequate diet. If the educational value of the school lunch is to be fully realized, the meals must not only demonstrate the principles of good planning for nutrition, they also must be considerate of cultural food patterns, palatably prepared, and attractively served.

In addition to the daily opportunities to learn by eating, the lunchroom may serve as a laboratory for many subjects studied at the elementary and secondary levels. For example, individual and group dietary evaluations might become a problem in mathematics, biology, or home economics. A tour of the kitchen and lunchroom permits the physics student to observe the nature of the equipment and to learn principles of its operation, aids the biology student in applying his understanding of microorganisms to the development of sanitary practices, and challenges the English student with timely and varied materials for a theme or the school paper. Art students may prepare posters relating to the lunch patterns or to depict practices in dining room conduct, while a social studies class may find opportunity to discuss cultural food patterns. Many opportunities exist for developing good attitudes and practices regarding social behavior and group conversation.



FIG. 24–6. These boys in a Louisville, Kentucky, school are obviously ready to enjoy their Type A lunch. (*Courtesy, U.S. Department of Agriculture.*)

PROBLEMS AND REVIEW

1. What criteria, other than height and weight, may be used to determine nutritional status?
2. What average yearly gains may be expected from the end of the first year until maturity is reached? How do these vary for boys and girls?
3. Compare the protein and caloric needs of the 1- to 3-year-old; 7- to 9-year-old; 10- to 12-year-old; and 13- to 15-year-old boy with those of the adult.

4. Why would you expect the calcium, phosphorus, and iron needs to be especially high during childhood?
5. How long should vitamin-D supplementation be provided? Why?
6. In terms of food habits, what can be expected at each of these ages: 18 months to 2 years; 5 years; 7 years; 10 years; 15 years?
7. Discuss the role of cultural pressures on food habits and attitudes to food.
8. In what way may disturbances in the mother-child relationship be reflected in feeding difficulties?
9. What is meant by the Type A lunch?
10. Why is skipping breakfast a serious problem? What factors may interfere with the child's appetite for breakfast?
11. What objections may there be to the use of fried foods in the diet of preschool children? To the sale of soft drinks and candy on school premises?
12. *Problem.* Record the food intake of a child for one day, and calculate the nutritive values. Are all the nutrients provided at recommended levels? What suggestions can you make for the improvement of the diet?
13. Plan three menus for packed lunches for an 8-year-old boy. Do these lunches provide ⅓ of the day's recommended allowances?
14. A mother asks you about the advisability of allowing her children to eat between meals. What suggestions can you make to her?
15. *Problem.* Plan a menu for 1 day for a family consisting of father, mother, 16-year-old boy, 13-year-old girl who tends to be overweight, 8-year-old girl, and 3-year-old boy. Indicate in table form the approximate amounts of food for each, and include any modifications in preparation which may be required.
16. *Problem.* List several ways in which you, as a school nurse, could assist in bringing about the improvement of food habits of school children.

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Chapter 25

NUTRITION AFTER FIFTY

The nature of aging. "The Enigma of Human Aging" is the provocative title of a two-part report published in *Chemical and Engineering News* in 1962.[1] During the past decade research on aging has expanded rapidly in many directions including the physiologic, the psychologic, and the social aspects. Aging is a continuous process of change throughout the life span. The Greek word for *old man* is *geron* and that for *treatise* is *logos,* therefore, the term *gerontology*—the study of the aging process. The suffix *-iatrics* means *the treatment of;* thus, *geriatrics* is the specialty in medicine concerned with the prevention and treatment of disease in older persons.

Tibbitts[2] has emphasized that there is too much tendency to group all persons over 65 years into one category, and points out that this is just as wrong as it would be to place all persons under 21 years under the single category of children. He points out that research is beginning to characterize three subgroupings, but obviously there is no clear line of demarcation from one to the other. In middle age one is likely to be at the peak of his career and fulfillment of his hopes[3] but is beginning to think of retirement; in later maturity, retirement has become a fact, but rightfully one should be able to live up to high expectations; in old age, decline has set in with increasing dependency based upon health, economics, and social change.

Vast differences are apparent from one decade to another, but it is dangerous to generalize. One individual in his 80's may well fit into the group characteristics of the 60's, while another in his 60's can be "older than his years."

One person in ten today in the United States is 65 years or older, thus accounting for some 20 million persons. A baby born today can look forward to living his appointed "three score and ten." Having reached the age of 65 years, an individual has a life expectancy of another 14 years; at age 70, the expectancy is 10 years. With the rapidly growing population and the longer life-span, it is not difficult to appreciate that much more concerted attention is required to bring about a solution of many problems of aging.

Several circumstances in the later years are of special significance.[2] With the technologic changes, many people are retiring at an earlier age than formerly, but they are living longer. With retirement comes reduced income, the majority of persons having no savings and being dependent largely upon Social Security as a source of income. One of the major aspects of aging is that a larger and larger proportion of the older population consists of women who are widowed or living alone.[2] By 1975, for example, there will be about 3.3 million more older women than older men.

Older persons can be an asset to the community inasmuch as the experience they have gained should give them good judgment and efficiency. (See Figure 25–1.) One need not look far to find examples of persons who have accomplished some of their greatest work in literature, music, politics, education, or social concern after they reached the age of 65 years.

Role of nutrition. Man's nutrition at age 60, 70, or 80 is the product of the influences of heredity, environment, and nutrition in the entire preceding years. Consequently, the variations in nutritional status are likely to be even

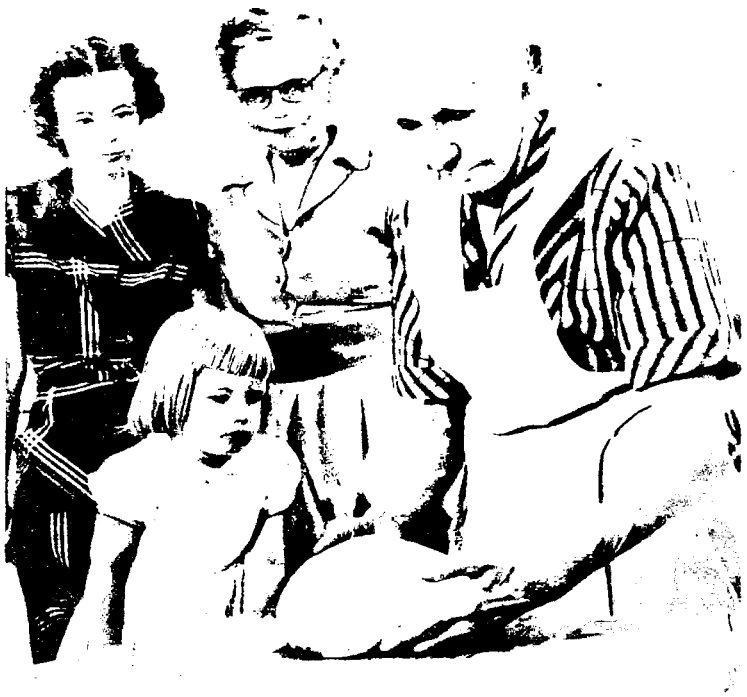


FIG. 25–1. People in their later years experience a sense of usefulness and personal worth when they contribute to the whole family's welfare and happiness. (*Courtesy, the* Minneapolis Sunday Tribune.)

more diverse than they are in the younger age groups which have been subject to influences for a shorter time period.

The individual who has had a lifetime of poor nutritional habits is not likely to be in as good health as the one who has enjoyed the benefits of a good diet. Good diet in later years cannot completely make up for the years of inadequacy or correct irreversible tissue changes. Furthermore, an older individual cannot completely change his whole pattern of eating. Nevertheless, even the individual with poor food habits who is in a poor state of nutrition can benefit greatly through the application of the principles of good nutrition.

One of the studies recently reported on the food habits and dietary intake of older persons[4] is representative of surveys on this subject. The study included 283 households in Syracuse, New York, in which one member was at least 65 years old, receiving the benefits of Social Security, and living alone or living with one adult at least 55 years old. About half of the households consisted of a husband and wife, while another third consisted of one woman. The survey evaluated the nutritive values of food brought into the household in one week and correlated these values with income, age of person, and other factors. Among the important findings of this survey were the following:

1. About half of the households had food that provided the recommended allowances for all nutrients.
2. Calcium and ascorbic acid were the nutrients most frequently in short supply; three of ten persons failed to receive the recommended allowances.
3. Persons with fair or poor diets usually lacked more than one nutrient. A third of those receiving inadequate amounts of one nutrient lacked five or more other nutrients as well.
4. More than one third of the householders used some vitamin supplements. Of this group, about one half had adequate diets and there would seem to be no clear indication for spending the money for the supplements. Of those persons who had fair or poor diets, only a small number effectively supplemented the diets with the missing nutrients, thereby indicating that the choice of supplement was poor. Obviously, this is an area of nutrition education meriting considerable attention.
5. A correlation existed between the level of income and the adequacy of diet, with more of the fair and poor diets being found in the lowest income group.
6. Householders in their 60's had more adequate diets than those in their 70's or 80's.
7. More persons in the good-diet group were overweight than in the fair- and poor-diet groups, indicating a surfeit of calories even though other nutrients were well supplied.
8. Most of the men had diets of better quality than did women.

Physiologic and nutritional changes. Increasing attention is being given in research to the changes taking place during aging at the molecular level.[1] The

study of changes in connective tissue, which is so abundant in the human body, are of especial note. Collagen is one of the fibrous materials found in tendons, ligaments, skin, and blood vessels. With aging the amount of collagen increases and becomes more rigid; the skin loses flexibility, the joints creak, and the back becomes bent. A considerable group of investigators are studying the effects of dietary fat upon aging.[5] By modifying the amount of fat and the kind of fat (high or low in polyunsaturated fats) in the diets of experimental animals changes occur in the structure of blood vessels and in longevity. A number of changes of significance in dietary planning are discussed below.

The basal metabolic rate gradually declines from the time maturity has been reached. This may be explained by the increasing proportion of body fat to body tissue, the lesser muscle tension, and sometimes by a diminution of thyroid activity. The decline in basal metabolism is somewhat less when it is related to the active protoplasmic tissue rather than the total body weight. Thus, a group of vigorous, healthy women of middle age were found to have a higher rate of metabolism than has been reported for other women of similar age.[6]

The individual of 60 to 70 years cannot be expected to be as physically active as the person 25 years of age, but the eating habits of youth are likely to be continued into the later years. In the population as a whole the weight increases steadily throughout the years of maturity until it plateaus at the decade of 65 to 74 years.[7] Thereafter, a gradual decline takes place. However, several studies have shown that the incidence of overweight and underweight after 65 years follows the pattern of the population as a whole. Undoubtedly, obesity increases the susceptibility to the degenerative diseases of middle age, becomes an extra burden on weight-bearing joints, and increases the likelihood of accidents.

The senses of taste and smell are less acute in later life, thus interfering with the appetite for many foods. The loss of natural teeth and a seeming inability on the part of the individual to become accustomed to dentures make it difficult to chew food properly or to eat with comfort. Consequently, more and more carbohydrate-rich foods which require a minimum of chewing may be selected, leading to seriously deficient intakes of protein, minerals, and vitamins.

Digestion in later years is affected in a number of ways. A reduction of the tonus of the musculature of the stomach, small intestine, and colon leads to less motility so that the likelihood of abdominal distention from certain foods is greater, as is also the prevalence of constipation. The volume, acidity, and pepsin content of the gastric juice are often reduced, achlorhydria being observed in 35 per cent of those 65 years and older.[8] A reduction in acidity is known to have an adverse effect on the absorption of calcium and iron, and may also explain the lower vitamin-B_{12} levels of blood observed in many older persons.

Fats are often poorly tolerated because they further retard gastric evacuation, because the pancreatic production of lipase is inadequate for satisfactory hydrolysis, and because chronic biliary impairment may interfere with the flow of bile to the small intestine.

The fasting blood sugar is usually normal. Likewise, the absorption of carbohydrate from the intestinal tract seems to be unchanged, but there is a somewhat diminished utilization of carbohydrate as may be seen by higher than normal blood lactic acid and pyruvic acid levels after exercise.

Many older persons, especially men, have an elevated blood urea nitrogen and blood uric acid, indicating some deterioration of kidney circulation. The occurrence of nocturia may lead to a voluntary reduction of the intake of fluid, thereby increasing the difficulty of satisfactory waste elimination.

Blood levels of vitamin C and hemoglobin are reduced in many older persons. In part, these levels may be correlated with low intakes of vitamin C and iron. The low hemoglobin levels may also result from the poor absorption of iron when gastric acidity is reduced, or when antacid preparations are used in the treatment for ulcers.

Hormonal imbalances occur more frequently during later years. A reduction of thyroid activity is reflected in a reduced energy requirement and also may be related to the occurrence of degenerative vascular disease. In women, especially, imbalances may lead to disturbances of calcium and nitrogen metabolism and the resultant condition known as osteoporosis. Nevertheless, a high proportion of women with this bone disease have been poor milk drinkers throughout life,[9] and do seem to have the ability to utilize calcium for bone remineralization if sufficiently high calcium intakes are provided.

About 90 per cent of the deaths from heart disease, malignancies, and vascular accidents of the central nervous system occur in people over 45 years of age. The blood cholesterol is usually elevated as age increases and is believed to be associated with an increased incidence of cardiovascular disease. The kind and amount of fat in the diet, the degree of overweight, the stresses of life and many other factors are being actively investigated with respect to their effect on the blood cholesterol. Even though no conclusions can be drawn at this time, it appears that maintenance of normal weight throughout life is of major importance.

Food habits. The older person tends to follow dietary patterns of his earlier years. He has been influenced by the many factors which determine food acceptance from infancy throughout life (see Chapter 15). By the time he reaches the age of 50 or 60, his pattern has become fixed and it is indeed difficult to introduce new foods or markedly changed patterns of eating.

With increasing years the individual sees and hears less well, moves more slowly, and may be troubled with chronic illness. When persons reach the age of retirement from a position, they may have a sense of not being needed either by their families or by the community. The frustrations and isolation

from the people and work one loves, and the feelings of being rejected and unwanted, may be expressed by complaints against food and refusal to eat, or, on the other hand, by self-indulgence in favorite foods such as sweets. (See Figures 25–2 and 25–3.)



FIG. 25–2. This public health nurse's warmth and genuine interest are important qualities for making a diet instruction more likely to be followed. (*Courtesy, The United Fund and Community Nursing Services, Philadelphia.*)

Good food served in pleasant circumstances by people who care may indicate to the older person that someone cares for him and that he is important. Attention to holiday customs, for example, bolsters the morale and the food intake. On the contrary, food poorly prepared or carelessly served may be associated with lack of love and thus will be refused.

Older persons who live alone often have no incentive to cook. They may eat carbohydrate foods to excess because they are easy to chew, require no preparation, and are inexpensive. Milk is taken poorly by many because of erroneous ideas concerning its value for adults, its supposed constipating or gas-producing effects, and its cost. Vegetables may be considered as too difficult to chew and too expensive. Fruits are often thought to be too "acid." Many older persons labor under the mistaken notion that their food needs are small because they no longer have growth needs, and because they are inactive.



FIG. 25–3. Pooling resources for food and companionship is one way for older people to solve the problem of lonely meal times when the temptation is to rely on snacks. Members of the Philadelphia Center for Older People demonstrate the principle. (*Courtesy, United Fund, Philadelphia.*)

Older persons are particularly susceptible to the claims of the food faddists. Having lost some sense of well-being they are likely to be misled by claims of unscrupulous persons concerning "miracle" diets and drugs. Although the foods recommended by these faddists may not in themselves be harmful, the undue emphasis placed upon them may mean that the necessary foods for nutritional adequacy are neglected and that the individual delays too long in seeking medical advice for his ills.

Dietary allowances. The basic needs of the healthy older person are the same as those of the younger individual.

ENERGY. The Recommended Dietary Allowances provide some reduction in calories for each decade after 25 years; thus, the allowance for a man at 65 years is 2200, whereas at 25 years for similar activity it is 2900. The allowance for a woman of 65 years has been reduced to 1600 calories.

PROTEIN. Adults of all ages should be provided with 1 gm of protein per kilogram of ideal body weight. Older persons who have had poor dietary habits or illness may benefit by increased intakes.

CARBOHYDRATE AND FAT. Since the caloric requirement is reduced, the carbohydrates and fats which comprise the rest of the diet must be chosen with considerable care in order that the protein, calcium, iron, and vitamins may be included in optimum amounts. It has been suggested by some that the fat intake might be reduced to 25 per cent of the total calories, and that part of this fat might well be obtained from the vegetable oils which are rich in polyunsaturated fatty acids.

MINERALS. The allowance for calcium is the same as that for younger adults, while the iron allowance for postmenopausal women is the same as that for men—10 mg. Anemia is of rather common occurrence in women, as is also osteoporosis, and a diet liberal in these mineral elements is desirable.

VITAMINS. The allowances for vitamin A and ascorbic acid are the same as those for younger adults. The B-complex vitamins are needed in the same proportion of caloric intake as for younger persons. However, the reduction in the caloric requirement means that the total daily needs for thiamine, riboflavin, and niacin are likewise lower. (See Table 4–1.)

WATER AND FIBER. About 6 to 8 glasses fluid is as essential for the older person as it is for the younger individual. The kidneys can function more adequately when there is sufficient fluid with which to eliminate the waste solids. Water stimulates peristalsis and thus aids in combating constipation. When nocturia is a problem, the individual should be encouraged to take as much water as possible early in the day.

Many older persons select diets that are smooth in character. This choice, together with an inadequate fluid intake, can lead to persistent constipation and often to the use of harmful laxatives and mineral oil. Although rough fiber is not advised for older persons, the fiber of tender vegetables, fruits, and whole-grain cereals will encourage normal peristalsis.

Planning the daily diet. The Basic Diet outlined for the younger adult (Table 14–2) will serve as a foundation for planning the diet after 50. Especially for the woman, with her lower calorie requirements, the remaining foods must be chosen with care lest the caloric intake be excessive.

Any plans for the diet must give consideration to the individual's income, facilities for food preparation, ability to purchase and prepare foods, social and cultural background, and any other pertinent factors. With increasing age, the problems of management in the home are likewise greater. For those living in their own homes and who are ambulatory but unable to prepare food, the program of "Meals-on-Wheels" sponsored in a number of communities is valuable, as are also the services of homemakers who are supervised by one of several public or voluntary agencies. (See Chapter 28.)

Three menus for a low-cost diet are shown below.* Include a glass of milk at least once a day in addition to the foods listed; coffee or tea as desired.

* From "Sample Menus for a Week," in *Food Guide for Older Folks.* Home and Garden Bull. 17, U.S. Department of Agriculture, Washington, D.C., 1963.

SUNDAY	MONDAY	TUESDAY
Orange juice Scrambled egg Toast	Orange juice Oatmeal Milk Toast	Prunes French toast Syrup
Swiss steak Mashed potatoes Broccoli Bread Chocolate pudding	Frankfurters stuffed with mashed potatoes and cheese Scalloped tomatoes Hot rolls Apple brown betty	Lamb stew Beets Tossed green salad Bread Rice and raisin pudding
Welsh rarebit Crisp bacon strip Apple-raisin salad Ice cream Cookies	Lamb stew with potatoes Snap beans Bread Chocolate pudding	Spaghetti, tomato, chopped meat casserole Broccoli Bread Grapefruit segments

The following suggestions may serve as a reminder in counseling older persons.

FOR FOODS EASY TO CHEW. Meat, vegetables, and fruits can be finely minced with a sharp kitchen scissors or knife, or they may be ground. In either case, food is sufficiently finely divided for ease in swallowing and rapid digestive action. These should be emphasized:

Milk as a beverage
Cottage or cream cheese; American cheese in sauces or casserole dishes
Eggs, soft-cooked, scrambled, poached
Tender meat, or poultry, finely minced or ground; flaked fish; finely diced meat in sauces often taken more readily
Soft raw fruits as banana, berries; canned or cooked fruits; fruit juices
Soft-cooked vegetables, diced, chopped, or mashed. Raw vegetables such as tomatoes can often be eaten if finely chopped—skin and seeds removed
Cooked and dry cereals with milk
Bread, crackers, and toast with hot or cold milk
Desserts: diced cake with fruit sauce; fruit whips; gelatin; ice cream and ices; puddings; pie, if crust is tender and cut up

FOR ENJOYMENT OF MEALS, EASE OF DIGESTION, AND GOOD REST, give heed to the following:

1. Serve colorful foods attractively on a tray if eating alone.
2. Eat leisurely in pleasant surroundings.
3. Eat four or five light meals instead of three heavier meals.

4. Include essential foods first. Sweets may be taken in moderate amounts but excess may cause discomfort and lead to overweight.
5. Eat a good breakfast to start the day right.
6. Fats may retard digestion. If there is discomfort, avoid fatty meats and fish; fried foods; gravies, sauces, and salad dressings; rich cakes, doughnuts, pastries, and puddings.
7. Certain foods may cause distress for some people. These are most likely to be dried cooked beans, Brussels sprouts, cabbage, cantaloupe, cauliflower, cucumber, onions, radishes, turnips, watermelon. Do not arbitrarily omit these foods if the individual enjoys and tolerates them.
8. Eat the heaviest meal at noon rather than at night if sleeping is difficult.
9. Avoid tea and coffee late in the day if insomnia is a problem.
10. Drink hot milk just before going to bed.

PROBLEMS AND REVIEW

1. What changes occur with aging which may modify the digestion of foods?
2. Compare the nutritional needs of the adult of 25 years with one of 65 years.
3. What reasons can you give for the difficulty many older women experience in the healing of a bone?
4. What are the dangers of overweight in the middle aged?
5. A widow has no cooking facilities in her room and eats dinner in a restaurant. Her income is limited. What are some foods she could eat at home which require no cooking, but which would be nutritionally valuable?
6. *Problem.* Plan menus for 2 days which could be prepared with only a single gas burner available for cooking.
7. *Problem.* Using the low-cost plan on page 252 plan a week's menus for a man and woman 65 years old.
8. Consult the suggestions for effecting economy in food purchasing in Chapter 18. Which of these might not be practical for a single person or an older couple? Why?

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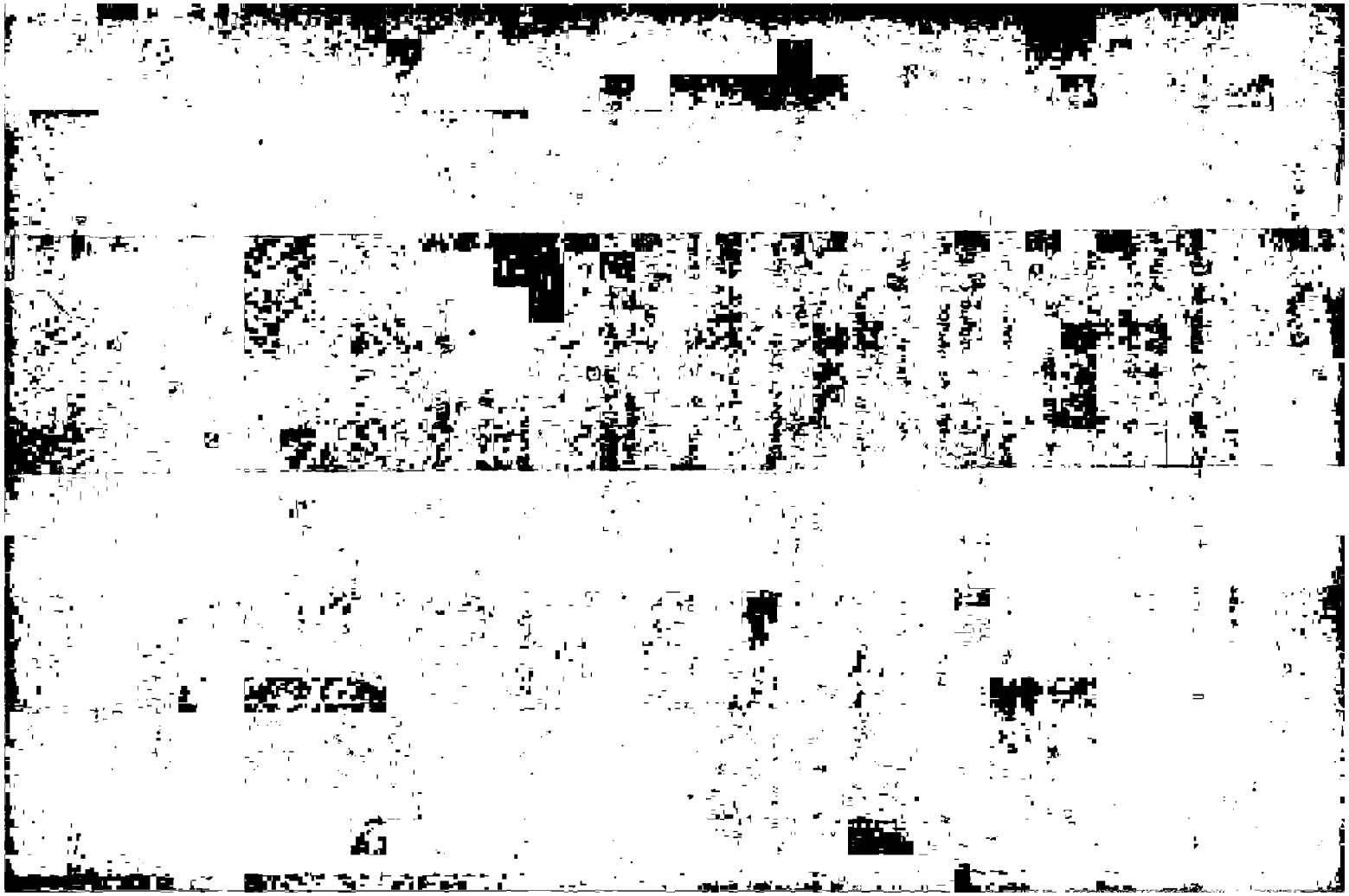
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UNIT VII
Nutrition and Public Health

Chapter

26 NUTRITION IN THE COMMUNITY

Chapter 26

NUTRITION IN THE COMMUNITY

The best resource of a community is its people, for it is the population which determines and controls the use of the physical resources. The people may be well educated, well fed, and in optimum health, and the community will prosper; or the people may be circumscribed by the taboos and ignorance of centuries, unable to adapt to the limitations of their environment, ill fed, and in ill health. Although it is an oversimplification to say that food alone makes the difference, yet one can see that the individual, by being well fed, is helped to achieve that state of health which enables him to play a responsible role in society.

The many problems inherent in the improvement of the nutrition, and hence the health of a people, have necessitated group action in the community —local, state, national, international. Some dietitians and nurses find worthwhile careers in governmental and private agencies whose primary concern is better health through better nutrition. But all professional workers are helped to do a better job when they utilize the resources of these groups.

The term *public health nutrition* is generally understood to be concerned with those problems of nutrition which affect large numbers and which can be solved most effectively through group action. The term *community* may be used to refer to any group of people—small or large; it might be, for example, a closely knit group such as the student community, or it might be a city, state, or nation in which one lives.

The purposes of this chapter are (1) to enable the student to appreciate that problems of nutrition are a concern of the community; (2) to create an awareness of the many facilities that exist in official and voluntary organizations for working with these problems; and (3) to show that the cooperative efforts of professional and lay workers can give rich rewards in better health. Only a few examples of needs and programs can be given in this chapter since the numerous agencies and their activities are too diversified to permit comprehensive description.

NUTRITION PROBLEMS IN THE UNITED STATES

Defining nutritional needs. The young and the old—the healthy and the sick—the rich and the poor—people in all walks of life have needs in terms of better nutrition. No sound program of nutrition can be initiated without first establishing the need of the time in a given place. The statistics on incidence of disease and of mortality are usually valuable. Data obtained on food production, imports and exports, and income may point the way to changes in agricultural policies. The survey technique has been used widely to determine what courses of action are necessary.

A survey might be concerned with information on the food consumption of individuals and the correlation of nutrient intakes with physical and biochemical measurements of nutritional status. Surveys might likewise study the food habits, buying practices, food preparation procedures, and so on (see Figure 26–1). Surveys of dietary intakes and nutritional status are time consuming, costly, and require the most careful planning of a public health team, including such personnel as physicians, nurses, nutritionists, laboratory technicians, statisticians, and others. The surveys not only point out the kinds of action which are necessary, but they also have the advantage of alerting and interesting the individuals and the organized groups within the community to their own problems. A number of surveys have been cited in other chapters of this text (see pp. 6, 327, and 360).

All age groups are concerned. The earliest efforts of public health nutrition in the United States were directed to the health and well-being of infants and their mothers. More recently the satisfactory nutrition of the school child, the teen-ager, and the aging individual has also been accepted as a responsibility of health agencies. The specific problems of these age groups and ways to meet their needs have been detailed in Chapters 22 to 25.

Dietary imbalances. Classic deficiency diseases are rarely seen in the United States, but the study of the causes of dietary imbalances and their treatment and prevention are included in the programs of health groups. Overweight is a problem of children, young adults, and the middle aged (Chapter 32), while underweight is also too common, predisposing the individual to infections such as tuberculosis. Endemic goiter is still a possibility not overlooked by public health authorities. Factors affecting food acceptance and cultural food patterns may impose inadequacies in certain situations (Chapters 15 and 16).

Special population groups. The nutritional and health problems of certain groups may be seen in one part of the country and not in another. For example, the rapid influx of Puerto Ricans to eastern cities of the United States means that many have low incomes and are living in crowded quarters, with limited ability to speak English, without access to familiar foods, and not knowing how to use American foods (see p. 230). More than one million migrant

workers and their families present a complex problem to the public health worker. They too are living in crowded, often unsanitary, conditions, with low, uncertain incomes, and no fixed roots in any community so that their needs are not fully appreciated.[1] The 370,000 American Indians living on reservations have long experienced poverty, malnutrition, and disease, and are now receiving more health services including nutrition under the auspices of the United States Public Health Service.[2] In every large city unemployed persons, families in which the breadwinner is absent, and many retired persons are unable to achieve an adequate diet. All of these groups require education and guidance in the selection of an adequate diet, assistance in budgeting, tangible aid with surplus foods, and sometimes financial assistance.



FIG. 26–1. An anthropologist studies living habits in an Indian community as part of a nutrition survey. (*Courtesy, Pan American Sanitary Bureau, World Health Organization.*)

Group feeding. Children in orphanages, schools, and camps; prisoners; the retarded in mental institutions; the physically handicapped or invalids in nursing homes; and the aged are captive to the dietary regimen of the place in which they are living. The inadequate training and experience of food service managers and personnel employed in many of these situations may

lead to the poor use of money available for the purchase of foods, improper sanitary practices, nutritionally inadequate meals, poorly prepared food, and chronic malnutrition for the residents. Most institutions are eager for assistance in the improvement of food service standards.

Needs of the sick. Research pertaining to the cause of disease, programs for the prevention of disease, and the rehabilitation of the sick are continuing problems of community nutrition. That diet plays an etiologic role in cardiovascular diseases is generally accepted, although the specific factor or factors involved have not been entirely determined. The amount and nature of the dietary fat, the amount and kind of carbohydrate, the energy balance, and the frequency of meals are among the more important elements being studied in cooperative research of the United States Public Health Service, state departments of health, medical centers, and hospitals.

Suitable programs for therapeutic diets, such as diabetic, sodium-restricted, low-calorie, bland, and others, are an ever-present need. Consultant services to nursing homes and hospitals which do not have the services of qualified dietitians, the preparation of diet manuals for the use of personnel in such institutions, and in-service training programs for physicians, nurses, nutritionists, and food service supervisors are among the continuing needs related to therapeutic nutrition.

Legislation establishing medical care for those over 65 years has given great impetus to programs of rehabilitation of the sick and handicapped together with extension of care into the home. (See Chapter 28.)

Plans for the rehabilitation of the sick and handicapped go beyond the responsibility of the nurse or dietitian in the hospital. Rehabilitation might involve a better kitchen arrangement which minimizes effort for a homemaker with a damaged heart; a camp for a diabetic child; suitable feeding equipment for a child with cerebral palsy or who is crippled; or adapting a therapeutic diet to a foreign food pattern. These and many other problems in rehabilitation occur with such frequency that research in the development of satisfactory solutions is a legitimate function of a public health agency.

Food quackery. The exploitation of the public by the food quack presents at least three dangers: the economic waste, the placement of good nutrition in jeopardy, and the hazard to health. More than half a billion dollars is spent annually by Americans for nonmedically prescribed food supplements and pills. This money is often spent by the economically depressed, people in poor health, or the aged. Even though the purchases are usually, in themselves, harmless, the prices paid are fantastic in terms of value received. Moreover, the misrepresentation of the nutritive value of the product and the diversion of money to buy the product often mean that a nutritionally adequate diet cannot be realized. The greatest harm comes to those who believe the claims that the food supplement can cure organic diseases such as cancer, diabetes, ulcers, and others; too often medical advice is not sought early enough.

The Food and Drug administration has listed four myths around which current quackery is centered:[3]

MYTH 1. All diseases are due to faulty diet. It is held that it is almost impossible to get an adequate diet without using a food supplement. Advertising for such supplements lists scores of diseases and may imply, or actually claim, that the supplement cures them.

MYTH 2. Malnutrition is caused by soil depletion; chemical fertilizers are useless or are poisons.

The facts are that genetic make-up of the seed rather than soil composition affects the nutritive value of foods. Both chemical and organic fertilizers increase crop yields but do not improve the nutritive value per unit of weight.[3]

MYTH 3. Foods are overprocessed; much of the nutritive value of foods has been lost.

The facts: Processing results in some losses, but the claims are grossly exaggerated. Freezing and canning of fruits and vegetables takes place at the moment of peak nutritive values, and the product may be as good as, or better than, fresh foods which have been shipped long distances before reaching the market. Both fresh and processed foods are needed in the diet. The homemaker does not require expensive cooking equipment to retain maximum nutritive values.

MYTH 4. Subclinical deficiencies are common; aches, pains, and fatigue are ascribed to a faulty diet.

The facts: Many vicissitudes of life lead to fatigue, aches, and pains. Nutritional deficiency is not common in the United States. Only qualified physicians can diagnose vitamin and mineral deficiencies.

Among the types of products foisted upon the unwary public are the following:[4] "shotgun" vitamin formulas; high-potency preparations, often taken without prescription; "natural" or "organic" foods, these being foods produced without chemical fertilizers, pesticides, etc.; "miracle" foods or supplements for cure of many diseases; reducing pills; mail-order products; doorbell "doctors" who discuss health and problems of diet; products to reduce blood cholesterol and prevent heart disease; and popular books on nutrition interwoven with scientific facts, fiction, and unsound medical advice. The proposed regulations of the Food and Drug Administration pertaining to the standards of identity for vitamin and mineral supplements, and the bases for dietary foods (low-calorie, sodium-restricted, and so forth) are designed to reduce the number of products which have no valid purpose in the diet.

INTERNATIONAL PROBLEMS OF NUTRITION

The problems in nutrition facing people all over the world are not entirely unlike those which have been described in the United States, but they are greatly intensified.

Nutritional surveys. Research teams of the United States Interdepartmental Committee on Nutrition for National Defense (ICNND) have cooperated with local investigators of countries of the Near and Far East in conducting nutritional studies. Although these studies were concerned with the armed forces, they do give information pertaining to the economics of the country, the development of food technology, and the food habits of the population. Two surveys under private auspices have also been completed in Cuba and Haiti.

The most widespread deficiency observed in these surveys was that of riboflavin.[5] The signs of ariboflavinosis include angular stomatitis and nasolabial seborrhea, both of which are symptoms that cause little alarm. Whether lack of riboflavin may result in more serious impairment of human life has not yet been established.

Next to riboflavin, diets were most likely to be lacking in ascorbic acid and vitamin A. Biochemical and clinical studies showed that the nutritional status of the military forces was adversely affected by these dietary inadequacies. Comparisons with civilian populations indicated that the armed forces, in general, were better fed.

Deficiencies. In the underdeveloped countries malnutrition is not necessarily universally existent, since the food supplies vary widely from one area to another, food preparation practices and food habits may differ, and economic variability means that there are the "haves" and the "have-nots." The most vulnerable groups are infants, preschool children, pregnant and nursing women. (See Figure 26–2.) Using mortality figures as indicative of malnutri-



FIG. 26–2. This child is eating raw flour distributed during a sudden food shortage in Dahomey in 1962. (*Courtesy, Food and Agricultural Organization.*)

tion, Hundley[6] has cited the fact that the mortality of infants under 1 year ranges from 18 to 28 per thousand in three well-developed countries—Sweden, Switzerland, and England, while it ranges from 94 to 208 per thousand in three underdeveloped countries—Egypt, Mexico, and Brazil. For children between 1 and 4 years of age, mortality is 1.0 to 1.6 per thousand in the three well-developed countries but 16.2 to 49.7 per thousand in the underdeveloped countries. The high incidence of kwashiorkor (see p. 69) is at least partly responsible for the high mortality rate in the latter countries. Infantile protein malnutrition prevails in those countries where any of these staple foods—rice, wheat, corn, cassava, and millet—is the predominant food of the infant.

The classic deficiency diseases described in Chapters 10 to 12 remain as public health problems in some parts of the world. Even though it could be eradicated, beriberi is still prevalent in rice-eating countries of south and east Asia, especially affecting infants. Pellagra is of frequent occurrence in some eastern European countries and in Egypt, Basutoland, and Southern Rhodesia. Xerophthalmia and keratomalacia occasioned by vitamin-A deficiency account for much blindness and many infant deaths in southeast Asia and Africa. Macrocytic anemias which appear to be associated with deficiencies of vitamin B_{12} and folic acid, and microcytic anemias caused by iron deficiency are widespread. Endemic goiter is a major public health problem in Yugoslavia, Burma, Thailand, Central America, and other areas.

Food needs. Hundley cites the causes of deficiency as "agriculture, climate, economics, cultural and social patterns, transportation, communication, educational and even religion."* Of all of these, he asserts that expansion of agricultural production is the key to permanent correction of malnutrition. The annual increase in population is about 2 per cent, a rate which has no precedent in history; in some countries, the rate is over 3 per cent. The present world population of about 3300 million persons will increase to 6000 million persons by the year 2000.[7] Of these, 80 per cent will live in the countries which are now poorly nourished and underdeveloped. Asia comprises one third of the land surface of the world, but must feed two thirds of the world's population. No country of Latin America is free of hunger; about two thirds of the people are ill fed, ill clothed, and ill housed. (See Figure 26–3.)

MANY DOORS OPEN TO BETTER NUTRITION

Nature of services. In the hospital or clinic the nurse and dietitian give direct service to the individual. Some nutrition services of the community are also provided on an individual basis, especially at the city-county level. For example, such direct services are given by a visiting nurse, or a homemaker from a welfare agency, or a volunteer who delivers a hot meal to an aged person. Direct service may also be provided by a physician, nurse, or other

* Hundley, J. M.: "Malnutrition—A Global Problem," *Federation Proc.*, **18**(No. 2, Part II):78, 1959.

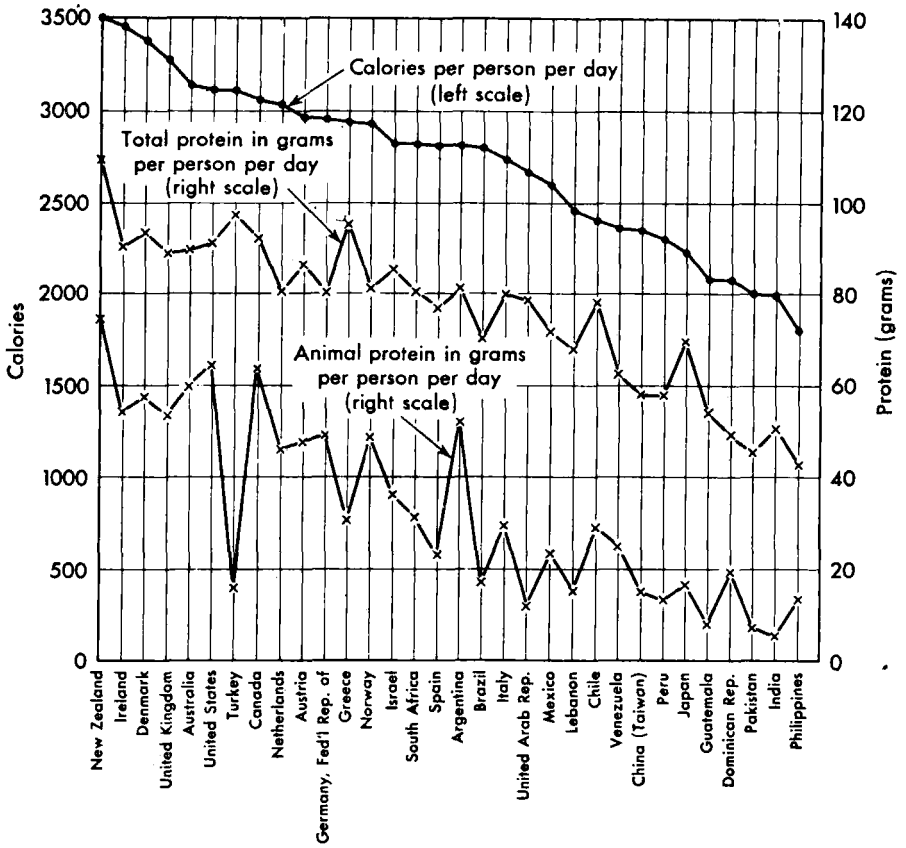


FIG. 26–3. Estimated number of calories and grams of total protein and animal protein in 32 countries of the world. Note that countries having the greatest calorie shortages also have the lowest protein levels. (*Data from* The State of Food and Agriculture, 1965. *Food and Agriculture Organization, Rome, 1965.*)

member of a public health team which is setting up a study or a demonstration project in a given locality.

Community programs in nutrition seek to improve nutrition through research, education, improvement of the food supply, and feeding. The individual reaps the rewards of activities such as these: legislation which protects the food supply; research concerning the preventive and therapeutic aspects of diet with respect to disease; methods for preserving the food supply; the development of new and better foods through food technology; a more abundant food supply because of research on plant varieties, soil conservation, pest control; education for an adequate diet—and so on.

Facilities of the community. The problems of food production and of nutrition are being met by a large number of groups which work either cooperatively or independently. The partial listings in Tables 26–1, 26–2, and 26–3 give the student some idea of the scope of efforts being made by many groups at local, state, national, and international levels. A number of categories

Table 26–1. A Partial List of Organizations at the Local and State Levels Concerned Directly or Indirectly with Nutrition Problems

Official	Voluntary (cont.)
Department of Agriculture (state)	children's aid
Department of Health	family service
food sanitation	Salvation Army
nutrition	settlement houses
Department of We fare	visiting nurse societies
Board of Education	welfare
health education	Institutions:
home economics	children's camps, day nurseries, orphanages
Extension services	hospitals, nursing and convalescent homes
Public libraries	homes for the aged
State universities	correctional institutions
Voluntary	Professional organizations: see national listing
Educational groups:	Civic groups:
private elementary and secondary schools	chambers of commerce
private colleges and universities; home economics, medicine, nursing	service organizations
parent-teachers associations	women's clubs
libraries	Industry sponsored:
Social agencies: church and community support	health centers and hospitals
	plant cafeterias and restaurants
	demonstration programs of stores and utility companies

are included: official agencies constitute those which have been authorized by the government and which are tax supported; voluntary agencies are supported by private funds, such as the United Fund, foundations, and other means; professional organizations; and industrial groups, especially from the food industry.

Nutrition education. Perhaps the greatest single challenge in nutrition today is that of educating people to make full use of the available knowledge in the selection of the daily diet. The needs of various age categories have been emphasized throughout this text, and methods for the instruction of patients have been discussed in some detail in Chapter 28.

Nutrition education should be an integral part of the classroom instruction throughout elementary and secondary school. It should be supported by a school lunch program (see p. 374) which affords opportunity to put knowledge gained in the classroom into practice. Thus, it becomes a joint responsibility of the administration and faculty to include nutrition in the curriculum and to provide the facilities for a successful program. Many prospective teachers now include a course in nutrition in their college programs. Fully effective programs are possible only when all teachers have some preparation in this area of education, not only through college courses but also in continuing education supported by the school administration—inservice courses, conferences, etc.

Table 26–2. A Partial List of Organizations at the National Level Concerned Directly or Indirectly with Nutrition Problems

Official	Voluntary
Department of Agriculture	American Red Cross
Agricultural Research Service	National Academy of Sciences—National Research Council
Consumer and Marketing Service	Food and Nutrition Board; committees on food protection, dietary allowances, amino acids, cereals, milk, fats, protein malnutrition, infant nutrition, and others
Cooperative State Research Service	Professional societies and voluntary health associations:
Economic Research Service	American Academy of Pediatrics
Federal Extension Service	American Cancer Society
Foreign Agricultural Service	American Dental Association
International Agricultural Development Service	American Diabetes Association
Department of Health, Education, and Welfare	American Dietetic Association
Children's Bureau	American Heart Association
Food and Drug Administration	American Home Economics Association
Office of Education	American Institute of Nutrition
Public Health Service	American Medical Association Council on Foods and Nutrition
Bureau of Medical Services: hospitals, Indian Health	American Nurses' Association
Bureau of State Services: special health services (aging, diabetes, cardiovascular, tuberculosis), dental health, international health	American Public Health Association
National Institutes of Health: allergy and infection, arthritis and metabolic, cancer, heart, mental	American School Food Service Association
Department of the Interior	Institute of Food Technologists
Bureau of Commercial Fisheries	National League for Nursing
Bureau of Indian Affairs	Foundations:
Department of State	Milbank Memorial Fund
Agency for International Development	National Vitamin Foundation
Interdepartmental Committee on Nutrition for National Defense (includes representation from departments of State; Defense; Agriculture; Health, Education and Welfare; and the Atomic Energy Commission)	Nutrition Foundation
	Williams-Waterman Fund of the Research Corporation
	Industry sponsored groups:
	American Institute of Baking
	Cereal Institute
	National Dairy Council
	National Livestock and Meat Board

Nutrition education also belongs in our industries, health agencies, clubs, and homes. Industrialists have recognized that well-organized feeding programs lead to greater efficiency, less lost time from illness and injury, and better attitudes toward work. Many industries have comprehensive health programs, including nutrition advice not only for the worker but also for his family. Nutrition education is likely to be well accepted by the woman having her first baby, because she is anxious to do her very best in ensuring her child's health. The physician, nurse, and nutritionist have an excellent opportunity at this point. Boy Scouts, Girl Scouts, 4-H clubs, and women's clubs can be effectual in the furtherance of nutrition information.

MACHILING... COLLEGE SCIENCE

Table 26–3. Some International Organizations Concerned with Nutrition Problems

United Nations Specialized Agencies
Children's Fund (UNICEF)
Educational, Scientific and Cultural Organization (UNESCO)
Food and Agriculture Organization (FAO)
International Bank for Reconstruction and Development
World Health Organization (WHO)
Church groups such as: American Friends Service Committee, Catholic Relief Services, Joint Jewish Distribution Committee, Lutheran World Relief, and others
CARE
Foundations: Ford, Rockefeller, and others

Among the many factors determining the success of an educational endeavor, the following should be kept in mind:

1. Nutrition education must recognize the complex social, emotional, economic, and physiologic factors involved in changing food habits of long-standing origin.
2. Education must be directed to the needs of the individual. One may begin with the felt needs, but it is often necessary to bring about realization of needs not felt by the individual.
3. The individual must take an active part in the learning process.
4. Learning should proceed from the simple to the more complex concepts.
5. The individual should know where he can get reliable information. He needs to know what is not true, as well as what is true, if he is not to be misled by the food faddist and quack.
6. Every diet has something good about it, and should be used as the starting point for improvement of food habits.
7. Nutrition education involves a change in behavior—the adoption of improved food habits. Knowledge concerning the principles of nutrition cannot, of itself, be considered as nutrition education.

SOME TYPICAL ACTIVITIES IN COMMUNITY NUTRITION

Some of the groups listed in Tables 26–1, 26–2, and 26–3 are concerned primarily with problems of nutrition, while others include nutrition as one part of broader programs. Several are concerned solely with the distribution of food, others with education, still others with research, while many are more or less involved in all aspects of community nutrition. Four examples of nutrition programs within the United States have been selected for more detailed discussion: the activities of a nutrition division of a state department of health; two approaches to nutrition education; and emergency feeding as a program which has not yet caught the interest of much of the population. Other programs of special importance discussed elsewhere in the text are: the develop-

ment of dietary allowances and guides by the Food and Nutrition Board and the Consumer and Food Economics Research Service of the United States Department of Agriculture, respectively (Chapter 4); the role of the Food Protection Committee and the Food and Drug Administration (Chapter 21); the school lunch program (Chapter 24); enrichment of cereals and grains (Chapters 6 and 21 and Table A-9); and obesity control (Chapter 22). In addition a brief description of international agencies will be presented.

A typical state program. The organization of a nutrition department varies from state to state, and likewise no two states will have identical programs at any given time. A good nutrition program is tailored to the needs of the population of that state, and is thus dynamic. Nutritionists in state programs work closely with physicians, nurses, dentists, dental hygienists, social workers, administrators of institutions, food service managers, dietitians, and others. The activities listed below are representative of those included in a number of state nutrition programs:

1. Provide materials on nutrition information.
   a. Analyze and interpret findings of science.
   b. Prepare leaflets on topics such as: weight control; meal planning; infant feeding; food misinformation; recipes for use of special foods such as nonfat dry milk or for therapeutic diets; diet patterns for various cultural groups; teenagers; senior citizens.
   c. Prepare diet manuals, food value charts, exhibits, newspaper, magazine, radio, and television releases.
2. Consultant service to institutions: child caring, nursing homes, small hospitals, mental hospitals, homes for the aged (see Figure 26–4).
   a. Planning food service facilities.
   b. Personnel training; budgeting; menu planning; purchasing; sanitation; preparation and service of food; therapeutic diets.
3. Work with schools: elementary, secondary, college, medical, nursing.
   a. Plan and conduct dietary surveys as part of research program.
   b. Assist in developing projects such as "Better Breakfast" and weight control.
   c. Conduct workshops for school faculty.
   d. Assist in training programs for school lunch personnel; help to interpret educational value of school lunch.
4. Cooperate with other health groups in rehabilitation and in chronic disease programs: cardiovascular disease, diabetes, tuberculosis, arthritis, cerebral palsy, orthopedic disabilities, mental retardation, etc.
   a. Preparation of materials for professional and lay instruction.
   b. Conduct of institutes for staff education of nurses, nutritionists, physicians.
5. Work with patients (usually on a demonstration basis with nurses).
   a. Clinics:child health, crippled children, cardiovascular, diabetes, prenatal, tuberculosis.
   b. Food budgets.
   c. Home visits.
6. Work with other groups:
   a. Social and welfare agencies on dietary standards and budgets.
   b. Public instruction.
7. Assist in programs of research with schools of home economics, medical schools, departments of health, federal and private agencies.



FIG. 26–4. Child care centers throughout the world are an effective means by which nutrition of preschool children may be improved. This center provides a thick soup and milk for children in a drought-stricken area of Brazil. (*Courtesy, Jean Speiser and the United Nations Children's Fund.*)

Dial-a-Dietitian. A program of nutrition education which has had encouraging response was initiated in Detroit in 1958 through the support of the Nutrition Foundation and the enthusiasm and sustained effort of a number of dietitians.[8] Dial-a-Dietitian is a telephone service now avaliable through 16 regional dietetic associations to people who have questions regarding nutrition. The program in each location has been publicized through newspapers and spot announcements on radio and television, giving a telephone number where people may call for information. A telephone answering service records the question, the name, address, and telephone number of the person calling. Within 24 to 48 hours a dietitian returns the call and provides the information requested. (See Figure 26–5.)

Reports of typical cases[8] illustrate that the dietitian usually has an opportunity to provide more information than that posed by the question. Dietitians have been able to clarify technical terminology, to give specific information pertaining to normal and therapeutic diets, to reinforce the teaching which a patient has received from a dietitian and physician, to evaluate a product, to



FIG. 26–5. Dial-a-Dietitian Program in action. (*Courtesy, The Nutrition Foundation.*)

disprove a fallacy, and to urge medical advice if the individual gives indication that he has health problems not being treated. The questions asked fall into these categories: composition of foods, details of therapeutic diets, food sanitation, food preparation, food additives, food buying, and resource materials. About one fourth of the calls have pertained to food composition, chiefly the caloric value of foods. Thus, concern about weight control seems evident. A number of guidelines have been established for this service. For example, no modified diet is prescribed, nor is the detailed instruction for a modified diet provided by telephone or mail; the person is advised to seek the help of a physician or dietitian.

Project Head Start. Preschool children are especially vulnerable in meeting their physical and social needs, they represent an age group less easily reached, and they cannot adequately express their needs.[9] Poorly nourished children are apathetic and inattentive, and there is some basis for believing that malnutrition in early childhood may affect behavior and learning ability. The growth of the brain is dependent upon protein synthesis, suggesting that protein-calorie malnutrition may adversely affect the development of the central nervous system.[10]

Project Head Start initiated in the summer of 1965 by the Office of Economic Opportunity is of particular significance in that it aims to give underprivileged preschool children an opportunity to fulfill their potential in growth and physical and mental development. Head Start Child Development Centers are established through community action and involve educators, health workers, and parents who share the responsibility of getting children ready for school.

Nutrition is an essential element of each program. Children who attend a half-day session receive a snack and lunch, using the food plan in Table 26–4 as a guide.

Table 26–4. Food Plan for One Meal and One Snack—Project Head Start*

	Amount	Sample Menu
Morning Snack		
Fruit or fruit juice	⅓–⅔ cup	Orange juice
Bread and butter	½–1 slice	Whole-wheat bread and butter or margarine
Noon Meal		
Meat, poultry, or fish	½–1 ounce	Ground beef pattie
Vegetables	1–2 tablespoons cooked	Spinach
	2–4 strips raw	Carrot strips
Bread	½–1 slice	Whole-wheat bread and butter
Butter or margarine	½–1 teaspoon	
Fruit or pudding	¼–½ cup	Vanilla pudding
Milk	½–1 cup	Milk

* *Nutrition Guidelines for the Project Head Start Centers Feeding Program.* Office of Economic Opportunity, Washington, D.C., May 1965, p. 3.

Breakfast is also provided in some programs and would include:

Fruit or fruit juice
Milk
Cereal, bread, or roll, plus one or more of these:
  piece of cheese
  egg, hard cooked or scrambled
  peanut butter

When children are at the center for only two hours, a more substantial snack consisting of milk, a sandwich, and fruit should be provided.

An important aspect of this program is the parent participation and education. Guides have been developed for those who will teach nutrition, including such topics as the daily food guide, planning meals for preschool children, food habits of young children, how to buy food, sanitary practices in storage and handling of food.

EMERGENCY FEEDING

Following a natural or man-made disaster, the goals of emergency feeding are "to keep people alive, to restore and maintain morale, and to provide adequate and familiar food that will keep people at work or enable them to return to work."* The American Red Cross assumes responsibility for emergency feeding in a natural disaster such as a flood, while the civil defense and welfare services carry out feeding during disaster from war.

Problems associated with emergency feeding. Disruption of one or more utilities may make it impossible to cook foods or to use water. Stockpiles must be so planned that some foods not requiring heating are available. The lack of water limits the kinds of foods which can be cooked, and seriously interferes with cleaning and waste disposal.

The dietary needs of special groups require preplanning. Infants and young children are especially vulnerable to the lack of food, and parents are likely to become panic stricken if their children are not cared for. Dry and evaporated milk supplies are vital for infants and children. When no water is available for formula preparation, Bovee has suggested that canned fruit juices and even carbonated beverages might be used. The ill and the aged should also be considered. Most patients on modified diets can survive a short period when some foods needed by them are not available. For example, patients with peptic ulcer may get along quite satisfactorily if it is at all possible to eat a food such as bread at more frequent intervals. Every diabetic should be fully instructed on what to do when he is unable to get his food or his insulin.

The worker in a disaster—fire fighter, rescue worker, or the person restoring facilities—must receive sufficient food allowances so that he can keep his work at a maximum output; this may require 3000 to 3500 calories daily.

A disaster is no time to give unfamiliar foods, since the stress of the emergency will usually lead to refusal. Therefore, local foods which are familiar and well liked should be used.

During the first few days following a disaster, food to allay hunger and to sustain morale takes precedence over meeting nutritional needs. A cup of hot coffee to the adult and milk to the child given as soon as possible are tangible evidence that someone is caring for them and that some community facilities are functioning. When an emergency is of more than a few days duration, nutrient needs must be considered. The recommended allowances, however, are likely to provide unrealistic goals when there are food shortages; rationing priorities must be defined.

Safety of food supplies. Following a nuclear attack, the hazards of radioactive contamination of food and water must be appreciated. Foods which are in sealed, unbroken packages or in cans are safe for use, as are those in a refrigerator or freezer which has remained closed. However, the outside of the

* Bovee, D. L.: "Emergency Feeding in Disaster," *Am. J. Clin. Nutrition*, 6:77, 1958.

food container or utensil for cooking and eating must first be washed in detergent solution to remove the radioactive substances. Wash water and cloths used for cleaning must be buried.

If no refrigeration facilities are available, food spoilage occurs rapidly and food poisoning may affect large numbers of people. Cream fillings, milk, ground meat, sandwich fillings, and salads mixed with mayonnaise are especially likely to spoil. Infant formulas may be prepared from dry milk just before use if they cannot be refrigerated.

GUIDE FOR AN EMERGENCY SHELF FOR THE FAMILY*

General considerations

1. Allow about 2 quarts liquid per person per day—fruit and vegetable juices, bottled water, soft drinks.
2. Plan menus in advance using foods the family likes, and keeping these situations in mind: (1) no fuel available and water is limited; (2) no fuel available but there is sufficient water; (3) cooking facilities but little water; (4) cooking facilities and ample water.
3. Stock foods on the basis of menus planned. Avoid those foods which increase thirst. A 2-week supply of foods is recommended.
4. Rotate food supplies at least every 6 months so that stock is always fresh.
5. Use only air-tight containers—metal, plastic, or heavily waxed cardboard. Glass is not satisfactory since it may shatter.
6. Consider emergency cooking facilities.

Suitable foods from which to select (all in air-tight containers):

Liquids: fruit juices including citrus juices; vegetable juices; carbonated beverages; water

Milk: nonfat dry and evaporated

Canned foods: fruits; vegetables; soups; stews; baked beans; spaghetti and other pastes with sauces; chicken, meat balls, sea food, pressed pork; peanut butter; cheese; oils; shortening; jelly, jam, preserves

Dried foods: dried fruits; legumes

Cereals and breads: dry cereals; ready-to-eat cereals; spaghetti, macaroni, rice, noodles; flour; canned or frozen breads; cookies

Infant foods: dry milk, cereals, fruits, vegetables, strained meats

Miscellaneous foods: instant coffee, tea, salt, pepper, sugar, candy, pickles

Supplies: cooking and eating utensils, paper dishes, matches, candles, bottle and can openers, covered cans for waste disposal, water containers, paper towels and napkins, detergent powder

INTERNATIONAL PROGRAMS IN NUTRITION

Food and Agriculture Organization. Of all international agencies, the Food and Agriculture Organization of the United Nations (FAO) is most

* Adapted from "Confidentially Speaking—A Report on Emergency Feeding," Nutrition Section, Louisiana State Department of Health, August, 1957.

directly concerned with food. It was founded in Quebec, Canada, in October, 1945, the aims being:

To help the nations raise the standard of living;
To improve the nutrition of the people of all countries;
To increase the efficiency of farming, forestry, and fisheries;
To better the condition of rural people;
And, through these means, to widen the opportunity of all people for productive work.*

The headquarters office of FAO is in Rome where the work of the organization is supervised by the Director-General. A conference in which each member nation has one vote meets every 2 years to develop the program of work. A smaller group, the Council, with representatives from 24 member nations, meets every spring and fall and acts as the interim governing body. Regional offices are located in various parts of the world, the one in the United States being situated in Washington.

FAO provides assistance to its member states by maintaining an intelligence service which gathers, analyzes, and distributes information on which action can be based, and by developing programs of action in cooperation with the governments of a given country. An informational and educational division is responsible for library services and publications and for the dissemination of information to the public.

Technical assistance is provided through five divisions—agriculture, economics, fisheries, forestry, and nutrition. All of the participating countries supply technical experts so that the team going to any given locality truly gives an international approach. The local government shares in the cost of the project and of facilities for work, while FAO covers travel expenses and salaries of the experts and provides a minimum of demonstration equipment. Of the hundreds of projects completed since the inception of FAO, the following are examples:

EDUCATION

Establishment of home economics department: Queen Aliya College, Iraq
School feeding programs: Costa Rica, Colombia, Iraq
Nutrition training programs for teachers: Ecuador

AGRICULTURE

Weed elimination: Chile
Development of rust-resistant wheat: Near East
Inland fish culture in ponds, rice fields: Haiti, Thailand, Israel
Control of locusts and other plant perils: Near East, Central America, Yugoslavia, Syria, Iraq
Control of animal diseases: Far East, Near East, Central America

* *Food and Agriculture Organization—What It Is—What It Does—How It Works.* Leaflet, Food and Agriculture Organization of the United Nations, Rome, 1956.

TECHNOLOGY
Improved bread-baking techniques: Chile
Pilot plant production of saridele (liquid soybean "milk"): Indonesia
Large-scale canning: India

ENGINEERING
Irrigation, drainage, land reclamation: Pakistan, Ceylon
Machine shops and tractor stations: India, Ceylon

World Health Organization. The World Health Organization (WHO) was created in 1948 and is directed by a Director-General with headquarters in Geneva, Switzerland, and with six regional offices, one of which is in Washington, D.C.

WHO is "the directing and coordinating authority for international health work." It is governed by two principles defined in its constitution:

Universality: The health of all peoples is fundamental to the achievement of peace and security. The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.

Concept of health: Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.*

The assistance which WHO renders to governments includes:

. . . strengthening national health services; establishing and maintaining epidemiological and statistical services; controlling epidemic and endemic diseases; maternal and child health; promotion of mental health to foster harmonious human relations; improvement of sanitation and of preventive and curative medical services.*

Major efforts of WHO have been directed to the eradication of malaria, tuberculosis, venereal diseases, and yaws. These crippling diseases yearly reduce by thousands the number of workers available to produce food; the return of these people to productivity has incalculable effects on improving the food supply. The improvement of the sanitary standards—pure water supplies, pure milk and other food, insect control, housing, waste disposal—is likewise concerned with the improvement of nutrition.

United Nations Children's Fund. To children in different countries UNICEF means different things. It may mean an injection to cure them of yaws, a crippling disease, or vaccination to protect against tuberculosis; but to all children in these countries UNICEF has come to mean milk (see Figure 26–6).

Organized in 1947, UNICEF continued the emergency feeding in war-devastated countries of Europe, with emphasis on protein-rich foods, especially

* *World Health Organization—What It Is—What It Does—How It Works.* Leaflet, World Health Organization, Geneva, 1956.



FIG. 26–6. Undernourished children throughout Bombay State receive a daily ration of milk supplied by UNICEF. (*Courtesy, United Nations Children's Fund.*)

milk. Now, all over the world, children are benefited by milk distribution through emergency relief, school feeding, and maternal and child health centers. Nonfat dry milk has been donated from the surplus in the United States, while UNICEF has provided for its transportation and distributio

While UNICEF continues to provide emergency relief, mos of its funds are now diverted to long-range programs, for it is realized that countries must be able to solve their own nutritional problems. With UNICEF funds demonstration programs, such as acceptance tests of fish flour, have been initiated with the cooperation of FAO and WHO.

Food for Peace. Public Law 480, called the Food for Peace Program, was adopted by the Congress in 1954 as a means for disposing of agricultural surpluses. The principal surpluses over the years have been cereals (especially wheat), nonfat dry milk, butter, cheese, and more recently, soybeans. Throughout the years this program has provided food for vulnerable groups through UNICEF, CARE, and other relief agencies working in maternal and child health centers. Food has been available for refugees and to feed people in disasters such as floods, hurricanes, and crop failures.[11] Surplus foods have also been used as part payment for laborers working on development programs: irrigation projects, dams, roads, drainage, and so on. Important as the contribution of the Food for Peace Program has been, at least two facts stand out: (1) probably ten times as many children could have benefited through the milk program had more milk been available; and (2) food surpluses are dwindling because of the increasing United States population, the expansion of food imports by Europe and other parts of the world, and the large-scale

disasters, especially the recent crop failures in India.[11] Obviously, increased food production in the countries now growing less food than they need is of paramount importance.

PROBLEM AND REVIEW

1. How could you determine what nutritional problems exist in your school? In your community?
2. List superstitions concerning food with which you are familiar. What facts can you give to establish that they are erroneous ideas?
3. What are the dangers of food faddism and quackery?
4. What are some of the criteria by which you could tell whether a person is a food quack?
5. List the public and voluntary agencies in your own community who work for better nutrition in one way or another. If possible, arrange for an interview to learn more of the activities of one of these.
6. Plan a 15-minute program for a group of parents of underprivileged preschool children on one of these topics: menus for preschool children; taking care of food in the home; food habits of children.
7. List a number of learning experiences related to foods for children in a Head Start program.
8. Select one of the organizations listed in this chapter and prepare a report of its objectives and its activities.
9. *Problem.* Prepare a 1-day menu for each of the four limitations listed on page 408 with respect to emergency feeding.
10. Suggest ways by which nutrition education can be made more effective for teenagers. What methods might appeal to a group of people over 65 years?
11. Discuss the activities of FAO; WHO; UNICEF.

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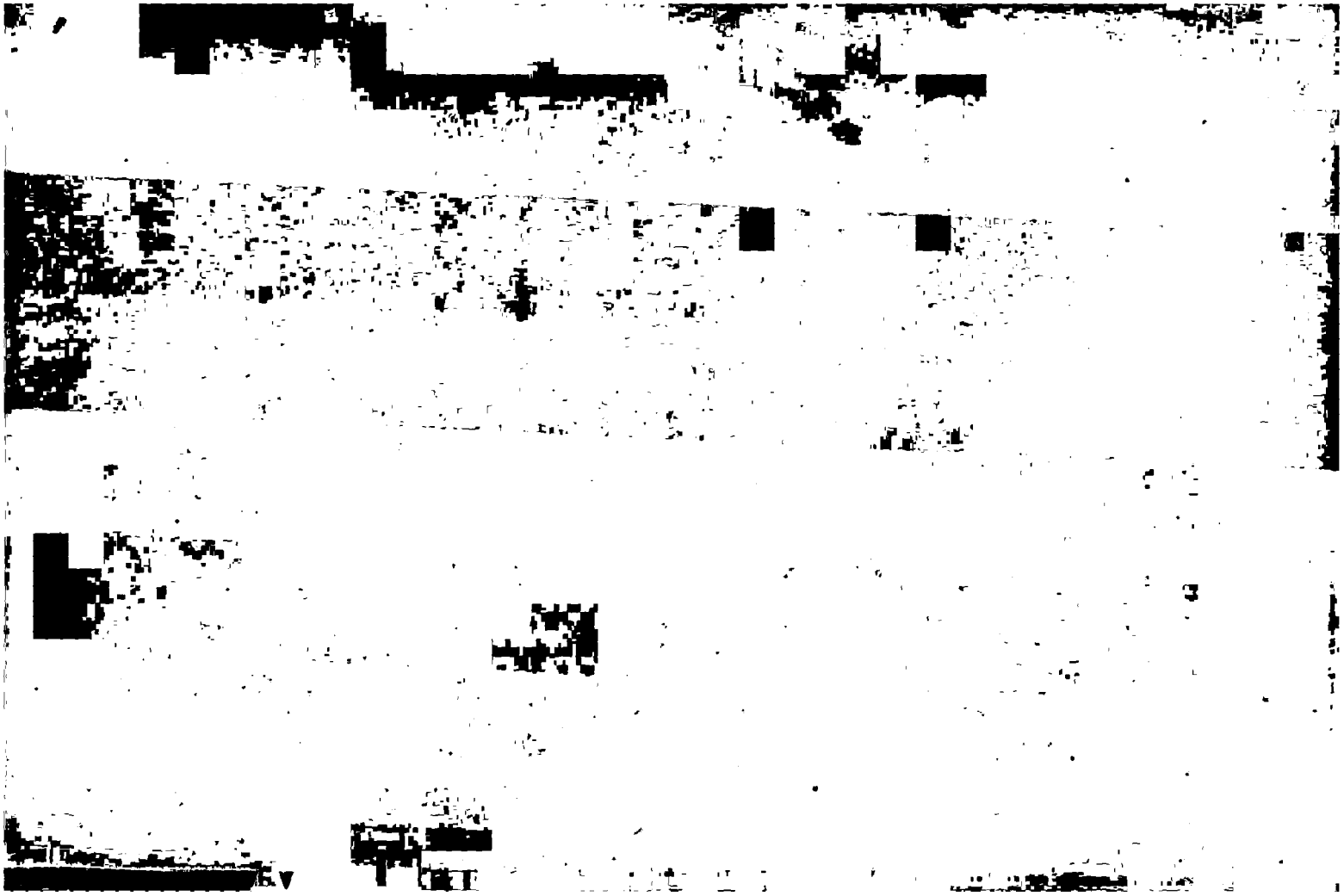
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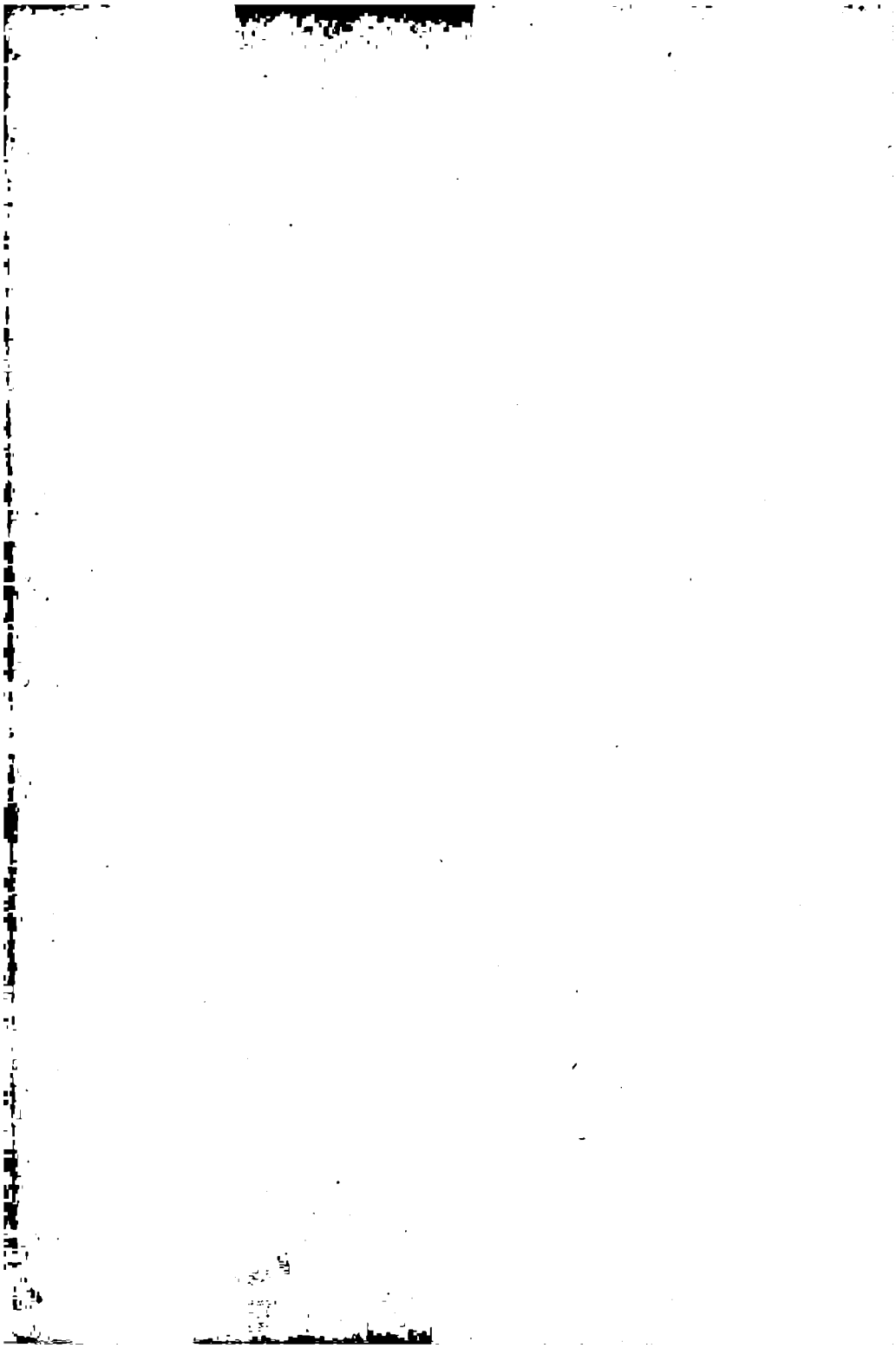
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PART TWO
THERAPEUTIC NUTRITION



UNIT VIII

Introduction to the Study of Therapeutic Nutrition

Chapter

27 THERAPEUTIC NUTRITION: FACTORS IN PATIENT CARE

28 COORDINATED NUTRITIONAL SERVICES FOR PATIENTS

29 THERAPEUTIC ADAPTATIONS OF THE NORMAL DIET:
Normal, Soft, and Fluid Diets

30 SHORT METHOD OF DIETARY CALCULATIONS: USE OF THE MEAL EXCHANGE LISTS

THERAPEUTIC NUTRITION: FACTORS IN PATIENT CARE

"The best doctors in the world are Doctor Diet, Doctor Quiet, and Doctor Merryman."

—Jonathan Swift.

Good nutrition is a prerequisite to health. Man has probably always associated food, in one way or another, with health or illness. In fact, many of the ideas held by people for preventing or curing disease are based on folklore. The attributes of good nutrition and the principles and practices for achieving them have been discussed for all age categories in Part I of this text. The failure to ingest an adequate supply of the proper nutrients, or inability to digest, absorb, or metabolize foodstuffs, invariably leads to deficiency diseases (see Chapter 31). These, in turn, may initiate or aggravate diseases of nonnutritional origin because of the body's lowered resistance.

Many illnesses such as infections, injuries, and metabolic disturbances lead to deficiencies even in persons normally possessing good nutritional status, because the individual is unable to ingest sufficient food or because the disease process imposes greatly increased demands for most, if not all, of the nutrients. Thus, a vicious cycle of disease, malnutrition, and prolonged convalescence is created. It should be apparent that proper attention to nutrition not only can prevent illness but also can remarkably alter the course of illness when it does occur.

Therapeutic nutrition. Diet therapy is the use of food as an agent in effecting recovery from illness. It is concerned with the nutrition of all patients —those receiving normal diets as well as those for whom modified diets have been prescribed. In most instances a normal or modified diet supplements the medical or surgical treatment. Regardless of the diagnosis, the satisfactory intake of food by the patient is essential for the maintenance of tissue structures and body functions so that recovery from illness is not impeded. On the other hand, the failure to ingest sufficient food from a normal diet may retard the rate of recovery and may, in fact, result in unnecessary complications.

Modified diets are the principal therapeutic agents in some metabolic diseases such as diabetes mellitus or phenylketonuria. In other circumstances diet therapy serves as a preventive measure as well as a therapeutic aid; for example, fat-controlled diets may be beneficial to those individuals who have genetic, physical, and biochemical characteristics that predispose to coronary disease. (See Chapter 41.)

The purposes of diet therapy are (1) to maintain good nutritional status, (2) to correct deficiencies which may have occurred, (3) to afford rest to the whole body or to certain organs which may be affected, (4) to adjust the food intake to the body's ability to metabolize the nutrients, and (5) to bring about changes in body weight whenever necessary.

Team approach in nutritional care. Meeting the patient's nutritional needs involves the coordination of the medical, nursing, and dietary staff. The physician prescribes the diet, and should also give the patient some information concerning the reasons why a modified diet has been ordered. Whenever possible, it is helpful to give some estimate concerning the length of time a diet may be required. The dietitian interprets the physician's order in terms of daily meal patterns which have been individualized according to the patient's food habits as well as modified to meet the therapeutic needs. The dietitian is responsible for the preparation and service of food to the patient, and the subsequent instruction of the patient if a home diet is required.

The nurse is a central figure in a number of ways for she has the closest and most constant association with the patient. Among the specific activities of the nurse are the following.

1. She assists the patient at mealtimes as the situation may require.
2. She serves as a liaison between the physician and patient or the dietitian and patient by:
   a. Helping the patient to select his menu when a selective menu is available;
   b. Interpreting the patient's attitudes and problems to the nursing, medical, and dietary staff;
   c. Observing the patient's acceptance or rejection of food, noting the response on the patient's record, and assuming responsibility for calling problems to the attention of the physician, dietitian, or both, as may be needed;
   d. Interpreting the prescribed diet to the patient, and developing his understanding and acceptance.
3. She assists in or assumes responsibility for dietary instruction of the patient, under supervision of the dietitian.

Communication lines between patient, physician, nurse, and dietitian must be kept open at all times. (See Figures 27–1 and 27–2.) Not infrequently the social worker and others are also involved in the team approach to nutritional care.

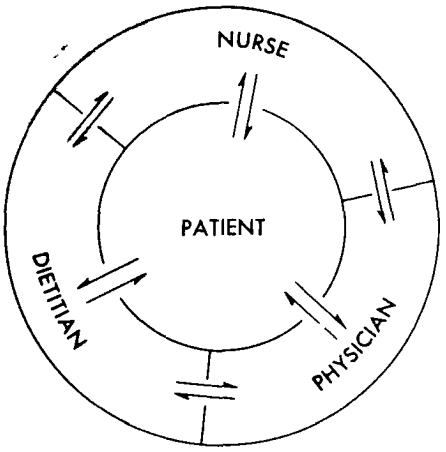


FIG. 27–1. Lines of communication must be kept open between patient, dietitian, nurse, and physician.



FIG. 27–2. Physician, dietitian, and nurse discuss dietary changes with patient. (*Courtesy, Miss Ruth Dickie and University Hospitals, University of Wisconsin Medical Center.*)

Factors to consider in the study of diet therapy. In order to assume the roles described above in patient care, it will be seen that certain understandings and abilities must be developed. An appreciation and knowledge are required of (1) the underlying disease conditions which require a change in diet, (2)

the possible duration of the disease, (3) the factors in the dietary which must be altered to overcome these conditions, and (4) the patient's tolerance for food by mouth.

The planning of a therapeutic diet implies the ability to adapt the principles of normal nutrition to the various regimens for adequacy, accuracy, economy, and palatability. This may necessitate the calculation of one or more nutrients. Also essential is a recognition of the need for dietary supplements such as vitamin and mineral concentrates when the nature of the diet imposes severe restrictions, the patient's appetite is poor, or absorption and utilization are impaired.

A correctly planned diet is successful only if it is eaten. The dietitian and nurse must be able to apply the principles pertaining to the preparation and service of appealing, palatable, and nutritious food. They must have the necessary understanding of the psychologic and emotional factors influencing food acceptance.

Patient care includes planning for his full rehabilitation. For some patients a modified diet may be required for weeks, months, or even a lifetime; for others, guidance may be desirable in the improvement of a normal diet. Such planning necessitates consideration of social, religious, and cultural patterns, availability of foods, cost of food, suitable methods of food preparation, and so on. (See Chapter 28.)

EFFECT OF ILLNESS ON FOOD ACCEPTANCE AND UTILIZATION

The physiologic, psychologic, and emotional factors governing food acceptance have been discussed in Chapter 15. Likewise, a number of cultural food patterns have been presented in Chapter 16. Illness may modify or accentuate the influence of any of these factors.

Illness modifies food acceptance. The disease process itself may have a profound effect on food acceptance. Some foods may produce marked anorexia, others may be distending, while still others may be irritants to the gastrointestinal tract. According to Moore[1] and others, the illness may turn the preferences back to those of earlier years. These may be the bland foods of childhood, but they might be the special dishes associated with one's ethnic origin.

The sick person has many fears: those relating to the outcome of the illness itself; economic concerns for himself and his family; emotional adjustments to having to depend on others during the illness; anxiety about loss of love and self-esteem.

When illness takes the individual from the home to the hospital, food acceptance becomes much more difficult. When the patient most needs the comfort and companionship of family and friends, he is relegated to eating

alone. Perhaps the meal hours are different from those to which he is accustomed; the foods appearing on his tray may be unlike those he usually eats with respect to choice, or flavoring, or size of portion; a single food to which he has a strong aversion may so upset him that he is unable to eat anything served with it; managing a tray and the utensils for eating may be awkward when one is in bed; his expressed needs are often minimized or brushed aside.

Modified diets impose additional problems. When a patient is confronted with the need for a therapeutic diet, he may respond with comments such as these: "I just can't get it down." "This food is tasteless." "I can't afford such food when I go home." "Who is going to prepare my food at home?" "I can't buy these foods at work." These reactions and many others must be met by the nurse or dietitian during instruction by providing help in budgeting, arrangements for preparation, suggestions for palatability, and other useful advice.

Babcock[2] has pointed out that remarks such as the above also imply many responses to the diet: unwillingness to accept change; anger at those associated with the diet—nurse, dietitian, physician, or even mother or wife who have nagged about the food habits at home; fear of having to eat disliked foods or those foods to which he has a strong aversion; sense of deprivation with respect to choice of foods; fear of loss of social status and self-esteem; and the feeling that diet is, in some way, a punishment of him.

Young[3] states that the patient may express fear by being angry, self-conscious, talkative or reticent, uneasy, depressed, indifferent, impatient, hostile, apologetic for his failure, or resentful. Some patients may use diet as a means of gaining the attention from hospital personnel and later from the family who must provide this food. They may insist upon meticulous attention to the minutest of details, in order to gain this attention. They may actually enjoy the trouble this may be to others, and the release of responsibility for their welfare to others. Occasionally, one may actually prefer not to get well!

Stress. Physiologic, psychologic, and emotional disturbances are often accentuated in illness and may have profound effects upon the nutritional requirements. Immobilization is a stressful situation in which nitrogen and calcium excretions are elevated. In long-term illness, immobilization may be responsible for serious demineralization of bones.

Any trauma to the body such as bone fracture, wound injury, or infection increases the losses of nitrogen and various electrolytes. The secretion of several hormones is often increased, thereby elevating the needs for vitamins required to carry on metabolic processes.

Balance studies on healthy young people have shown that emotional stress, such as the taking of examinations or a pregnancy for an unmarried girl, leads to increased losses of nitrogen and calcium. In fact, persons under such stress may achieve balances only with considerable difficulty. One may reasonably assume that the anxiety concerning illness may also accentuate such losses.

INTERPERSONAL RELATIONSHIP WITH THE PATIENT

By her warmth and sincere interest in the welfare of the patient, the nurse, dietitian, or homemaker can do much to allay the anxieties of the ill person. Her work is often more successful if she can place herself in the patient's role, although she must guard against overidentification; if she becomes too close to the patient, she may accept his reactions as being always so reasonable that she is unable to do anything about changing them.

Listening. She who cares for the patient must learn to listen carefully—not only to the words themselves but also to their tone and inflection. By taking time to listen, she may be made aware of a legitimate complaint about something wrong with the trays a patient receives—for example, cold coffee, an egg not cooked to his liking, or a vegetable he thoroughly dislikes. Such details are relatively easy to correct, and the patient is thereby made quite comfortable and satisfied. The seemingly casual conversation with the patient may bring to light that the past diet has been inadequate for a long period of time because of lack of teeth, poor health, inadequate income, or the inability to prepare food. Permitting the patient to talk about other things as well as the diet will often reveal that the problems encountered in food acceptance are actually a by-product of the deep anxieties caused by other problems; through understanding, the patient can often be helped.

Recognition of attitudes. How does the nurse or dietitian feel about the patient who doesn't eat his food, who eats too much, or who complains about his food a great deal? When the patient expresses resentment or hostility toward her, does she realize that this may be against the restrictions the diet puts upon him and not against her as an individual? It is important that she recognize her own attitudes toward the patient, lest she show him that she is pitying, superior, intolerant, resentful, or critical of him. Moreover, she must avoid an expression of any negative attitudes she may have toward food.

Encouragement to the patient. When adjustments are made with difficulty, praise for even a little progress and encouragement to keep on trying will usually accomplish more than a critical, scolding approach. Regard for the patient as a mature individual, allowing him to protect his self-esteem, will help to gain his confidence. Reassurance with respect to the diet is essential, but it must be realistic in terms of the difficulties of adjustment to it and its legitimate role in the total therapeutic program. To illustrate, appropriate diets for obesity and diabetes are basic to treatment, but some patients may find the adjustment to the restrictions extremely difficult; to minimize the problems involved is to invite failure. A low-fat diet may be helpful to the patient with gallstones, but it should never be held as a guarantee that surgery would not be required at a later time. Likewise, benefit may accrue to a patient with cardiovascular disease who is placed on a diet with modification of the amount and nature of the fat, but success is so variable that promises of marked improvement would be ill-advised and rash.

FEEDING THE PATIENT

Environment for meals. Time and effort directed toward creating an atmosphere conducive to the enjoyment of food is well spent. Such an environment implies that the surrounding areas are orderly and clean; that ventilation is good; and that distracting activities such as treatment of patients and doctors' rounds are not occurring at mealtime except as emergencies may arise.

Patients who are ambulatory enjoy eating with others. In some hospitals a dining room is provided for patients, while in others food service may be easily arranged at small tables set up in the patients' lounge.

Readiness of the patient. The patient should be ready for his meal whether he is in bed or ambulatory. This may entail mouth care, the washing of the hands, and the positioning of the patient so that he can eat with comfort. If tests or treatment unavoidably delay a meal, arrangements must be made to hold trays so that the food can be fresh and appetizing when the patient is ready to eat.

The patient's tray. The appearance of the tray is of the utmost importance since the patient's consumption of the food presented to him is the goal to be achieved. It will be seen that some of the items listed below which describe standards for tray service are the primary responsibility of the dietary department, but that others require the maximum cooperation of nursing and medical staffs with the dietary department.

1. Variations in color, flavor, and texture for appeal to the senses would be expected as essentials in menu planning and food preparation. (See Unit IV.)
2. The tray should be of a size suitable for the food to be served—small trays for liquid nourishment and large trays for full meals.
3. The tray cover and napkins, of linen or good quality paper, should be of suitable size for the tray, immaculately clean, and unwrinkled.
4. Everything on the tray must reflect cleanliness—sparkling glassware, shining silver, clean china. Salt and pepper shakers with finger marks, or soiled name cards detract markedly from good appearance.
5. The tray should be set with the most attractive china available.
6. The tray should be symmetrically arranged for the greatest convenience. All necessary silver and accessories should be included.
7. Foods should be attractively served, with the size of portions not being overlarge. Spilled liquid or sloppy serving of food is inexcusable. Garnishes help to make foods more appealing.
8. Foods should be served on time. This requires careful planning so that foods will be prepared in the proper sequence.
9. Foods should be served at the proper temperature. Hot foods should be served on hot plates, protected with a cover, and cold foods should be served on chilled dishes.
10. A final check of the tray should establish that it fully meets the require-

ments of the diet order, and that the patient's preferences have been implemented. (See Figure 27–3.)



FIG. 27–3. Dietitian and nurse work closely together to assure satisfactory tray service to the patient. (*Courtesy, National Institutes of Health, U.S. Department of Health, Education, and Welfare.*)

Assistance in feeding. Some patients may require assistance in the cutting of meat or other foods, the pouring of a beverage, or the buttering of a piece of toast. Very ill or infirm patients must be fed. It is well for the nurse to sit down while she feeds the patient so that she can be at ease and avoid undue haste. Food will be enjoyed more if it can be eaten with reasonable leisure and if there is some conversation. Obviously, if the nurse is responsible for feeding several patients, she will make arrangements to delay tray service or to keep foods hot for those who must await their turn.

PROBLEM AND REVIEW

1. What purposes are served by diet therapy?
2. Discuss the role of diet in total patient care.
3. How can you be sure that the diet prescribed for your patient is meeting his needs?
4. *Problem.* Keep a record of comments that your patients make about their meals. On the basis of these comments what can you do to ensure that your patients enjoy maximum comfort and optimum therapy insofar as their diets are concerned?

5. Discuss reasons why a patient's nutritional status may be unsatisfactory when he comes to the hospital.
6. A patient complains to you that his food is always cold. What steps can you take to correct this?
7. If a patient is having laboratory studies which will extend beyond the lunch hour, what arrangements will you make for the service of his meal?

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Chapter 28

COORDINATED NUTRITIONAL SERVICES FOR PATIENTS

Comprehensive care—a challenge. Chronic illnesses including cardiovascular diseases, neoplasms, diabetes, and arthritis are leading causes of illness in the United States. These diseases account for a large share of hospital admissions, and place severe burdens of care, loss of income, and heavy medical costs on families who are often ill prepared to cope with these problems. The security and well-being of all members of the family may well be threatened.

Chronic diseases afflict the elderly more frequently, but younger people are not altogether immune to them. Many patients remain in hospitals longer than their therapy requires because there is no one in the home to adequately care for them, or because the other adult in the family is also the wage earner. Nursing homes sometimes provide for the transition from hospital to home. If single or multiple services are available within the home, the patient's rehabilitation is likely to be hastened in the happier environment of the home and the costs of care may be considerably reduced.

With the initiation of Medicare for those 65 years and older a new challenge has been provided for the adequate care of the elderly. The provisions of this legislation will have far-reaching effects, for the programs developed for this age group will undoubtedly be applicable to younger persons as well. On a given day it has been estimated by public health authorities that 500 persons for each 100,000 are homebound because of illness or disability. Of these 500 persons, 200 could use some aspect of home care, and 40 would benefit most through coordinated home-care services. On the basis of a population of approximately 200 million persons, the total number of homebound persons who could benefit by home care is staggering. New approaches by the health disciplines will most certainly be developed in the near future so that these needs can be adequately met.

The dietitian, nurse, and nutritionist assume important responsibilities related to nutritional care of patients. In a recent survey of 200 agencies[1] respondents were asked to list those subjects for which increased teaching-aid material would be required as a result of the Medicare provisions. Of more

than 30 subjects listed, nutrition ranked second only to rehabilitation. This list revealed, in part, the types of services most often needed.

This chapter is concerned with (1) dietary counseling as a sound approach to patient rehabilitation, and (2) dietary aspects of home-care services.

DIETARY COUNSELING

The plan for rehabilitation of many patients includes counseling to effect improvement of a normal diet or adjustment to a modified diet. Brandt[2] has suggested that the term *home diet* is more appropriate than the term *discharge diet,* in that the former immediately establishes the setting of the diet.

Responsibility for counseling. Dietitians, nutritionists, nurses, and physicians share responsibility for dietary counseling. Within the hospital the dietitian may provide the formalized instruction for the patient's home diet or she may have supervisory responsibility for nurses who give instruction to selected patients. The physician has an obligation to the patient to discuss the reasons why he has ordered a given diet, and what the patient may expect in terms of health as a result of adherence to the diet.

Numerous opportunities arise within the hospital for informal instruction by the nurse, dietitian, or physician as the occasion arises. It goes without saying that all who provide guidance should be in common agreement about the essentials of the patient's diet. The nurse who doesn't know the answer to a question should seek the correct information from the dietitian, or ask the dietitian to see the patient, if the problem is complex. Nothing is more confusing to the patient than to receive information from several sources which varies widely or is contradictory.

Instruction begins early. For the in-patient, dietary instruction should be planned well in advance, for little can be accomplished when the home diet is given just as the patient is ready to leave the hospital and is concerned about his trip home, the medicines he is to take, and his readjustment to normal activities. The process of instruction, in fact, is part of the daily care of the patient. For example, the diabetic tray becomes, at each meal, a lesson in the use of the meal exchange lists; a complaint about unsalted food may provide opportunity to tell about the use of other flavoring aids. Such informal instruction provided day by day gives the patient an opportunity to get used to the idea of the diet, to reflect on it, and to ask questions when they occur to him.

Establishing rapport. The nurse and dietitian have ample opportunity for establishing good rapport with the patient in the hospital, but in the clinic the patient may be seen for only a short time. The interviewer, then, must make every effort to make the patient feel comfortable and at ease before proceeding with the instruction. She must be cheerful, genuinely interested, and inspire confidence.

A quiet, pleasant room where privacy can be assured is essential. The patient and interviewer should be comfortably seated, preferably at a table or desk.

In establishing rapport, the interviewer gradually encourages the patient to talk about himself.[3] Initial questions may well be of a general nature, such as the patient's address, occupation, height, weight or age. The conversation is then directed to the food habits and should bring out the home situation and possibly give some clues to the patient's emotional state.

Timing is important. According to Hildreth,[4] choosing the right time of day for instruction is important. Just before or during meals, the patient is directed to familiar foods which have satisfied his hunger in the past, and he will resist efforts to divert him from them. Immediately following the satisfaction of hunger, he will have little interest in, and may even be nauseated by, the further mention of food. Therefore, some time should elapse after the meal when food can be discussed objectively. Instruction should come at a time when the patient need not be interrupted for routine care, treatments, etc. The instructor must have sufficient time for calm, unhurried teaching.

The dietary history. The individualization of the therapeutic diet necessitates information concerning the patient's practices: Where does he eat meals? When? With whom? Who prepares the food? What are the shopping, storage, and preparation facilities? How much money can be spent for food? What are some typical meal patterns at home? What amounts of food are eaten? Is food eaten between meals? If so, when? What foods? What are some favorite foods? Which foods are disliked? Has he ever been on a diet before? If so, how long? What was the outcome?

On the basis of the dietary history an evaluation may be made of the approximate adequacy of previous diets, and suggestions may be made for improvement. The prescribed diet may be adjusted realistically to the patient's home situation.

Dietary counseling based on patient needs. A fundamental tenet is to begin where the patient finds himself. Something good can be found in every diet, and every effort should be made to impose as few changes as necessary—not a complete discarding of the old pattern. The instruction should be in simple terms readily understood by the layman. Some judgment concerning the amount of detail which may be included is essential, for a weary patient may remember little when he gets home.

The patient will require guidance with respect to choice of foods, methods of preparation, kinds of seasonings which may be used, amounts of food allowed, the number of meals, and time for meals. A written meal pattern which has been developed with the patient is essential. Printed menus that have little or no regard for individual preferences are of doubtful value.

Although the emphasis should always be directed to the foods the patient may have, in some instances, such as the sodium-restricted diets, it may be

desirable also to provide a list of foods that are contraindicated. Printed aids such as the meal exchange lists are useful and time saving, but they should always be accompanied with appropriate explanation. Illustrations, posters, and food models are helpful in clarifying instruction; even films may be used where group instruction is used as for pregnant women, the obese, diabetics, and others.

Other members of the family must often be included in the instruction. The wife or mother of the patient may not understand the reasons for the diet, may feel that the diet is an imposition upon her, and may not understand the methods for preparing the necessary foods unless she is present at the time of instruction. For some patients it is necessary to plan a food budget, to make arrangements for meals carried to work, to make suggestions for a conference with the employer, or to provide guidelines for eating meals away from home.

Continuity of guidance. Dietary counseling is time consuming. The effort is often wasted when no opportunity is given for follow-up of the instruction given. The out-patient clinic and home visits serve to extend and clarify the instruction itself, to provide reassurance, to check progress, and to recognize any tensions which are building up in the patient.

The initial instruction may have been provided by a therapeutic dietitian or sometimes a nurse in the hospital, but it is quite likely that follow-up of the patient is the responsibility of a clinic dietitian, a nutritionist, or a visiting nurse. Obviously, an important element of such continuing guidance is an adequate record of what has been presented to the patient initially.

Teaching machines have been used with some success for instruction of patients with diabetes mellitus.[5] Their use in hospitals, clinics, and health centers serves to reinforce the personalized instruction which has been given and to save instructional time. Programmed instruction through booklets pertaining to modified diets also merits attention. These aids allow the patient to progress at his own speed; they are not intended to replace individualized instruction, however.

Group instruction. In a food clinic or health center, classes may be held for groups with similar diet problems: pregnant women, mothers with preschool children, diabetic patients, those requiring sodium restriction, and so on. Economy of time for the professional worker is an apparent advantage of using group instruction. Many patients are helped by this approach inasmuch as they learn to appreciate that others have similar problems and that they can share experiences with one another. The person who is given to much self-pity may receive encouragement toward a more positive outlook on his problems it proper guidance is provided in the group setting. Group instruction may be supplemented by individual teaching, particularly with respect to problems of finance and emotional reactions to the diet.

Group instruction must be a democratic process in which everyone feels free to participate. The nurse or dietitian cannot be authoritarian, the talka-

tive patient should not monopolize all of the time, and the self-conscious, shy patient should not be made uncomfortable by having to respond when he is not ready. Verbal instruction should be coordinated with visual aids, including dietary lists, leaflets, posters, food models, and films as the occasion may warrant. The leader of the group cannot change the individual or the group; she can only help them to recognize their own goals and to make their own decisions for change.

COMPREHENSIVE CARE SERVICES

Concepts of comprehensive care. The provision of all necessary health services so that the patient can maintain or be restored to independent living is implied in the term "comprehensive care." Although such a goal has long been held by professional health workers, its achievement through continuing services from hospital to home has been limited.

Piper[6] has described the concepts of comprehensive care programs as widening circles which surround the patient and his family as the focus. These include evaluation and referral; the setting of the care service; and the essential professional services.

Careful evaluation and reevaluation of the physical, psychologic, economic, and social dimensions are first required.[6] With each evaluation, and reevaluation as the needs change, the patient is referred to the essential service. The services may be provided on an in-patient basis, including hospital care for the acutely ill, a minimum-care facility within a hospital, or convalescent care in a nursing home. Care may be furnished through an out-patient clinic, utilizing a single service in a physician's office or multiple services provided by a clinic or health center. Home care, of course, implies services provided in the home, and can range from a single service such as nursing to coordinated services by many disciplines that could include medical, nursing, dental, dietetic, social, occupational therapy, physical therapy, and others.

Many home-care programs are now being developed in communities, some of which are sponsored by the hospital while others are directed by a public or voluntary health agency. Such services will require the assistance of a variety of technicians so that the services of the professional nurse, dietitian, and others may be most effectively used. A brief discussion of some elements of home care is given below.

Home-delivered meals. Many individuals or couples with physical limitations can remain in their own homes rather than be institutionalized if some provision can be made for their meals. Others who are temporarily disabled by illness but who are ambulatory and can feed themselves may find it possible to return to their homes at an earlier time if they can procure their meals.

A service described as "Meals-on-Wheels" was first offered by The Lighthouse in Philadelphia in 1954 and is now available in a number of communities though still on a limited basis. Most programs have been operated by women's clubs, church groups, family service organizations, and so on. Dietitians, nutritionists, or home economists usually serve as consultants, giving particular attention to menu planning, food purchasing, and food preparation. Paid employees and volunteers may share the responsibility for the actual purchase, preparation, packing and delivery of meals.

Usually a hot noon meal and a packaged evening meal are delivered by a volunteer on a five-day basis. The recipient pays a fee for these meals, with gradations according to ability to pay. One important benefit of the service is the daily contact which the homebound person has with the volunteer who delivers the meals.

Homemaker services. The purpose of this service is to maintain the family in a healthful setting when no one in the family can fulfill the homemaking function. For example, the mother may be ill or convalescing from physical or



FIG. 28–1. A home health aide adapts to the facilities within the home in providing meals that will be satisfying to the patient. (*Courtesy, Community Nursing Service, Philadelphia.*)

mental illness; an aging person or couple is unable to perform the necessary tasks in the home, but could remain at home at less expense with homemaker assistance; death of the mother in a home with young children presents a major problem to the working father unless relatives help out or homemaker service is available.

The sponsoring organization may be a public or voluntary agency such as the welfare division, the family service organization, or the visiting nurse society of a city. The organizations recruit, define duties, provide formalized training and in-service programs of education, and supervision on the job.[7] Social workers, public health nurses, home economists, and others have participated in these duties.

The terms *homemaker, home health aide, housekeepers,* and *visiting homemakers* are used with some variations of duties depending upon the sponsoring agency. Generally speaking, homemakers are mature women who have had responsibility for raising their own families, who like to help other people, and who can follow instructions. Among the responsibilities pertaining to nutrition are meal planning, marketing, food preparation, and food service. (See Figure 28–1.) One of the problems may be that of getting children to eat regular meals; another may relate to a modified diet; a common problem is that of stretching the food dollar. The homemaker must be an adaptable individual who adjusts to the facilities within the home, whatever they may be. She must respect the wishes of the family and adhere to their socioeconomic and cultural values. She will accomplish little if in doing her job she creates antagonism and jealousy in any member of the family.

Nutrition and the handicapped individual. Arthritis, cardiac disease, hemiplegia, and a variety of orthopedic disabilities may impose handicaps of self-feeding for some, and of food preparation for others. The quality of nutrition may be impaired because of difficulty in manipulating feeding equipment or in chewing. The forced reduction in activity often brings obesity which further impairs movement. The difficulties presented in food preparation when the heart is impaired, when hand grasp is poor, or when getting around is restricted to a wheel chair may affect the entire family because the homemaker is unable to prepare satisfactory meals.

Most handicapped individuals can be retrained in a rehabilitation center or in the home by physical and occupational therapists who are skilled in the mechanics of body movement and in the use of appropriate devices. Dietitians, nutritionists, and home economists are highly qualified to modify kitchen arrangement for those with limited physical abilities. Many hand and electric appliances ease the work load for the handicapped. Organizations such as The American Heart Association and The Arthritis Foundation have made recommendations for adapting kitchen facilities to the use of the handicapped. (See Figure 28–2.)

The special needs of handicapped children are discussed in Chapter 46.



FIG. 28–2. An occupational therapist shows a handicapped homemaker how to modify food preparation procedures for her physical limitations. (*Courtesy, The Arthritis Foundation.*)

PROBLEMS AND REVIEW

1. Why is the term *discharge diet* undesirable?
2. Keep a record for a week of questions which relate to diet asked by patients under your care. How did you answer these questions?
3. *Problem.* Obtain a diet history from one of your patients who is receiving a normal diet. Use a form available in your hospital or develop one of your own. Evaluate the adequacy of the patient's diet according to the Four Food Groups. What recommendations can be made to the patient? How would you plan for this counseling?
4. Define these terms: coordinated home care services; patient evaluation; homemaker service; programmed instruction.
5. *Problem.* Determine the services available in your community for home care of patients. List the ways in which these services include nutritional care.
6. If you were asked to provide some guidelines for a group in your community which is setting up a meals-on-wheels service, what are the categories you would consider? What consultants would be desirable for this group?

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Chapter 29

THERAPEUTIC ADAPTATIONS OF THE NORMAL DIET
Normal, Soft, and Fluid Diets

Therapeutic nutrition begins with the normal diet. No diet is more important in the care of the sick than is the normal diet. In the first place, the majority of ill persons require no modification of the normal diet, but recovery may be hastened when particular attention is given to supplying the needs of normal nutrition. Secondly, therapeutic diets are adaptations of the normal diet and should be so planned that they maintain, or restore, good nutrition in any given situation.

The nutritive value of a basic diet composed of minimum amounts from each of the Four Food Groups is shown on page 210. One of the many ways in which such a foundation diet may be amplified to meet the Recommended Dietary Allowances is shown in Table 29–1. It will be readily seen that this plan provides for meal patterns which are typical of those used in many hospitals. The additional cup of milk is desirable because it provides so many nutrients required in greater than normal amounts by most individuals recovering from an illness and because milk, contrary to popular opinion, is one of the best-accepted foods in the hospital dietary.

For the sake of convenience in comparing one diet with another, this plan will be used as the basis for dietary evaluation for all modified diets. However, it is emphasized that other equally desirable plans could be used; for example, 2 cups of milk instead of 3 cups; a more generous allowance of meat; more or less fruit, vegetables, cereals, and so on. It must also be remembered that the normal diet does not necessarily represent ideal allowances in illness since past state of nutrition, modification of activity, increased or decreased metabolic demands brought about by the illness, changes in absorption, and so on may increase or decrease the needs for one or more nutrients.

When the normal diet is used as the basis for planning therapeutic diets, it is easy to see what the effects of omissions or additions of specific foods may have on the nutritive value by consulting the calculation for the normal pattern in Table 29–1. For example, if an individual is allergic to milk, it becomes immediately apparent that some other means must be sought to provide espe-

cially for the calcium, riboflavin, and protein. If vegetables were contraindicated, as in some very low-residue diets, it is obvious that there will be a deficiency in vitamin A and in ascorbic acid.

The use of the normal diet as a basis for planning therapeutic diets is psychologically advantageous. When as much of the normal diet is retained as possible, the patient is not set apart from his family and friends. Moreover, many foods can usually be used by all persons in the group so that food preparation procedures can be simplified in the home.

The normal diet in the hospital is variously described as regular, general, house, or full diet. It may consist of any and all foods eaten by the person in health. Fried foods, pastries, strongly flavored vegetables, and spices or relishes are not taboo, but good menu planning means that these foods are used judiciously.

REGULAR OR NORMAL DIET

Include these foods, or their nutritive equivalents, daily:

3 cups milk

5 ounces (4 ounces cooked weight) meat, fish, or poultry; cheese, additional egg or milk, or legumes may substitute in part

1 egg

4 servings vegetables including:
- 1 medium potato
- 1 serving dark-green leafy or yellow vegetable
- 1–2 servings other vegetable
- One of the above vegetables to be served raw

3 servings fruit including:
- 1 serving citrus fruit, or other good source of ascorbic acid
- 2 servings other fruit

1 serving enriched or whole-grain cereal

3 slices enriched or whole-grain bread

Additional foods such as butter or fortified margarine, soups, desserts, sweets, salad dressings, or increased amounts of foods listed above will provide adequate calories. See calculation in Table 29–1.

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Fruit	Sliced banana in orange juice
Cereal, enriched or whole-grain	Oatmeal
Milk and sugar for cereal	Milk and sugar
Egg	Soft-cooked egg
Whole-grain or enriched roll or toast	Whole-wheat toast with butter
Butter or margarine	
Hot beverage with cream and sugar	Coffee with cream and sugar

MEAL PATTERN (Cont.)	SAMPLE MENU (Cont.)
LUNCHEON OR SUPPER	
Soup, if desired	
Egg or a substitute of cheese, meat, or fish	Cheese soufflé
Potato, rice, noodles, macaroni, spaghetti, or vegetable	Buttered peas
Salad	Lettuce and tomato salad
Enriched or whole-grain bread	Russian dressing
Butter or margarine	Hard roll with butter
Fruit	Royal Anne cherries
Milk	Milk
DINNER	
Meat, fish, or poultry	Meat loaf with gravy
Potato	Mashed potato
Vegetable	Buttered carrots
Enriched or whole-grain bread	Enriched white, rye, or whole-wheat bread with butter
Butter or margarine	
Dessert	Apple Betty
Milk	Milk
Coffee or tea, if desired	

Therapeutic modifications of the normal diet. The normal diet may be modified (1) to provide change in consistency as in fluid and soft diets to be described below; (2) to increase or decrease the energy values; (3) to include greater or lesser amounts of one or more nutrients, for example, high protein, low sodium, etc.; (4) to increase or decrease bulk—high- and low-fiber diets; (5) to provide foods bland in flavor; (6) to include or exclude specific foods, as in allergic conditions; and (7) to modify the intervals of feeding.

Rationale for modified diets. The nurse and dietitian soon discover that the practices for normal and modified diets in a given situation may vary from those described in this text. Moreover, they will find that the regimens in no two hospitals are exactly alike. At least part of this variation is caused by the empiric basis, even today, for some modified diets. Controlled research to fully establish the merits of a particular regimen is often wanting. Fortunately, a number of widely varying dietary programs may work equally well because of the remarkable adaptability of the human body.

Probably no diets are subject to more criticism than those modified for fiber and flavor. To reduce the fiber content of a diet, ground meats and puréed cooked fruits and vegetables have been required. Yet, few patients consume nutrients at a satisfactory level when such foods are fed, and thus nutritional status is bound to suffer. If one considers the nature of the digestive process, it seems unlikely that the fiber of an ordinary mixed diet is as irritating as it is presumed to be.

Strongly flavored vegetables, melons, and legumes are believed by many to produce distressful symptoms such as heartburn, distention, and flatulence.

Again, the evidence for this is not established.[1] Undoubtedly, wide variations from one person to another exist in tolerance to specific foods. Whether such differences are physiologic or psychologic, it would seem the part of wisdom to permit patients to accept or to omit specific foods depending upon their tolerance of them.

The general principles for diet therapy in many diseases are now well understood and regimens based upon a sound rationale have been described. Even so, the interpretations of diet may vary according to ethnic, and socioeconomic factors.

Diet manuals and dietary patterns. Numerous manuals are available as guides in the standardization of dietary procedures for a given hospital. The best of these manuals have been prepared by committees including representatives of the various medical specialties, nursing, and dietary departments. The manual generally includes statements concerning principles of diet, food allowances with detailed lists of foods to use and to avoid, typical meal patterns, and nutritive evaluations. They serve as a guide for the physician in prescribing a diet, a reference for the nurse, a procedural manual for the dietary department, and a teaching tool for professional personnel.

Although a manual achieves standardization in procedures, it does *not* mean that every patient on a given diet must have exactly the same food allowances as every other patient. In fact, within the guide ample opportunity is provided for individualization of a given patient's regimen. The diet manual is *not* an instructional guide for the patient for whom individualized and more detailed aids are necessary. It may, however, serve as the basis for the development of such teaching aids.

Throughout this text dietary regimens which are representative of those used in many hospitals are presented. By using a standard format for statement of characteristics, lists of foods to include, detailed lists of foods permitted and contraindicated, a typical meal pattern, and a sample menu, comparisons of a variety of regimens are facilitated. The student will learn much by making such comparisons, and will begin to understand the rationale for diet therapy and how the goals may be achieved in a number of ways.

Nomenclature of diets. Insofar as possible, the nomenclature used in this text will describe the modification in consistency, in nutrients, or in flavor; thus, *bland* diet, *1200-calorie* diet, etc. When the quantity of one or more nutrients is important to the success of the diet, it is essential that these quantities be specified in the diet prescription. Thus, the term *diabetic diet* has little meaning, while a prescription for 200 gm carbohydrate, 80 gm protein, and 90 gm fat can be accurately interpreted. Likewise, a *sodium-restricted* diet gives no indication of the exact level of restriction required, while the designation *500-mg sodium diet* leaves no room for misinterpretation.

Several undesirable practices have been, and still are, common in the naming of diets. The literature is replete with illustrations of diets named for their originators. The Sippy diet is a classic example, but there have been

Table 29–1. Nutritive Value of the Normal Diet Pattern as a Basis for Therapeutic Diets*

Food	Measure	Weight	Energy	Protein	Fat	Carbohydrate	Minerals		Vitamins				
							Ca	Fe	A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm	*calories*	*gm*	*gm*	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*
Milk	3 cups	732	480	27	27	36	844	0.3	1050	0.24	1.26	0.3	6
Meat Group													
Egg	1	50	80	6	6	tr	27	1.1	590	.05	.15	tr	0
Meat, fish, poultry (lean cooked)	4 ounces	120	240	33	10	0	17	3.6	35	.32	.26	7.4	0
Vegetable-Fruit Group													
Leafy green or deep yellow	½–⅔ cup	100	30	2	tr	6	28	1.0	7180	.06	.08	.6	28
Other vegetable	½–⅔ cup	100	40	2	tr	8	26	1.0	600	.08	.06	.8	18
Potato	1 medium	122	80	2	tr	18	7	.6	tr	.11	.04	1.4	20
Citrus fruit†	1 serving	100	40	1	tr	10	18	.2	150	.07	.02	.3	42
Other fruit	2 servings	200	120	2	tr	32	24	1.0	1200	.08	.08	.8	18

Food	Measure	Weight	Energy	Protein	Fat	Carbohydrate	Minerals		Vitamins				
							Ca	Fe	A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm	calories	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg
Bread-Cereal Group													
Cereal, enriched or whole grain	¾ cup	30 (dry)	105	3	tr	22	10	.8	0	.12	.04	.8	0
Bread, enriched or whole grain	3 slices	69	180	6	3	36	57	1.8	tr	.18	.15	1.8	tr
			1395	84	46	168	1058	11.4	10,805	1.31	2.14	14.2‡	132
Additonal foods													
Butter or margarine	2 tablespoons	28	200	tr	22	tr	6	tr	920	—	—	—	—
Sugars, sweets	3 tablespoons	36	135	0	0	36	0	0	0	0	0	0	0
Dessert§	1 serving	varies	190	4	6	30	70	0.3	190	0.03	0.10	0.1	tr
Bread	3 slices	69	180	6	3	36	57	1.8	tr	.18	.15	1.8	0
Total Nutritive Value			2100	94	77	270	1191	13.5	11,915	1.52	2.39	16.1	132

* The nutritive values of the foods listed for the normal diet, page 437, have been calculated using Table A–1 in the Appendix. The additional foods listed at the bottom of the table suggest one of many ways to complete the diet.

† Other ascorbic acid–rich foods such as cantaloupe, strawberries, etc., are also included.

‡ The tryptophan content of this diet is about 840 mg, equivalent to about 14 mg niacin, thus providing a niacin equivalent of 28.2 mg.

§ Desserts include plain gelatin, pie, cake with icing, custard, ice cream, cookies, and plain pudding.

others from time to time. Unfortunately, such nomenclature tells nothing about the diet, and it is wise to discourage the practice.

Others have used the name of a disease condition to specify a given diet, such as ulcer, ambulatory ulcer, ulcer discharge, cardiac, and gallbladder diets. Psychologically, this is not good practice, for the patient should not need to be reminded of his condition every time he looks at a diet list, or every time he notes the name of his diet on a tray card. Moreover, the diets used for many of these conditions have multiple uses, and the uninitiated may overlook the full usefulness of a given regimen with such specific terminology.

Frequency of feeding. Research on experimental animals and on humans has shown that more than three meals daily may be desirable for some patients. By consuming five or six or more meals a day which are approximately balanced for protein, fat, and carbohydrate the metabolic load at a given time is less, and the nutrients can be more effectively utilized. It is well known that protein is inefficiently used if the day's allowance is more or less concentrated in one meal. Large amounts of carbohydrate at a given meal require the use of alternate metabolic pathways which favor the deposition of fat.

Norton[2] has described the principles for adapting home diets of patients to a six or seven meal program: breakfast, midmorning, luncheon, midafternoon, dinner, early evening, and late bedtime. She points out that the patient's daily food needs should be divided into the six or seven meals, with some protein, fat, and carbohydrate in each. Thus, milk or a protein sandwich may be useful for interval feedings, but juices or sweets alone do not satisfy the requirements. The interval between meals should be 1½ to 3 hours, with meals spread throughout the waking hours.

A bedtime snack is believed by some to enhance sleep, while others claim that it interferes with sleep. Hamilton and associates[3] recently studied the effects of snacks or their omission on 36 male subjects including students and patients with tuberculosis. The 275-calorie snack consisted of cereal with sugar and milk given at bedtime. A recorder was used to note the bed movements of the subject, and a psychologic rating scale concerning the subject's evaluation of his sleep was completed on the following morning. No measurable differences between snack and no-snack periods were found either in the patterns of body movement or in the psychologic evaluations.

On the basis of these studies any of the modified diets might be presented in more than three meals. A judicious choice of bedtime snacks apparently does not modify sleep.

Mechanical soft diet. Many persons require a soft diet simply because they have no teeth. The objective of dietary planning for such individuals is to modify the normal diet so that foods require little chewing. It is neither desirable nor essential to restrict the patient to the selection allowed on the customary Soft Diet (p. 443) employed for a postoperative patient or for a patient with a gastrointestinal disturbance. For example, stewed onions, baked beans, and apple pie are foods considered to be quite unsuitable for the latter

patients but which may be enjoyed by those who simply require foods that are soft in texture. The terms *mechanical soft* and *dental soft* are used in some diet manuals to describe such a dietary modification. The following changes in the normal diet will usually suffice for individuals without teeth:

Meats should be finely minced or ground.
Soft breads are substituted for crusty breads.
Cooked vegetables may be used without restriction, but dicing or chopping may be desirable for some; for example, diced beets, chopped spinach, corn cut from cob.
Most raw vegetables are omitted; raw tomatoes, cut finely, may usually be used. Sometimes finely chopped lettuce in a sandwich may be accepted.
Many raw fruits may be used: banana, orange, grapefruit, soft berries, soft pear, apricots, peaches, grapes with tender skins.
Hard raw fruits such as pineapple and apple are usually avoided; but finely diced apple in fruit cup may be used.
Tough skins should be removed from fruits: raw, soft pear, or baked apple, etc.
Nuts and dried fruits, when used in desserts or other foods, are acceptable if finely chopped.

Soft diet. This diet represents the usual dietary step between the full fluid and normal diet. It may be used in acute infections, some gastrointestinal disturbances, and following surgery. The diet is soft in consistency, easy to chew, made up of simple, easily digested food, and contains no harsh fiber, no rich or highly flavored food. It is nutritionally adequate when planned on the basis of the normal diet.

SOFT DIET

Include these foods, or their nutritive equivalents, daily:

3 cups milk
5 ounces (4 ounces cooked weight) very tender or ground meat, fish, or poultry; soft cheese, or additional eggs or milk may substitute in part
1 egg
4 servings vegetable including:
  1 medium potato
  1 serving dark-green or yellow vegetable—tender chopped or strained
  2 servings other vegetable—tender chopped or strained
3 servings fruit including:
  2 servings citrus fruit or juice
  1 serving banana, cooked fruit without skin or seeds, or strained cooked fruit
1 serving enriched or strained whole-grain cereal
3 slices enriched or fine whole-grain bread

Additional foods such as butter or fortified margarine, soups, desserts, sweets, or increased amounts of the above will provide adequate calories.

Nutritive value. See calculation for the normal diet in Table 29–1.

FOODS ALLOWED	FOODS TO AVOID
All beverages	
Bread—white, fine whole-wheat, rye without seeds; white crackers	*Bread*—coarse dark; whole-grain crackers; hot breads; pancakes; waffles
Cereal foods—dry, such as cornflakes, Puffed Rice, rice flakes; fine cooked, such as corn meal, farina, hominy grits, macaroni, noodles, rice, spaghetti; strained coarse, such as oatmeal, Pettijohn's, whole-wheat	*Cereals*—bran; coarse unless strained
Cheese—mild, soft, such as cottage and cream; Cheddar; Swiss	*Cheese*—sharp, such as Roquefort, Camembert, Limburger
Desserts—plain cake, cookies; custards; plain gelatin or with allowed fruit; Junket; plain ice cream, ices, sherbets; plain puddings, such as bread, cornstarch, rice, tapioca	*Desserts*—any made with dried fruit or nuts; pastries; rich puddings or cake
Eggs—all except fried	*Eggs*—fried
Fats—butter, cream, margarine, vegetable oils and fats in cooking	*Fats*—fried foods
Fruits—raw: ripe avocado, banana, grapefruit or orange sections without membrane; canned or cooked: apples, apricots, fruit cocktail, peaches, pears, plums—all without skins; Royal Anne cherries; strained prunes and other fruits with skins; all juices	*Fruits*—raw except as listed; stewed or canned berries; with tough skins
Meat—very tender, minced, or ground; baked, broiled, creamed, roast, or stewed: beef, lamb, veal, poultry, fish, bacon, liver, sweetbreads	*Meat*—tough with gristle or fat; salted and smoked meat or fish, such as corned beef, smoked herring; cold cuts; frankfurter; pork
Milk—in any form	
Soups—broth, strained cream or vegetable	*Soups*—fatty or highly seasoned
Sweets—all sugars, syrup, jelly, honey, plain sugar candy without fruit or nuts, molasses Use in moderation.	*Sweets*—jam, marmalade, rich candies with chocolate
Vegetables—white or sweet potato without skin, any way except fried; young and tender asparagus, beets, carrots, peas, pumpkin, squash without seeds; tender chopped greens; strained cooked vegetables if not tender; tomato juice	*Vegetables*—raw; strongly flavored, such as broccoli, Brussels sprouts, cabbage, cauliflower, cucumber, onion, radish, sauerkraut, turnip; corn; dried beans and peas; potato chips
Miscellaneous—salt, seasonings and spices in moderation, gravy, cream sauces	*Miscellaneous*—pepper and other hot spices; fried foods; nuts; olives; pickles; relishes

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Fruit or fruit juice	Orange sections and banana slices
Cereal—strained, if coarse	Oatmeal
Milk and sugar for cereal	Milk and sugar for cereal
Egg	Soft-cooked egg
Soft roll or toast	Buttered toast
Butter or fortified margarine	
Hot beverage with cream and sugar	Coffee
LUNCHEON OR SUPPER	
Strained soup, if desired	Cream of tomato soup
Egg or substitute of mild cheese, tender or ground meat, fish, or poultry	Cheese soufflé
Potato without skin, rice, noodles, macaroni, or spaghetti; or	
Cooked vegetable	Tender peas
Enriched bread	Soft roll
Butter or fortified margarine	Butter
Fruit	Royal Anne cherries
Milk	Milk
Coffee or tea, if desired	Coffee or tea, if desired
DINNER	
Orange, grapefruit, or tomato juice	Grapefruit juice
Tender or ground meat, fish, or poultry	Meat loaf (no onion or pepper) with gravy
Potato, any way except fried	Mashed potato
Cooked vegetable	Buttered carrots
Enriched bread	Rye bread without seeds
Butter or fortified margarine	Butter
Dessert	Baked apple without skin; cream
Milk	Milk
Hot beverage with cream and sugar, if desired	Tea with sugar and lemon

Liquid diets. Fluid diets are used in febrile states, postoperatively, or whenever the patient is unable to tolerate solid foods. The degree to which these diets are adequate will depend upon the type of liquids permitted.

CLEAR-FLUID DIETS. Whenever an acute illness or surgery produces a marked intolerance for food as may be evident by nausea, vomiting, anorexia, distention, and diarrhea, it is advisable to restrict the intake of nutrients. A clear-fluid diet is usually used for 1 to 2 days, at the end of which time the patient is commonly able to retain and utilize a more liberal liquid diet.

Tea with lemon and sugar, coffee, fat-free broth, carbonated beverages, and cereal waters are the usual liquids permitted. In addition, strained fruit juices, fruit ices, and plain gelatin are often included. A more liberal clear-fluid diet permits the addition of egg white, whole egg, and gelatin to strained fruit juices and other beverages. The recipes for beverages in the appendix will be of value in the planning and preparation of this diet.

The amount of fluid in a given feeding on the clear-fluid diet is usually

restricted to 30 to 60 ml per hour at first, with gradually increasing amounts being given as the patient's tolerance improves. Obviously, such a diet can accomplish little beyond the replacement of fluids.

FULL-FLUID DIET. This diet is indicated whenever a patient is acutely ill or is unable to chew or swallow solid food. It includes all foods liquid at room temperature and at body temperature. It is free from cellulose and irritating condiments. When properly planned, this diet can be used for relatively long periods of time. However, iron is provided at inadequate levels.

FULL-FLUID DIET

General rules

Give six or more feedings daily.

The protein content of the diet can be increased by incorporating whole egg, egg white, nonfat dry milk in beverages and soups. Strained canned meats (used for infant feeding) may be added to broths.

The caloric value of the diet may be increased by: (1) substituting 10 per cent cream for part of the usual milk allowance; (2) adding butter to cereal gruels and soups; (3) including glucose in beverages; (4) using ice cream as dessert or in beverages.

If a decreased volume of fluid is desired, nonfat dry milk may be substituted for part of the fluid milk.

Include these foods, or their nutritive equivalents daily:

6 cups milk
2 eggs
1–2 ounces strained meat
½ cup strained cooked cereal for gruel
¼ cup vegetable purée for cream soup
1 cup citrus fruit juice
½ cup tomato or vegetable juice
1 tablespoon cocoa
3 tablespoons sugar
1 tablespoon butter
2 servings plain gelatin dessert, Junket, custard, ices, or plain ice cream
Broth or bouillon

Nutritive values of foods specified above: Calories, 1950; protein, 85 gm; calcium, 2.1 gm; iron, 7.7 mg; vitamin A, 7150 I.U.; thiamine, 1.1 mg; riboflavin, 3.2 mg; niacin equivalents, 19.1 mg; ascorbic acid, 160 mg.

Foods allowed: *Avoid all foods not specifically listed below*

Beverages—carbonated, cocoa, coffee or substitute, tea
Cereal—fine or strained whole-grain: in gruels only
Dessert—soft or baked custard, gelatin without fruit or nuts, plain ice cream, ice, sherbet, Junket, plain cornstarch puddings
Eggs—raw in broth, with fruit juice, or in milk; soft-cooked
Fruit—all strained juices
Meat—strained in soups

Soup—strained cream, meat, or vegetable; no pepper or onion
Vegetables—purée for soups; juices
Miscellaneous—butter, cocoa, flavoring extracts, sugar, salt

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Citrus juice	Orange juice
Cereal gruel with butter, sugar	Cream of wheat with milk, butter, and sugar
Milk	
Beverage with cream, sugar	Coffee with cream and sugar
MIDMORNING	
Fruit juice with egg	Lemonade with egg white
or	
Milk, plain, malted, chocolate, or eggnog	
LUNCHEON OR SUPPER	
Strained soup	Beef broth with strained meat
Tomato juice	Tomato juice
Custard, Junket, ice cream, sherbet, ice, gelatin dessert or plain pudding	Maple Junket
Eggnog, milk, or cocoa	Milk
Tea with sugar, if desired	Tea with sugar and cream
MIDAFTERNOON	
Same as at midmorning	Pineapple eggnog
DINNER	
Strained cream soup	Cream of carrot soup
Citrus juice	Grapefruit juice
Custard, Junket, ice cream, ice, sherbet, or gelatin dessert	Vanilla ice cream
Milk or cocoa	Cocoa
Tea, if desired	Tea with sugar and lemon
EVENING NOURISHMENT	
Same as at midmorning	Hot malted milk

Other methods of feeding. Food by mouth is the method of choice when the patient can eat, digest, and absorb sufficient food to meet his nutritive requirements. In illness, however, it may be occasionally necessary to augment the oral intake by giving parenteral feedings of one type or another.

When the patient is unable to chew or swallow because of deformity or inflammation of the mouth or throat, corrosive poisoning, unconsciousness, paralysis of the throat muscles, etc., tube feeding is used (see p. 510).

Intravenous feeding is used when it is necessary to rest the patient's stomach completely. Fluids given by such means include solutions of glucose, amino acids, salts, and vitamins. Fat emulsions have been employed successfully by a few, thus making it possible to provide sufficient calories as well as protein, minerals, and vitamins. Transfusions of whole blood or of plasma are commonly used.

Table 29–2. Summary of Routine and Therapeutic Diets

Type of Diet	Indications for Use of Diet	Characteristics of the Diet	Food Selection
Regular or Normal Diet (Chap. 29)	Most frequently used of all diets; used for all ambulatory and bed patients whose condition does not necessitate a modified diet. Many modified diets progress ultimately to the regular diet. All therapeutic diets are based upon the normal diet.	This diet provides recommended allowances of all nutrients, permits the use of all foods, and follows the principles of good meal planning and preparation for any normal diet.	**Basic foods included:** 2–3 cups milk 1 egg 4 ounces meat, poultry, fish 1 medium potato 1 serving green leafy or deep yellow vegetable 1 serving other vegetable 2 servings fruit including 1 citrus 1 serving enriched or whole-grain cereal 3 slices bread Others as desired for sufficient calories.
Soft Diet (Chap. 29)	One of the most frequently used routine diets; many patients are placed on this until diagnosis is made. It bridges the gap between acute illness and convalescence.	This diet is nutritionally adequate; it is soft in texture and bland in flavor A mechanical soft diet is a regular diet modified in texture for a person who cannot chew satisfactorily.	**Foods included:** Milk, cream, mild cheese; eggs, except fried; tender, minced, or ground meat, poultry, fish; cooked, mild-flavored, low-fiber vegetables; cooked fruits without seeds or skin, citrus juices and sections, ripe banana; white or fine-grained breads and cereals; plain cakes, cookies, puddings; fats; sweets. **Foods to avoid:** Those with skin, seeds, coarse fiber; raw fruit, except citrus and banana; raw and strongly flavored vegetables; coarse cereals and breads; rich pastries; fried foods; tough meats; highly seasoned food. **Intervals of feeding:** Usually three meals; intermediate feedings if

Clear-Fluid Diet (Chap. 29)	In acute infections before diagnosis; in acute inflammatory conditions of the intestinal tract; in acute diarrhea; following operations on the colon or rectum when it is necessary to prevent evacuation for several days. To relieve thirst, to supply water to the tissues.	The diet is made up of clear liquids that leave no residue; it is nondistending, nonirritating, and nonstimulating to peristaltic action. This diet is entirely inadequate from a nutritional standpoint; its use is usually limited to 24 to 48 hours.	Tea, coffee, and coffee substitutes; fat-free broths; carbonated beverages; cane sugar or glucose in moderation. **Occasionally permitted:** Fruit juices, egg white, whole egg, gelatin, thin water gruels. **Intervals of feeding:** Small amounts every 1 to 2 hours.
Full-Fluid Diet (Chap. 29)	This diet bridges the gap between the clear-fluid and soft diet. It is used in acute infections, gastritis, diarrhea when milk is permitted, following surgery, and for patients too ill to eat solid or semisolid foods.	The normal diet is restricted to those foods which are liquid or which become liquid on reaching the stomach. This diet may be made adequate with careful planning and may be used for an extended period of time.	**Foods included:** All liquids included on the clear-fluid diet plus milk in all forms including malted milk, milk shakes, chocolate milk or cocoa, eggnogs; soups; soft custard; plain ice cream; Junket; tomato juice and fruit juices; plain gelatin. **Intervals of feeding:** Usually 2- to 4-hour intervals.
Tube Feeding (Chap. 34)	Inability to chew or to swallow; obstruction of esophagus; anorexia nervosa; severe burns; gastric surgery.	A liquid diet providing normal nutritional requirements. May be modified for one or more nutrients such as protein, fat, carbohydrate, sodium, etc. Fiber is carefully removed. May be prepared from calculated formula of selected foods; or may be prepared by liquefying foods of a normal diet in a blender and storing.	**Foods included:** All foods of a normal diet which are liquid or which can be liquefied in a blender. **Intervals of feeding:** Hourly at first with small feedings; then every 3 to 4 hours.

Table 29–2. Summary of Therapeutic Diets (Continued)

Type of Diet	Indications for Use of Diet	Characteristics of the Diet	Food Selection
Very Low-Residue Diet (Chap. 34)	Severe diarrhea to afford rest to the gastrointestinal tract. Ulcerative colitis in initial stages. Preceding and following operations on the colon or rectum when no movement is desired for several days. Partial intestinal obstruction.	This diet is made up of foods which can be completely absorbed, thereby leaving little or no residue for formation of feces. Insufficient minerals and vitamins are provided; if used for more than a few days it must be supplemented. Usually progresses to Bland Low-Fiber Diet, II or III.	**Foods included:** Eggs; tender meat, fish, or poultry; fruit juices; refined cereals and breads; butter or margarine; sugar; fat-free clear soups; plain gelatin desserts; coffee, tea. **Foods to avoid:** Milk; cheese; vegetables; fruits (except juices); coarse breads and cereals; tough meats; rich desserts; fried foods or excessive fat; condiments; relishes; excessive sweets. **Intervals of feeding:** Usually three meals; intermediate feedings if necessary.
Bland Diet (Chap. 35)	This diet is used to neutralize acid, to reduce gastric secretion and motility, 1. Gastric and duodenal ulcers 2. Gastritis 3. Diarrhea 4. Ulcerative colitis (see High-Protein Diet)	Three stages of this diet are described in the text. Foods are mild in flavor and low to moderate in fiber. When used for the treatment of ulcers, small frequent feedings are necessary. Rest, relaxation, and a happy environment are essential to success of dietary treatment.	**Foods included (stages II and III):** Milk, cream, butter, mild cheeses; eggs; tender meat, fish, poultry; cooked and raw fruits and vegetables depending on stage of diet; citrus fruits, banana; enriched bread; refined cereals; white potato, macaroni, rice, etc.; plain desserts. **Foods usually restricted:** Foods with seeds, skin, coarse fiber; pepper and seasonings in excess; relishes, pickles; caffeine-containing beverages; alcohol. **Intervals of feeding:**

High-Fiber Diet (Chap. 36)	When there is marked stasis in the colon resulting from impairment in the tone of the muscles lining the tract—atonic constipation.	Normal diet with fiber increased to 10 to 11 gm daily. Fluid intake increased to 2000 ml or more daily; 1 to 2 glasses water before breakfast. Concentrated foods replaced by those of greater bulk.	**Foods included:** All foods of the normal diet with emphasis on long-fibered vegetables such as greens, kale, cabbage, celery; raw vegetable salads; raw and cooked fruits; whole-grain cereals and breads. **Foods to restrict:** Highly refined and concentrated foods; excessive amounts of rough bran; excessive seasonings. **Intervals of feeding:** Three meals daily.
High-Calorie Diet (Chap. 32)	This diet is used especially in fevers, in diseases with high metabolic rate such as hyperthyroidism, following prolonged or severe illness which has resulted in loss of weight and undernutrition.	This is a normal diet with an increase in the caloric level to 3000 or more. Reinforcements such as sugars and fats are used. If appetite is poor, small servings of highly reinforced foods are given. The diet may be modified in consistency and flavor according to specific needs.	**Foods included:** All foods of the normal diet with added glucose and other sugars and sweets; increased amounts of cereals, breads, potatoes, etc.; butter, cream, and other fats. **Foods to avoid:** Excessive amounts of bulky, low-calorie foods; fried foods or others which may interfere with appetite. **Intervals of feeding:** Four to six meals daily.
Low-Calorie Diet (Chap. 32)	Treatment of obesity, especially important in: 1. Diabetes mellitus 2. Cardiovascular and renal diseases 3. Hypertension 4. Gout 5. Gallbladder disease 6. Preceding surgery	Normal diet with energy value reduced to 1500, 1200, or 1000 calories. Protein levels at 65 to 100 gm. Fats and carbohydrate restricted to caloric limit of the diet. Low-carbohydrate fruits and vegetables are used, with restriction of concentrated sugars, fats.	**Foods included:** (1200 calorie diet) 3 cups milk 2 group A vegetables (Appendix, Table 4) 1 group B vegetable 3 fruit exchanges 2 bread exchanges 5 meat exchanges 1 fat exchange

Table 29–2. Summary of Therapeutic Diets (Continued)

Type of Diet	Indications for Use of Diet	Characteristics of the Diet	Food Selection
Low-Calorie Diet (*cont.*)		Concentrates of vitamin A and thiamine usually required for diets below 1000 calories.	**Foods to avoid:** *All except those allowed in the exchange lists.* **Intervals of feeding:** Three meals daily; may use six smaller meals, if desired.
High-Protein Diet (Chap. 31)	Protein deficiency following inadequate intake, before and after surgery, injury, burns, high fevers, increased metabolic rate (see High-Calorie Diet).	This is a regular diet with protein increased to 100–150 gm or more daily. It may be planned as a soft or fluid diet when necessary. Each meal should contain complete protein for optimum utilization. Carbohydrate and fat must be liberal to cover energy needs.	**Foods included:** All foods on regular diet with emphasis on dry and liquid milk; eggs; cheese; lean meat, fish, poultry. **Intervals of feeding:** Three meals with evening feeding. Mid-morning and midafternoon feedings of high-protein beverages may also be used.
(Chap. 46)	Nephrosis, chiefly in children.	Protein allowance of 3 to 4 gm per kg. Sodium restriction when marked edema is present.	Low-sodium milk may replace regular milk if sodium is restricted; foods cooked without salt.
(Chap. 43)	Chronic nephritis to cover protein losses in the urine. Not *indicated when there is marked nitrogen* retention.	Protein for a normal diet plus allowance to cover loss in the urine; usually 80 to 100 gm daily. *Ample calories essential to reduce tissue catabolism.* Mild to moderate sodium restriction often needed.	
(Chap. 44)	Pernicious anemia	About 100 gm protein daily. Fat is often poorly tolerated. *A soft diet may be needed.*	***Foods to avoid (depending upon tolerance):*** Fatty meats; fried foods; salad dressings; gravies and sauces; rich cakes, cookies, desserts; high-fiber fruits, vegetables, cereals; excessive seasonings.

(Chap. 36)	Ulcerative colitis	100–150 gm protein daily 3500–4000 calories Low-fiber foods	Food selection as for the Bland Low-Fiber Diet, usually Stages II and III. Milk often poorly tolerated; may be evaporated, homogenized, boiled. If omitted, must provide liberal lean meat and eggs.
(Chap. 37)	Hepatitis Cirrhosis of the liver without hepatic coma	100–150 gm protein 100–150 gm fat 300–400 gm carbohydrate Sodium restricted to 250 mg daily if ascites present. Soft diet without coarse fiber when esophageal varices are present.	All foods on regular diet with emphasis on milk, eggs, lean meat, fish, poultry. **Foods to avoid:** If sodium is restricted, regular milk, salted foods in cooking or at table (see Sodium-Restricted Diet).
(Chap. 39)	Hyperinsulinism (see Low-Carbohydrate Diet)		
(Chap. 34)	Dumping syndrome (see Low-Carbohydrate Diet)		
(Chap. 46)	Celiac disease Cystic fibrosis	6 to 8 gm protein per kg; gradual return to normal in celiac disease. Fat is markedly restricted; some unsaturated fats tolerated in mild celiac syndrome. Carbohydrate restricted to formula at first; then simple sugars in small amounts; starch only after 6 to 12 months without severe diarrhea. Puréed foods with gradual return to normal foods by 3 to 4 years of age. Vitamin supplements always used. Pancreatin for patients with cystic fibrosis.	**Food selection:** High-protein formula with glucose or banana powder. Gradual additions of ripe banana, applesauce; strained meat, low-fat cottage cheese; puréed carrots, green beans; egg yolk; gelatin; citrus juices. Diet is gradually liberalized according to individual progress (see schedules in Chap. 46).

Table 29–2. Summary of Therapeutic Diets (Continued)

Type of Diet	Indications for Use of Diet	Characteristics of the Diet	Food Selection
			Foods included (40 gm protein)
Protein Restricted Diet (Chap. 43)	Hepatic coma Chronic uremia Acute glomerulonephritis	Protein is restricted to 20 to 60 gm daily. Carbohydrate is liberal. Adequate calories for maintenance should be derived from carbohydrate and fat to avoid burning of body tissue. Sodium may be restricted to 500 mg or less. This diet may be of soft, liquid, or regular consistency. Potassium may be restricted to 850–1500 mg or less.	½ cup milk ½ cup cream, light 1 egg 1 ounce meat 2 potatoes 2–3 servings vegetables 3 servings fruit 1 cup fruit juice 1 serving cereal 4 slices bread 3 tablespoons butter **Foods to avoid:** In excess of amounts stated above; meat; eggs; milk; bread; cereal. Avoid entirely: legumes; nuts; gelatin. At 20 gm protein level omit all milk, meat, egg.
			Foods included:
Protein-Free Diet (Chap. 43)	Hepatic coma Acute anuria	This diet provides carbohydrate and fat for about 1500 to 2000 calories daily. The diet is used only as an emergency measure, and is then progressed to 20 gm, 40 gm, and 60 gm protein.	Fruit juices with glucose if potassium is not restricted. Butter-sugar mixture. Sugar-fat emulsions.

			Foods included:
High-Carbohydrate Diet (Chaps. 37, 43)	Toxemias of pregnancy Liver disturbances (see High-Protein diets) Acute glomerulonephritis Uremia Addison's disease Preparation for surgery	To ensure sufficient calories to meet energy needs, minimizing tissue catabolism. Other modifications depend upon condition for which diet is used; for example, low-protein in hepatic coma, or high-protein in hepatitis without coma.	High-carbohydrate foods: glucose, sucrose, syrups, jellies; fine cereals and breads; simple starchy puddings; fruits and vegetables high in carbohydrate. Milk, eggs, lean meat, fish, poultry, fats according to diet prescribed. **Intervals of feeding:** Three meals with interval feedings.
Carbohydrate-Restricted Diet (Chap. 38)	Diabetes mellitus	Most diabetic diets are now only moderately restricted in carbohydrate; nutrients are provided at levels for normal nutrition. Each diet is individually prescribed for protein, fat, and carbohydrate.	The diet is calculated using the exchange lists; daily meals are selected from these lists (see Table A–4)
(Chap. 39)	Hyperinsulinism	The carbohydrate level is drastically reduced to minimize the production of insulin. Protein, fat, and small amounts of carbohydrate are evenly divided in three meals for uniform, gradual rate of absorption, and reduced stimulation to insulin production: 120–140 gm protein and 75–125 gm carbohydrate. Fat to complete the caloric requirement.	The diet is calculated using meal exchange lists (Table A–4). **Intervals of feeding:** Three meals with equal distribution of protein, fat, and carbohydrate at each meal.
(Chap. 32)	Obesity (see Low-Calorie Diet)		
(Chap. 40)	Epilepsy (see High-Fat Diet)	Carbohydrate drastically reduced to 10–30 gm daily.	
(Chap. 46)	Celiac disease (see High-Protein Diet)		

Table 29–2. Summary of Therapeutic Diets (Continued)

Type of Diet	Indications for Use of Diet	Characteristics of the Diet	Food Selection
Carbohydrate-Restricted Diet (Cont.) (Chap. 34	Dumping syndrome	Three routines are described in the text. The first is carbohydrate free, with gradual progression in routines II and III. Six small meals high in protein and fat, and low in carbohydrate. Carbohydrate foods are measured carefully. Liquids are given only between meals. Vitamin and iron supplementation is essential.	**Foods included liberally:** Meat, poultry, fish, eggs, peanut butter Butter, margarine, bacon. **Foods restricted:** Breads, cereals, pastes, vegetables, fruits. **Foods omitted:** Sugar, candy, syrup, milk, ice cream, chocolate, gravies, rich sauces.
High-Fat Diet (ketogenic) (Chap. 40)	To produce an acidosis: 1. Epilepsy for alleviation of seizures; primarily for preschool children.	Protein is limited to 1 gm per kg of body weight; carbohydrates are restricted to less than 30 gm per day, but not less than 10 gm; sufficient fat is provided for adequate energy, and to effect a state of ketosis. The diet must be calculated for each patient, and the daily food allowances must be weighed. Calcium, iron, and the water-soluble vitamins should be supplied in the form of concentrates. Fluids are usually restricted.	**Foods included:** Cream (40 per cent); butter; bacon; salad oils and salad dressings; meat, eggs, cheese; small amounts of low-carbohydrate fruits and vegetables. Cellu bran wafers may be used for bulk. **Foods to avoid:** Breads and cereals; desserts; sugar, candy, syrups and all sweets; cakes, cookies, pastries; fruits and vegetables high in carbohydrate. **Intervals of feeding:** Three meals of equal carbohydrate, fat, and protein content.

Moderate-to-Low-Fat Diet (Chaps. 32, 37, 46)	Gallbladder disturbances Obesity (see Low-Calorie Diet) Celiac disease, sprue, and pancreatic disease (see High-Protein Diet) Intestinal disturbances when membranes show a sensitivity to fatty acids (see also Bland Diet)	For gallbladder disease, fats are moderately restricted, using those easily digested in amounts to ensure palatability. In obesity fats are restricted to ensure low caloric level. Fats are poorly tolerated in celiac disease and are severely restricted. When butter and whole milk are omitted, it is necessary to supply fat-soluble vitamin supplements, if there is inability to convert carotene to vitamin A.	**Foods included:** Milk, whole or skim; egg; lean meat; cottage cheese; egg white; bread and cereals; fruits vegetables. **Foods to avoid:** Fatty meat; gravies; salad dressings; rich desserts; pastries; fried foods. Strongly flavored vegetables, legumes, melons often poorly tolerated.
Fat-Controlled Diet (Chap. 41)	Atherosclerosis	A diet is planned to provide nutritional requirements with very low level of saturated fat. The intake of polyunsaturated fatty acids is increased by adding corn, cottonseed, soybean, or other oil rich in linoleic acid. Cholesterol-rich foods are restricted.	**Foods in measured amounts:** Beef, lamb, pork—3 times per week **Other foods:** Skim milk; fish, poultry; fruits; vegetables; bread cereals; sugars and sweets; Soybean, cottonseed, corn oil may be stressed for their linoleic acid content. **Foods to avoid:** Those rich in saturated fats: fat of meats, butter, hydrogenated fats; whole milk, whole-milk cheeses.
Sodium-Restricted Diet (Chap. 42)	To prevent edema in: 1. Nephritis 2. Nephrosis 3. Cardiac disease	The basic diet for the adult using selected unsalted foods contains 500 mg sodium. When sodium is reduced to 200 mg, low-sodium milk is necessary.	**Foods in specified amounts:** Milk, meat, eggs, fish, or poultry **Unrestricted foods:** Unsalted cereals or breads; fruits; vegetables; unsalted fats; sugars

Type of Diet	Indications for Use of Diet	Characteristics of the Diet	Food Selection
			Foods to avoid:
Sodium-Restricted Diet (Cont.)	4. Cirrhosis of the liver 5. Toxemia of pregnancy 6. ACTH therapy Hypertension	Protein should be sufficient for maintenance and repair. Bland, easily digested foods in small feedings are essential for critical illness.	All salted foods: canned fish, meat, vegetables; pickles, relishes, meat sauces; salted butter, bread, nuts. Foods containing regular baking powder or soda: cakes, cookies, prepared mixes, quick breads Spinach, beets, beet greens, kale, celery, chard, dandelion, carrots, sauerkraut
			Food selection:
Potassium-Restricted Diet (Chap. 43)	Oliguria Anuria	850 to 1500 mg potassium daily. Severe sodium restriction usually required. Protein intake at minimum levels—0.2 to 0.5 gm per kg. Carbohydrate and fat sufficient to allow for minimum tissue catabolism. Fluids restricted to 500 to 1000 ml daily.	Refined cereals and breads; sugars; fats **Foods in restricted amounts:** Milk, cream, eggs, meat, fish, poultry, fruits, vegetables
			Foods included:
Acid-Ash Diet (Chap. 43)	To aid in adjusting the reaction of the urine so that salts are held in solution: kidney stones—calcium and magnesium phosphates, carbonates, and oxalates.	This diet, when carefully planned, meets the requirements for normal nutrition. Acid-ash foods are emphasized—flesh foods, eggs, cereals. Fruits and vegetables of low alkaline ash are chosen. Neutral foods may be used as desired. Sodium is carefully calculated when used for cardiac edema. No salt is then used in food preparation.	Large servings of meat, fish poultry, eggs, whole-grain cereals, soda crackers, bread, cake, rice, macaroni, noodles, corn, plums, prunes, cranberries Limit: Milk, fruits, vegetables Neutral foods as desired: butter, sugar, plain candies, tapioca, oils and fat, coffee, tea **Foods to avoid:** Legumes, spinach, greens, dried fruits, molasses, olives, parsnips, salty foods such as canned fish and canned vegetables, salted nuts, catsup, relishes

Alkaline-Ash Diet (Chap. 43)	To aid in adjusting the reaction of the urine so that salts are held in solution: kidney stones—uric acid and cystine calculi.	This diet meets the requirements of normal nutrition. Alkaline-ash foods such as fruits, vegetables, and milk are emphasized. Acid-ash foods are limited to those necessary for good nutrition. Neutral foods may be used as desired.	**Foods included:** Large amounts of fruits, vegetables, milk Limited amounts: 2 ounces meat 1 egg 1 serving cereal 1–2 slices bread As desired: butter, sugar, oils and fats **Foods to limit or avoid:** Meat, fish, fowl; eggs; cheese; prunes, plums, cranberries, corn; breakfast cereals, macaroni, rice; cakes, cookies, crackers
Calcium- and Phosphorus-Restricted Diet (Chap. 43)	To reduce the absorption of calcium and phosphorus, and thus to minimize the tendency to form urinary calculi.	This diet provides maintenance levels of calcium and phosphorus, and is otherwise adequate.	**Foods included:** 1½ cups milk 1 egg 6 ounces meat 3 servings vegetables 3 servings fruit 2 servings cereals 6 slices bread 2 tablespoons fat **Foods to avoid:** Those made with milk, cheese; whole-grain breads, cereals, flours; legumes; nuts; milk, eggs and meat in excess of allowance; collards, kale, turnip greens, oysters, clams, and other high-calcium or high-phosphorus foods

Table 29–2. Summary of Therapeutic Diets (Continued)

Type of Diet	Indications for Use of Diet	Characteristics of the Diet	Food Selection
Low-Purine Diet (Chap. 39)	Gout	This is usually a normal diet with restriction of foods containing purine. The amount of fat may be limited because fats interfere with the excretion of urates. Whenever obesity is present, a low-calorie diet is necessary (see Low-Calorie diet).	**Foods included:** Milk, eggs, cereals and bread, potato, vegetables (note exceptions), fruits, butter in moderation **Foods to avoid:** Meat extracts, bouillon, gravies; meats, especially organ meats; fish; anchovies; sardines; alcoholic beverages
Wheat-, Oat-, Rye-Free Diet (Chap. 36)	Celiac disease Nontropical sprue	A nutritionally adequate diet from which all foods containing gluten and gliadin have been eliminated. Mineral and vitamin supplementation is often indicated in severe steatorrhea.	**Foods included:** Milk, meat, fish, poultry, eggs, fruits, vegetables, fats; sweets, rice, corn, soybean breads and cereals **Foods to avoid:** All wheat, oat, rye, or barley breads, cereals, and flours or foods containing them
Galactose-Free Diet (Chap. 47)	Galactosemia	An infant formula using no milk is needed. Synthetic formulas, and meat-base formulas may be used.	**Foods included:** All foods suitable for infant feeding except milk and milk-containing foods
Low-Phenylalanine Diet (Chap. 47)	Phenylketonuria	Protein foods contain about 5 per cent phenylalanine. Therefore, all protein foods are severely restricted to permit 20 to 40 mg phenylalanine per kg daily.	**Foods included:** A proprietary formula low in phenylalanine is used. With increasing age of the child, small amounts of low-protein fruits and vegetables are gradually added.

PROBLEMS AND REVIEW

1. Why is the normal diet used as a basis for planning therapeutic diets?
2. What is meant by routine house diets?
3. What are the advantages of developing dietary patterns for a given individual, or institution? What are the limitations?
4. What objections can you see to the following examples of dietary nomenclature: nephritic diet; low-protein diet; Kempner diet; ulcer discharge diet? Examine the nomenclature used in your hospital and suggest ways in which it might be improved.
5. *Problem.* Write a menu for 1 day for a patient who is to receive a regular diet. Indicate the changes you would make in this menu to make it suitable for another patient requiring a soft diet.
6. *Problem.* Plan a full-fluid diet for 1 day which will provide 2500 calories. Calculate the protein, calories, iron, and ascorbic acid. Compare with the recommended allowances for a 45-year-old man.
7. What foods are usually allowed on a clear-fluid diet? What nutrients are lacking in this diet?
8. From your work with patients up to this time, what modifications of the normal diet have you observed so far?

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Chapter 30

SHORT METHODS OF DIETARY CALCULATIONS: USE OF THE MEAL EXCHANGE LISTS

Need for quick methods of dietary calculation. Some therapeutic diets must be planned within a stated maximum of one or more nutrients, for example, the low-fat diet. For other diets, such as the diabetic diet, protein, fat, and carbohydrate levels must be kept within relatively narrow allowances of the prescription. Physicians sometimes request that the intake of one or several of the nutrients be charted from day to day for certain patients. Thus, the nurse and dietitian in their daily care of the nutritional needs of the patient are frequently expected to make quick, yet reasonably accurate, estimations of nutritive value.

The uses of Table A-1 have been described in Chapter 4, so that the student undoubtedly has had some experiences with dietary calculation on the basis of this table. Unquestionably of value for many purposes, it soon becomes evident that day-to-day calculations of all the listed nutrients—or for selected nutrients—are much too time consuming for the nurse or dietitian with many responsibilities. Such detailed calculations are not justified unless great care is also taken in carefully controlling the preparation procedures, and accurately measuring or weighing all food served to the patient and likewise all food which is returned on the tray. Moreover, the body itself varies from day to day in its net utilization of food, depending upon activity, endocrine balance, and the proportions of nutrients presented to it. Thus, it is evident that dietary calculation should be directed to reasonable assurances of control without time-wasting paper work. To this end, two short methods of dietary calculation will be discussed here.

Food composition table for short method. A number of short tables of food composition have been developed for determining nutritive values of diets used in group feeding situations. One of these is presented in Table A–3. It should be noted that foods which have similar nutritive values have been grouped together, thus assigning average energy, protein, mineral, and vitamin values to all foods within the group. For example, under *Cereals,* bread, crackers, breakfast cereals, and pastes such as macaroni have been grouped.

Thus, one may count the total number of servings of cereal foods fed during the day, keeping refined and whole-grain or enriched cereals in separate categories. Suppose that the following cereal foods were eaten on a given day: ½ cup oatmeal, ½ slice whole-wheat bread, 1 soft enriched roll, 2 slices enriched toast, and macaroni and cheese (½ cup unenriched macaroni). The calculations would then be based on 1 serving unenriched cereal and 5½ servings whole-grain and enriched cereal, thereby avoiding the necessity of looking up five different items.

Uses for the short method. Once the student has become familiar with the arrangement of items in the table and learns to translate the amount of food actually served to the size of servings described in the table she will find that much valuable time is saved when the adequacy of a diet is to be determined. This table is especially useful in the periodic check that a dietitian gives to her menus served in the hospital, institution, school dormitory, or school lunchroom.

If a single diet is calculated by using the data of Table A-1 and again with the short method of Table A-3, some variations will be noted. However, these variations tend to cancel out when the latter is used for calculations of many menus. The differences are not significant for the purposes for which the short method is intended.

Procedure for calculation. The following steps are followed in using Table A-3:

1. Record the amount of food served at each meal. If any food is refused, subtract it from the amount served.
2. Group the foods eaten according to the groupings of Table A-3.
3. Total the number of servings for each food group.
4. Enter the total number of servings of each group on a calculation form, and multiply the values of the food groups in Table A-3 by the number of servings.
5. Total the values for each column, and compare with the recommended allowances which apply to the particular individual.

Some mixtures of foods are not included in Table A-3. A typical recipe may be consulted, grouping the ingredients in the corresponding classes of Table A-3, taking care that the amount so recorded is representative of that eaten. Or, if nutritive values are given for such a mixture in Table A-1, it may be simpler to use this source for the mixed dish.

As an example of the short method of calculation, the menu for the normal diet on page 437 has been selected. The foods of this menu were grouped as shown in Table 30–1.

MEAL EXCHANGE LISTS

Evolution of the meal exchange lists. Probably the classic example requiring rapid dietary calculations is afforded by the diabetic diet. At one time

Table 30–1. Food Groupings for Short Method of Dietary Calculation
(Based on Sample Menu, page 437)*

		Number of Servings			Number of Servings
Milk group			**Fruit**		
Cheese (for soufflé)		1	Citrus (¼ cup)		½
Cream (coffee)		½	Other fresh		3
Milk		2½	apple (Betty)	1	
on cereal	½		banana	1	
to drink	2		cherries	1	
Meat group			**Grain products**		6
Egg		1½	oatmeal	1	
Meat loaf			bread	2	
beef, lean		1	rolls	2	
pork, lean		½	toast (Apple Betty)	1	
Vegetables			flour		1
Carrots		1	soufflé	1½ tsp	
Peas		1	gravy	1½ tsp	
Potato, small		1	**Fat**		
Tomato		1	Butter		8
Lettuce, 1 leaf		½	at meals	6 tsp	
			for Apple Betty, soufflé, gravy, vegetables	6 tsp	
			Russian dressing	1 tbsp	1
			Sweets		4½
			in beverages, cereal	1 tbsp	
			Apple Betty	3 tbsp	
			in cherries	½ tbsp	

* The nutritive values of this menu are calculated in Table 30–2.

these calculations were time consuming. Far too much faith was placed on decimal point calculations, with too little understanding of the variability of food composition and of body utilization. A number of tables of food composition were developed for calculation of the diabetic diet, but to the patient the several approaches were confusing to say the least. Incorporating the best features of several methods in use, the meal exchange lists (Table A-4) were evolved and published in 1950 by a joint committee of the American Dietetic Asociation, the American Diabetes Association, and the United States Public Health Service.[1] These lists are now the most widely used of any for diabetic calculations. They are equally applicable to the calculation of any diet for which protein, fat, and/or carbohydrate must be controlled; for example, the low-calorie diet. In Chapter 42 it will be noted that the sodium-restricted diet is also oriented about this method of dietary calculation. Because of their broad application, the meal exchanges are discussed at this point; further detail on the method of calculation of diabetic diets is given in Chapter 38.

Table 30–2. Nutritive Value of Normal Diet (Sample Menu p. 437) Calculated by Short Method*

Food	Number of Servings†	Energy	Protein	Fat	Carbohydrate	Minerals		Vitamins				
						Ca	Fe	A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		calories	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg
Cheese	1	105	6	9	1	165	0.2	345	0.01	0.12	tr	0
Cream	½	20	1	2	1	15	tr	75	.01	.02	tr	tr
Milk	2½	400	23	23	30	712	.3	875	.20	1.05	0.3	5
Egg	1½	120	9	9	tr	38	1.8	885	.09	.23	tr	0
Meat loaf: beef, lean	1	140	20	5	0	10	2.4	10	.05	.16	3.4	0
pork, lean	½	75	9	4	0	3	1.1	0	.29	.10	1.6	0
Carrots	1	30	1	tr	7	30	.6	10,145	.05	.05	.5	6
Peas	1	60	4	1	10	20	1.4	430	.22	.09	1.8	16
Potato	1	85	3	tr	30	10	.7	tr	.08	.04	1.5	16
Tomato	1	35	2	tr	7	14	.8	1350	.10	.06	1.0	29
Lettuce leaves	½	5	1	tr	1	17	.4	475	.02	.02	.1	5
Citrus fruit	½	25	1	—	7	13	.2	85	.04	.02	.2	28
Other fruit	3	240	—	—	63	45	1.5	420	.12	.09	.6	18
Grain products, enriched	6	390	12	6	96	120	3.6	60	.54	.30	4.2	—
Flour	1	25	1	tr	5	1	.2	0	.03	.02	.2	0
Butter	8	400	tr	48	tr	8	0	1840	—	—	—	—
Salad dressing	1	80	tr	9	1	2	.1	45	tr	tr	tr	0
Sugar	4½	200	0	0	54	0	tr	0	0	0	0	0
		2435	93	116	313	1223	15.3	17,040	1.85	2.37	15.4	123
Recommended Dietary Allowances												
Man, 18–35 years		2900	70			800	10	5000	1.2	1.7	19	70
Woman, 18–35 years		2100	58			800	15	5000	0.8	1.3	14	70

* Calculations based on Table A–3.

† Measure is expressed as multiples of the amounts of food in each group, Table A–3.

What is an exchange list? A grouping of foods which, for practical purposes, is approximately equal in carbohydrate, protein, and fat values is an *exchange* list. For example, in list 3, 1 small apple, or 2 prunes, or ½ small banana might be exchanged for ½ cup orange juice; that is, any of the fruits in the list, *in the amounts stated,* would provide 10 gm carbohydrate, and negligible protein and fat. To illustrate further, a patient allowed 5 bread exchanges a day might select as follows: ¾ cup dry cereal, 1 slice toast, 2 graham crackers, 1 small potato, and ½ cup cooked rice.

The sample menu for the normal diet on page 437 has been calculated in Table 30–3.

Table 30–3. Nutritive Value of Normal Diet Calculated by Meal Exchange Lists

Food List		Number of Exchanges	Carbohydrate gm	Protein gm	Fat gm
Milk		2½	30	20	25
Vegetable A					
lettuce, tomato		1	—	—	—
Vegetable B					
carrots, peas		2	14	4	—
Fruit		4½	45	—	—
banana	2				
citrus	½				
other	2				
Bread		6½	98	13	—
bread, rolls	4				
oatmeal	1				
potato	1				
flour	½				
Meat		6½	—	46	33
meat loaf	4				
cheese	1				
egg	1½				
Fat		15½	—	—	78
butter	12				
salad dressing	3				
light cream	½				
			187	83	136
Sweets (Table A–1)		4½ tbsp	63		
			250 × 4	83 × 4	136 × 9
Total Calories	2576		1000	352	1224

Using the exchange lists. The procedure for quickly estimating the carbohydrate, protein, and fat content of the diet follows the same steps as outlined for the short method of dietary calculation, noting, however, that the food groups of Table A-3 and of the exchange lists are not identical. It is important

that the student learn early that the words *exchange* and *serving* are not synonymous. For example, 1 small banana, 6 prunes, and ½ grapefruit would generally be considered to be 3 servings of fruit, but they are equal to 6 exchanges of fruit. Again, 6 exchanges of meat might be distributed as 1 egg for breakfast, 2 ounces of chicken in a luncheon sandwich, and 3 ounces of roast beef at dinner.

The exchange lists do not include sweets or mixtures, but these values may be obtained from Tables A-1 or A-3, as indicated in the above calculation.

Assuring mineral and vitamin adequacy. Since the exchange lists do not provide information on mineral and vitamin values it becomes evident that some degree of discretion must be used in establishing the meal pattern and in selecting specific menus. For example, less than 2 milk exchanges daily will compromise the calcium and riboflavin levels of the diet, unless the daily selection from the meat list includes hard cheese. Likewise, the ascorbic acid intake might be too low if citrus fruits were never selected from the fruit exchanges. To be sure, cantaloupe, strawberries, and a few other fruits from this list are also good sources of vitamin C. A far too common error is that of omitting the vegetables of the A group, simply because their carbohydrate, protein, and fat values are negligible. To do so is to reduce the dietary intake of a number of valuable nutrients, especially vitamin A, ascorbic acid, and iron.

PROBLEMS AND REVIEW

1. How can you explain the fact that Cheddar and cottage cheese are listed as meat exchanges, but that they are both included in the milk group of the Four Food Groups (p. 46)?
2. Which vegetables in the A group are especially rich in vitamin A? In iron? In ascorbic acid?
3. Explain the placement of potatoes, corn, Lima beans, baked beans in the bread exchange list. Note also the group C vegetables in the Unit Lists of the sodium-restricted diet (p. 632).
4. *Problem.* Plan a menu for a lunch which permits the following exchanges: 1 milk; 2 A vegetable; 1 fruit; 3 bread; 2 meat; 3 fat.
5. *Problem.* Write three breakfast menus based on the following exchanges: 1 milk, 1 fruit, 2 bread, 2 meat, and 3 fat.
6. *Problem.* Keep a record of your food intake for 1 day, and calculate the nutritive values using Table A–3.
7. *Problem.* Using the diet record of Problem 6, calculate the carbohydrate, protein, fat, and caloric value with the exchange lists. Compare these values with those obtained in Problem 6.
8. *Problem.* Calculate the total niacin equivalent of the diet in Table 30–2.
9. *Problem.* Examine the protein, fat, and carbohydrate values as calculated by Table A–3 and by the exchange lists (see Tables 30–2 and 30–3). See if you can determine why these differences exist. Are they significant? Explain.

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UNIT IX

Modification of the Normal Diet for Energy, Protein, and Texture

Chapter

31 NUTRITIONAL DEFICIENCIES AND THEIR CORRECTION
High-Protein Diets

32 OVERWEIGHT AND UNDERWEIGHT
Low-Calorie and High-Calorie Diets

33 DIET IN FEVERS AND INFECTIONS

34 NUTRITION IN SURGICAL CONDITIONS
Low-Residue Diet; Tube Feedings; High-Protein, High-Fat, Low-Carbohydrate Diet (for Dumping Syndrome)

Chapter 31

NUTRITIONAL DEFICIENCIES AND THEIR CORRECTION
High-Protein Diets

Nature and incidence. Nutritional deficiency diseases have one element in common, namely, that they occur as the result of an inadequate supply of one or more nutrients to the tissues. Beyond that, the clinical and biochemical findings of one deficiency disease vary as widely from another as do these signs in diseases of nonnutritional origin.

Primary deficiencies are those caused by failure to ingest sufficient amounts of nutrients to meet metabolic needs, while *secondary* deficiencies are those in which some fault in metabolism exists such as failure to absorb nutrients, increased metabolic needs, or excessive losses. The more common manifestations of deficiency in the United States are dental caries (see Chapter 6) and iron-deficiency anemia (see Chapter 44). Classic vitamin deficiencies (see Chapters 10, 11, and 12) are extremely rare; nevertheless, scurvy and rickets are occasionally seen in infants, and beriberi in alcoholics and simple goiter (Chapter 9) are not unknown.

A study conducted on 642 fifth- and sixth-grade pupils from underprivileged homes in six Manhattan schools failed to show any physical signs of frank deficiency disease.[1] However, data on numerous physical and biochemical examinations from these children are being analyzed to determine whether subclinical deficiencies can be detected. If such changes can be found, the individuals can become the focus for programs of prophylaxis through education and feeding before deficiency becomes clinically apparent.

Dietitians and nurses in the United States are more likely to encounter patients with nutritional deficiency secondary to some disease process. The situation is quite otherwise in many underdeveloped countries of the world where a wide spectrum of deficiency diseases are to be found. (See also Chapter 26.)

Some causes for nutritional deficiencies. Representative and important causes of nutritional diseases are listed here, and others will no doubt suggest themselves.

PRIMARY DEFICIENCIES. Inadequate intake of essential nutrients constitutes a major cause of all deficiency diseases for one or more of the following reasons.

1. Bad food habits are the result primarily of ignorance of the proper choice of foods. Too much of one type or too little of another type of food will lead to an unbalanced diet so that the required nutrients are not obtained in sufficient quantity.

2. Processing, marketing, and storage of foods may be such that important nutrients are lost. The restoration and enrichment of cereals have been of great significance in correcting deficiencies in thiamine, niacin, and iron. Generally speaking, the food supply in America today is of higher nutritive value than ever before.

3. Increased activity or body metabolism occurs without increase in intake. In pregnancy, lactation, and during childhood almost all nutrients are required in greatly augmented amounts. In fevers, hyperthyroidism, and under stress of surgery or injury the need for most nutrients is greatly increased.

4. Many diseases with accompanying poor appetite are responsible for grossly inadequate food intake. Some neuropsychiatric disturbances, pronounced food allergies, and the nausea of pregnancy are commonly accompanied by poor intake of food.

5. Faulty therapeutic diets, characterized by overzealousness of treatment for the disease condition rather than consideration of the patient as an individual, have led to omission of essential nutrients. For example, some regimens for treatment of ulcers have been low in protein, the B complex, and ascorbic acid; reduction diets have been low in protein, calcium, iron, and vitamins.

6. Chronic alcoholism and narcotic addiction are responsible for decreased intake of essential nutrients and are also known to impair various organs of the body so that utilization of the nutrients is interfered with.

SECONDARY DEFICIENCIES. Faulty utilization frequently produces deficiency even though the diet itself may have been adequate under normal conditions. Representative examples of factors which bring about poor absorption and metabolism are here given.

1. Achlorhydria may impair the absorption of iron, thiamine, and other factors.

2. Chronic gastrointestinal disorders such as sprue and colitis decrease the absorption of all nutrients to the point where the body's energy needs are not met, protein is inadequate for tissue repair, and mineral and vitamin deficiencies occur.

3. Pancreatic and hepatic disorders restrict fat digestion and absorption so that insufficient energy is available and the fat-soluble vitamins are absorbed poorly.

4. In some instances, such as diabetes mellitus, the liver is apparently unable to convert carotene to vitamin A. In uncontrolled diabetes, carbohydrate, protein, and fat metabolism is disrupted.

5. Excessive use of mineral oil may interfere with the absorption of carotene and other fat-soluble vitamins.

6. Extensive oral therapy with antibiotics or their drugs may modify or

destroy the microorganisms of the intestinal tract so that certain vitamins are not synthesized.

Some signs of nutritional deficiencies. Classic deficiency diseases are diagnosed relatively easily because the physical and biochemical findings are prominent. However, the diagnosis may be missed when the disease is seldom seen by clinicians, as is the case in the United States.

Many physical signs may suggest nutritional lacks, but most of them are nonspecific and other factors must be ruled out. For example, the student who obtains only five or six hours of sleep a night may complain that he is unable to concentrate well, he is irritable, and he always feels tired. On the other hand, these very same symptoms could also be produced by a continuing dietary lack of B-complex vitamins. Obviously, the treatment would be related to the cause. The following signs may suggest nutritional lacks, but it would be dangerous to make a diagnosis without corroborating laboratory studies.

1. Loss of interest and desire for food, causing loss of weight.
2. Difficulty in concentration and a progressive loss of interest in affairs formerly considered important.
3. Insomnia.
4. Nervousness and irritability.
5. Frequent respiratory infections.
6. Dermatitis and other skin disturbances.
7. Glossitis, gastrointestinal disturbances, including anorexia, diarrhea, or constipation.
8. Sore, painful muscles and joints, muscular weakness, and inability to coordinate.
9. Cheilosis—lesions at angles of the mouth and extending into the face with frequent eruptions occurring about the nose and ears.
10. Poor wound healing; proneness to bed sores.
11. Simple goiter.
12. Dental caries.
13. Bone deformities, especially of the long bones, the bones of the chest, spine, and pelvis; multiple fractures caused by fragility of the bones.
14. Difficulty in seeing in a dim light, especially after leaving a brightly lighted room.
15. Swollen congested eyelids, dry surface of the eye itself resulting from impairment of the lacrimal glands and the secretions therefrom and leading to infections of the eye and itching and burning sensations of the eye.

A carefully taken dietary history is one of the most valuable aids in making a diagnosis of nutritional deficiency. Many reliable laboratory tests can be used in determining the existence of deficiencies in human subjects. Determination of protein, mineral, and vitamin levels of the blood may be made. The urinary excretion of certain minerals and vitamins may be studied with respect to intake or to certain test doses. X-ray studies indicate bone changes as in rickets or in scurvy. Special types of apparatus, such as the biophotometer which

measures dark adaptation, may be used. These tests are primarily medical procedures and will not be discussed further here.

Treatment of deficiency diseases. As in any disease, treatment depends upon a clear understanding of the cause. In primary deficiencies the diet obviously must be improved until it meets the requirements for normal nutrition. This may entail education in the selection of a diet, assistance in budgeting the food money, suggestions for inexpensive foods of high nutritive value, and ways to prepare such food. (See Figures 31–1 and 31–2.)

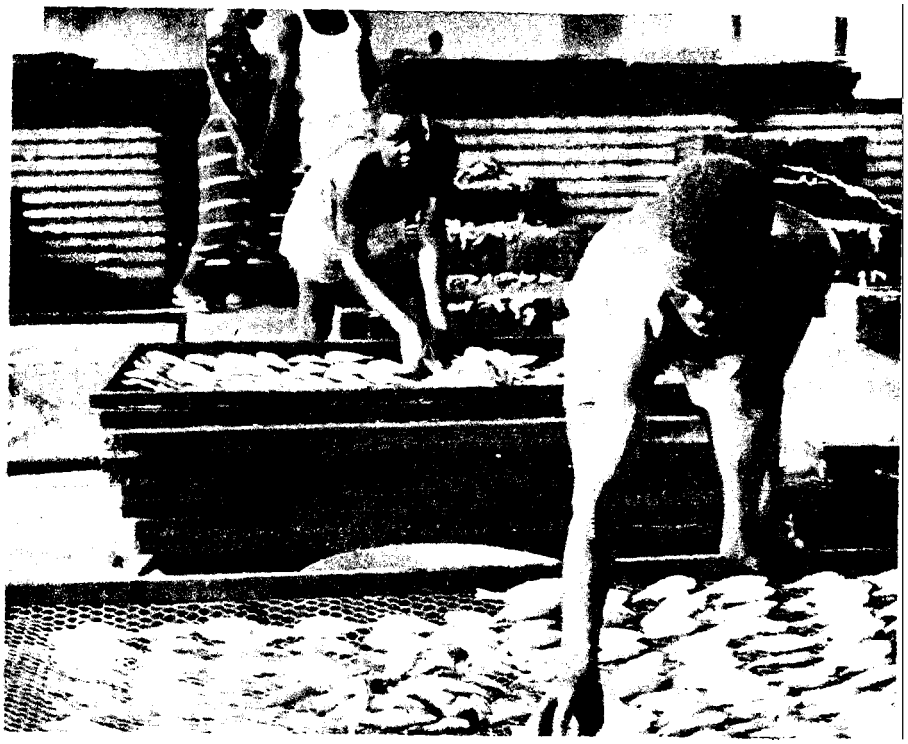


FIG. 31–1. Fish is an excellent source of protein, and may be utilized in many areas where the diet is deficient in animal protein. In this illustration fresh fish is being placed on trays for smoking near Abidjan. School gardens to produce legumes and poultry-raising centers are other ways to enrich the protein supply. (*Courtesy, United Nations Children's Fund and Priya Ramrakha.*)

When protein and calories have been lacking, it is necessary to use a high-protein, high-calorie diet until protein synthesis is again satisfactory. In iron-deficiency anemia, and in vitamin deficiency diseases, specific high-potency supplements constitute the most effective therapy.[2] Responses to supplements of thiamine, niacin, and ascorbic acid are indeed dramatic in beriberi, pellagra, and scurvy. It goes without saying that a fully adequate diet should be instituted in conjunction with such supplements.

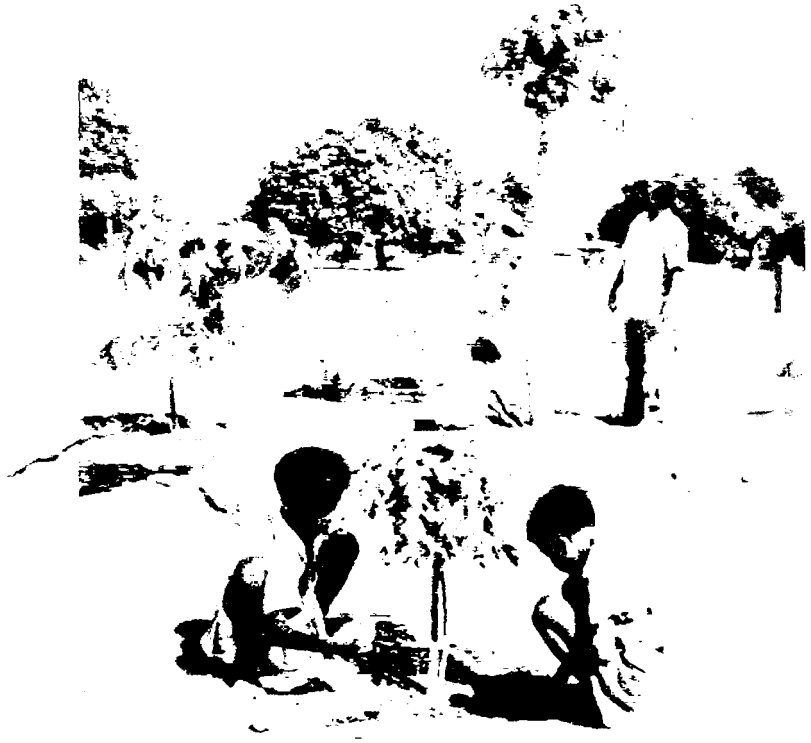


FIG. 31–2. Children in schools are encouraged to keep gardens and are taught the ways to raise fruits and vegetables for their lunches. Through education, the incidence of nutritional deficiency diseases may be reduced. (*Courtesy, United Nations Children's Fund and Jack Ling.*)

PROTEIN DEFICIENCY

Disease factors leading to protein depletion. The effect of inadequate intake of proteins supplying the essential amino acids has been discussed in Chapter 5. However, a mild deficiency may be aggravated by a disease process, or conditioning factors may initiate a deficiency when none existed before.

Even though the diet may normally be adequate, *poor digestion and absorption,* as in chronic diarrheas of any origin, may provoke deficiency symptoms. Edema of the intestinal tract caused by inadequate protein leads to continued poor absorption, and thus a vicious cycle is maintained. There may be *excessive metabolism of protein* as in fevers, following surgery or wound healing of any type, following burns, in diabetic acidosis, and thyrotoxicosis. *Excessive loss of protein* from the body occurs in nephrosis, hemorrhage, burns, and in

wound exudates. Then, finally, there may be a *failure to synthesize proteins* in a normal manner because of liver injury.

Detection of protein deficiency. The classic examples of protein deficiency are kwashiorkor (see Chapter 5) and marasmus, both of which are seen especially in children in underdeveloped countries of the world. Marasmus occurs when both protein and calories are severely lacking; it presents the signs described earlier for kwashiorkor, but there is also extensive wasting of the tissues.

Loss of weight to the point of emaciation also occurs in adults subjected to severe protein and calorie deprivation. Edema frequently but not always accompanies starvation and is also known as "hunger edema," "war edema," or "famine edema" because of the conditions under which it most frequently occurs.

Blood proteins may give a clue to the state of protein nutrition. In deficiency the total blood protein is reduced, the albumin fraction being especially affected. It is important to realize that these blood proteins are not decreased until the tissue stores have become so depleted that they can no longer supply protein for the important functions of the serum proteins; thus, a deficiency of plasma proteins reflects a much larger and more long-standing tissue protein depletion. Elman[3] has estimated that approximately 30 gm of tissue protein are lost for every gram of serum protein which is lost. To illustrate: If the total serum protein level has decreased from 7 to 6 gm per 100 ml, and the total circulating plasma volume is 2700 ml, this represents a loss of 27 gm of serum protein; it would represent, in addition, a loss of 30 × 27 gm or 810 gm of protein from the tissues.

The presence of edema cannot be explained entirely by changes in the hydrostatic and colloid osmotic pressure, and Keys[4] concludes that the condition is simply related to a low caloric intake.

Modification of the diet. The high-protein diet is useful in a wide variety of conditions, and the student will be well repaid for making a thorough study of the principles and applications.

PROTEIN AND CALORIES. The levels of protein and calories are of equal importance in achieving satisfactory tissue synthesis. Eddy and Pellett[5] in a study of high-protein diets in 152 British hospitals state that there is too much concern about the patient's protein intake and not enough emphasis upon the calorie level. Too often a high-protein diet is ordered, but the patient consumes such a low level of calories that the protein is used largely as a source of energy rather than for tissue synthesis. These investigators believe that no advantage accrues to giving more than 14 per cent of the calories as protein until the patient's daily calorie intake is at least twice his daily basal metabolism. Thus, at 2500 calories, an intake of 350 protein calories or about 90 gm protein would be just as satisfactory as a higher level of protein. When the calorie intake is more than twice the basal requirement, some advantage is realized

with protein being as high as 18 per cent of the total calorie level. These findings are in agreement with those of Keys who found that persons who were starving improved just as rapidly on moderate-protein, high-calorie diets as on high-protein diets.

Benditt *et al.*[6] have stated that the level of protein and the quality of protein are limiting factors in recovery from starvation, provided that the calories are also adequate. They have estimated that the afebrile individual at bed rest requires approximately 2600 nonprotein calories in order to achieve maximum benefit from protein intake. Thus, they too emphasize lack of sufficient calories as being restrictive.

On a practical basis, a high-protein diet is defined as one which furnishes 100 to 125 gm protein. It will also provide at least 2500 calories. Although the calorie ratio from protein is thus about 16 to 20 per cent, the selection of foods at this level provides for a diet more interesting to the American palate.

OTHER DIETARY FACTORS. A diet liberal in protein and calories, and including normal allowances of fruits and vegetables furnishes an abundant level of minerals and vitamins. It serves very well indeed as the foundation for treating any deficiency diseases, and would be supplemented with specific vitamins and/or minerals according to the nature of the deficiency.

Management of the diet. Patients with a good appetite can eat a diet containing 100 to 150 gm protein, together with the required calories, without difficulty. Continuous and determined effort on the part of the nurse can be very helpful in achieving the desired protein and calorie intake even by many patients with an impaired appetite. A number of palatable, inexpensive, and convenient proprietary compounds using nonfat dry milk and casein as the principal sources of protein are also available.

For emaciated patients a liquid diet in which beverages have been highly reinforced with concentrated protein so as to keep the volume at a minimum is prescribed until the gastrointestinal tract again becomes accustomed to handling more food, and until the heart and circulatory system can cope with the additional demands made on it. The amounts of food in such situations must be increased gradually.

For some patients, small meals with between-meal feedings may be most suitable. Others may achieve a greater intake by eating three meals and an evening feeding. High-protein beverages (see beverage recipes, p. 722) are effective in achieving maximum protein intake with a minimum of volume. The patient must be watched carefully lest he become anorexic.

HIGH-PROTEIN DIET

Characteristics and general rules:

Complete protein foods should be emphasized in this diet. Those of best quality include milk, cheese, eggs, and meat products.

Nonfat dry milk and egg white are effective reinforcing agents whenever it is difficult for the patient to eat the amounts of protein foods listed below. See recipes for high-protein beverages, page 724.

Include these foods, or their nutritive equivalents, daily:

4 cups (1 quart) milk
7–8 ounces (cooked weight) meat, fish, poultry, or cheese
2 eggs
4 servings vegetables including:
- 1 serving green or yellow vegetable
- 1 to 2 servings potato
- 1 to 2 servings other vegetable
- One vegetable to be eaten raw daily

2 servings fruit including:
- 1 serving citrus fruit—or other good source of ascorbic acid
- 1 serving other fruit

1 serving whole-grain or enriched cereal
5 slices whole-grain or enriched bread
Additional foods including butter or fortified margarine, sugars, desserts, or more of the listed foods to meet caloric needs.

Nutritive value: On the basis of specified amounts of foods above: protein, 125 gm; calories, 2500. All vitamins and minerals in excess of normal diet—see page 440.

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Fruit	Half grapefruit
Cereal	Oatmeal
Eggs—2	Fried eggs
Bread, whole-grain or enriched	Whole-wheat toast
Butter or margarine	Butter
Milk to drink and for cereal	Milk
Beverage	Coffee
LUNCHEON OR SUPPER	
Meat or substitute of egg, cheese, fish, or poultry—large serving	Chicken soufflé Mushroom sauce
Potato, macaroni, spaghetti, noodles, or vegetable	Buttered green beans
Salad with dressing	Shredded carrot and raisin salad
Bread with butter or margarine	Whole-wheat roll and butter
Fruit	Fresh peaches
Milk—1 glass	Milk
DINNER	
Meat, fish, or poultry—large serving	Broiled trout with parsley garnish
Potato	Creamed potato
Vegetable	Buttered spinach
Bread with butter or margarine	Rye bread with butter

MEAL PATTERN (Cont.)	SAMPLE MENU (Cont.)
Dessert	Lemon-flake ice cream Brownies
Milk	Milk
Beverage	Tea with lemon
EVENING NOURISHMENT	
Eggnog—1 glass	Chocolate eggnog
Sandwich with cheese or equivalent	American cheese and tomato sandwich

HIGH-PROTEIN SOFT DIET

General rules:

Include foods in the amounts listed under High-protein Diet, page 477.

Select foods from those allowed for Soft Diet, page 443, or Bland Diet, page 528.

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Cooked fruit, banana, or fruit juice	Grapefruit sections without membrane
Cereal—strained, if coarse	Oatmeal
Milk	Milk
Eggs—2	Scrambled eggs
Soft roll or enriched white toast	Toast
Butter	Butter
Sugar	
Beverage	Coffee
LUNCHEON OR SUPPER	
Cream soup	Cream of asparagus soup
Ground meat or substitute of egg, cheese, poultry, or fish—large serving	Chicken soufflé
Potato, macaroni, spaghetti, noodles, rice or tender chopped vegetable	Buttered green beans
Enriched bread with butter or margarine	Enriched bread with butter
Cooked fruit	Stewed peaches
Milk—1 glass	Milk
DINNER	
Orange, grapefruit, or tomato juice	Orange juice
Ground or flaked meat, fish, or poultry —large serving	Broiled trout
Cooked vegetable—tender chopped or strained	Creamed potato Buttered chopped spinach
Enriched bread with butter or margarine	Rye bread without seeds; butter
Dessert	Lemon-flake ice cream Plain sugar cookie

MEAL PATTERN (Cont.)	SAMPLE MENU (Cont.)
Milk	Milk
Beverage, if desired	Tea with lemon
EVENING NOURISHMENT	
Milk—1 glass	Milk
Sandwich with tender or ground meat or cheese	Sandwich with flaked salmon and chopped egg

HIGH-PROTEIN FLUID DIET

Include these foods, or their nutritive equivalents, daily:

3 cups milk
3 cups high-protein milk or eggnog (see recipes, p. 724)
4 eggs*
1–2 ounces strained meat
½ cup strained cereal—for use in gruel
1 cup citrus fruit juice
½ cup tomato juice
¼ cup vegetable purée for cream soup
2 or more servings plain dessert—gelatin, Junket, ice cream, custard
3 tablespoons sugar
1 tablespoon cocoa

Nutritive value: On the basis of specified amounts of foods above: protein, 110 gm; calories, 2100.

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Strained fruit juice	Grapefruit juice
Cereal gruel with milk and sugar	Strained oatmeal with milk and sugar
Hot beverage with cream and sugar	Cocoa
MIDMORNING	
Strained citrus juice with whole egg	Orange juice with whole egg
LUNCHEON OR SUPPER	
Cream soup	Cream of asparagus soup
Tomato juice	Tomato juice
High-protein milk, plain or flavored	High-protein milk with pineapple flavor
Fruit-juice gelatin, custard, Junket, or ice cream	Soft custard
MIDAFTERNOON	
Malted milk or eggnog	Chocolate eggnog

* Eggs are sometimes contaminated with salmonella. If the source is not known, raw eggs should not be used. Additional amounts of high-protein milk may need to be substituted.

MEAL PATTERN (Cont.)	SAMPLE MENU (Cont.)
DINNER	
Broth with whole egg	Chicken broth with whole egg
Strained fruit juice	Apricot juice
High-protein milk or eggnog	High-protein milk
Ice cream, custard, Junket, or fruit-juice gelatin	Raspberry ice
EVENING NOURISHMENT	
High-protein eggnog—plain or flavored	High-protein eggnog with nutmeg

PROBLEM AND REVIEW

1. What are some symptoms which may suggest nutritional deficiency of one type or another?
2. A careful dietary history may be of diagnostic importance in detecting deficiency disease. Illustrate.
3. What are outstanding nutritional deficiencies in the United States today? What nutrients are most likely to be received in less than optimum amounts?
4. Feeding programs for starving populations have placed special emphasis on providing cereal grains. Why is this class of foods so important? What limitations may such a program have?
5. What is marasmus? Kwashiorkor?
6. Deficiency diseases are usually treated by adjustment of the diet so that it is once again adequate and by using vitamin concentrates. Why are concentrates more satisfactory than a "high-vitamin" diet? What nutrients may be especially emphasized in the diet of such patients?
7. *Problem.* Jack, a 17-year-old boy, is recovering from a long illness. The doctor has prescribed a diet containing 150 gm of protein and 4000 calories. Jack is allergic to eggs. Using the High-protein Diet as a basis (p. 476), plan a diet which would be suitable for him.
8. What adverse effects is a protein deficiency likely to have upon recovery from illness?
9. Prepare an outline of classic deficiency diseases. Include principal nutrients which are lacking, characteristic symptoms, and principal factors which have brought about inadequate intake. Which foods are rich in the nutrients needed to prevent each disease you have listed? Consult Chapters 5, 9, 10, 11, and 12 for preparing this summary.
10. Why is a high-protein, high-calorie diet the most practical diet for the treatment of deficiency diseases? What other treatment would be indicated in the conditions you have listed in problem 9?

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apter 32

OVERWEIGHT AND UNDERWEIGHT

Low-Calorie and High-Calorie Diets

Importance of weight control. The greatest problem of preventive medicine today is obesity. Excessive weight is closely associated with cardiovascular and renal diseases, diabetes, degenerative arthritis, gout, and gallbladder disease. It constitutes a risk for the patient who needs surgical treatment. The complications of pregnancy and the hazards during childbirth are multiplied. The popular saying "The longer the belt, the shorter the life" is far too true.

Overweight is a physical handicap as well as a primary health hazard. Obese people are more uncomfortable during warm weather because the thick layers of fat serve as an insulator. More effort must be expended to do a given amount of work because of the increase in body mass. Because of their lessened agility, obese people are more susceptible to accidents. Fatigue, backache, and foot troubles are common complaints of the obese.

Obesity is no longer fashionable, although in times past moderate overweight was considered a sign of health and beauty. Emotional and psychologic problems stem from obesity, just as these problems may indeed be the cause of obesity. The obese individual may be the butt of jokes, is sometimes looked upon as one who is greedy or who has no will power, or may experience social humiliation and inability to get a job. He may lose his self-esteem and may withdraw from others in order to avoid embarrassment. Such attitudes may serve to reinforce the conditions that led to the obesity.

The national preoccupation with slimness is in itself—surprising as it may seem—a major problem. Too many people resort to fad diets, pills, and gadgets which result in nutritive inadequacy, economic loss, and sometimes serious effects on health. Medical supervision is not always sought and weight reduction may be ill advised for some. Many people resort to one merry-go-round after another of reducing diets, losing a little only to gain it again, thus submitting themselves to the repeated body stresses which accompany weight loss.

UNDERWEIGHT. Much less attention is directed to the problems of underweight, although many people in all age categories are not enjoying optimum [illegible] malnutrition usually associated with extreme under-

weight. Fatigue and lowered resistance to infection are corollaries of underweight. Tuberculosis, especially, is found more frequently among young people whose weight is considerably below normal. Underweight at the beginning of pregnancy and failure to gain at a sufficient rate during pregnancy were found by Tompkins[1] to be even greater hazards than overweight.

Desirable weight. The best weight for a given individual's height, age, bone structure, and muscular development is not exactly known. Height-weight tables (see Tables A–14, A–15) currently classify people as having a large, average, or small frame. The person who is stocky may be 5 to 10 per cent above the weight for average build without being considered overweight, while the individual who has a small frame should weigh 5 to 10 per cent less than the desirable weight for average build.

A large proportion of people continue to gain weight until late middle life, but this is not physiologically necessary, nor need it be inevitable. On the basis of life insurance statistics the most nearly ideal weight to maintain throughout life is that which is proper at age 25 for one's height and body build. Therefore, height-weight tables no longer indicate figures beyond the ages of 25 to 30 years. Generally speaking, the best weight is likely to be that at which one both looks and feels his best.

Obesity, overweight, and underweight are somewhat arbitrary terms. A deviation of not more than 10 per cent above or below the desirable weight for a given individual is not considered significant. The term *overweight* is applied to individuals who are 10 to 20 per cent above desirable weight. *Obesity* is applied to persons 20 per cent or more overweight. *Underweight* denotes those individuals who are more than 10 per cent below the established standards; those more than 20 per cent below these standards are considered to be seriously underweight.

It is probably not difficult to identify obesity which is marked, but height-weight tables provide only approximations on the degree of fatness. For example, a football player may be overweight by such standards but has a well-developed musculature and does not have excessive fat deposits. More exact measures of body fatness are now available to the clinician, including measures of the thickness of subcutaneous tissue at designated body locations by calipers (see Figure 32–1), and by anthropometric measurements.[2] Research laboratories also measure fatness through determination of body density by underwater weighing or in a volume of air, by measurements of total body water, or by determination of total body fat based upon the amounts of fat-soluble gases retained.

Estimation of weight gain or loss. Each gram of body fat represents the storage of approximately 9 calories. Thus, if an individual consumes an amount of food which provides 100 calories in excess of his energy requirement, there will be deposited 78 gm (700 ÷ 9) of fat each week, or approximately 9 pounds (4056 ÷ 454) in a year. If one were to overeat consistently by this amount for 5 or 10 years, it is obvious that obesity would be the result even though the person maintained he "didn't eat such large amounts of food"! It

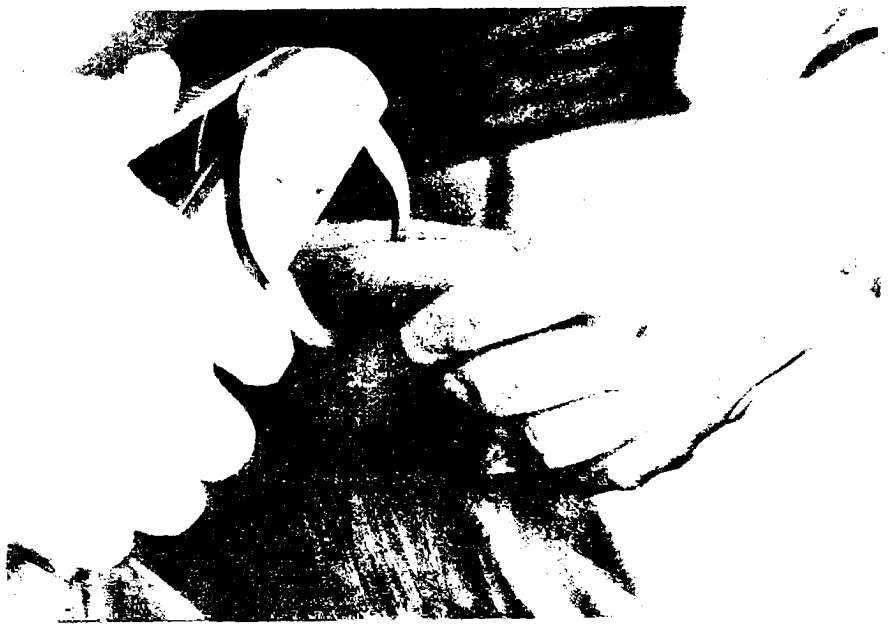


FIG. 32–1. A skinfold measurement is made by means of a caliper. This determines the amount of subcutaneous fat of an individual and is an indicator of total body fat. (*Courtesy*, Roche Medical Image, *Hoffman LaRoche, Inc.*)

would take only 3 teaspoons butter, or two 1-inch squares of fudge, or an oatmeal cookie to supply this additional 100 calories each day.

Conversely, the removal of 1 gm body fat requires the expenditure of 9 calories not provided by the diet. If the diet each day provides 1000 calories less than the daily energy requirement, the weekly weight loss is roughly 780 gm (7000 ÷ 9) or 1¾ pounds (780 ÷ 454). In practice weight loss does not follow a predicted straight line because of day-to-day variations in water balance and activity.

OBESITY

Incidence. The exact incidence of obesity is not known, but it does not take much people-watching to become aware of the high numbers of most age groups who exceed their desirable weight. Based upon weight-height standards, it has been estimated that half of all men over age 30 are at least 10 per cent overweight and one fourth are obese. The incidence is even higher for women, with about 40 per cent being obese by the time they reach 40 years.

Increasing attention has been given to obesity in children and in adolescents, with estimates of 15 to 30 per cent in the obese category in various school populations. The incidence is higher in girls than in boys. Contrary to popular opinion, most children do not "grow out of" their overweight; they remain

obese throughout life and are particularly refractory to treatment later in life.

Cause. Obesity is invariably caused by an intake of calories beyond the body's need for energy. Such a statement, however, tends to oversimplify the problem of obesity, for one might infer that its correction might be easily achieved by bringing the energy intake and expenditure into balance. The reasons for an existing imbalance are many and complex, and some understanding of the problems of the individual must be gained before therapy can be effectively instituted. A thorough physical examination, a dietary history, and an investigation of habits relating to activity, rest, and family and social relationships are indicated.

Mayer[3] has studied the effect of genetic, traumatic, and environmental factors in causing obesity in experimental animals. Although his studies on genetic and traumatic elements cannot be fully related to man at the present time, they may have some bearing upon the etiology of obesity. For example, he has noted that only 10 per cent of children with parents of normal weight are obese, 40 to 50 per cent of children with one obese parent are obese, and 80 per cent of children with two obese parents are overweight.[4] His observations have led him to conclude that food habits alone do not explain this difference.

Eating too much becomes a habit for some people. It may result from family customs in using concentrated high-calorie foods, or having to maintain social relationships including rich party foods in addition to usual mealtime eating, or eating excessive amounts of carbohydrate foods because they are cheaper, or maintaining irregular habits of eating, including snacks all day long.

Numerous persons continue to gain weight throughout life because they fail to adjust their appetites to reduced energy requirements. The many labor-saving devices in the homes and in industry reduce the energy requirement. Most people enjoy sports as spectators rather than as participants. Riding rather than walking to school or work is common practice even for short distances. Other circumstances may further reduce the energy needs: (1) basal metabolism is gradually decreased from year to year (see Chapter 8); (2) changes in occupation may result in reduced activity; (3) the middle years of life sometimes bring about a repose and consequent reduction of muscle tension; (4) periods of quiet relaxation and sleep may be increased; and (5) disabling illness such as arthritis or cardiac disease may reduce markedly the need for calories.

Recent years have brought an increasing awareness of the psychologic aspects of obesity. Numerous articles in current journals emphasize that eating is a solace and a pleasure to the individual who is bored, feels lonely or unloved, has become discontented with his family, social, or financial standing, has experienced deep sorrow, or needs an excuse to avoid the realities of life.

Obesity resulting from disturbances of the glands, such as the thyroid or pituitary, accounts for less than 5 per cent of the total incidence. The basal metabolism is lowered in this group of persons so that weight gain results unless the diet provides fewer calories than is usually considered normal.

Factors in treatment. Two criteria must be satisfied if treatment is to be considered as successful: (1) weight loss must be such as to achieve desirable weight for the body frame; and (2) the desired weight must be maintained. Measured against these criteria, the failures in weight reduction are far more frequent than the successes.

In the New York City antiobesity program,[5] a survey of almost 2600 obesity clinic patients has shown: (1) weight loss is more difficult to achieve as the duration of obesity and the degree of obesity increase; (2) married persons were more successful than single persons in effecting weight loss; (3) many women had onset of obesity associated with the first pregnancy; and (4) women over 40 years reduced more successfully than those who were younger. Men and women were equally able to reduce, level of education had no effect on success of reaching normal weight, and group methods supervised by the physician and nutritionist were more successful than individual instruction.

Weight reduction should be guided by a physician since the physiologic and psychologic stress are not equally borne by all Some persons, according to Young,[6] will lose weight satisfactorily when shown how to keep the caloric intake within the prescribed limits; others need help in relieving their tensions before a dietary regimen will be effective; still others have such deep emotional problems that weight loss should not be attempted until these problems have been corrected by psychiatric help.

Some current studies will be reviewed briefly before describing the dietary regimen recommended in this text.

STARVATION. Several clinicians have used total starvation for 30 or more days in the treatment of excessively obese individuals.[7] Patients were allowed water *ad libitum* and were given vitamin and mineral supplements. They must be carefully selected and must remain under constant supervision in a hospital since starvation is unphysiologic and there are a number of risks attached to this strenuous therapy. The regimen establishes rapid weight loss for the grossly obese; for example, during the first month weight losses for 12 patients were 24 to 63 pounds.[8]

The average nitrogen losses for 12 patients in the first month were equivalent to 1300 gm protein, and for 7 patients in the second month to 690 gm protein. This protein loss is the most critical deficiency encountered. It was noted that there was cessation of the growth of fingernails and hair; however, no changes were observed in the blood proteins. When patients were placed on 300- and 500-calorie diets, nitrogen equilibrium was rapidly established suggesting that nitrogen equilibrium can be achieved in the protein-depleted individual at low-calorie intakes when tissue fat is being metabolized for energy.

Duncan and his associates have used total starvation for periods up to two weeks and have then given the patients a moderately restricted calorie diet (1500 to 2300 calories) with the instructions that they were to fast one day a week.[9] The continued weight loss by most patients was found to be disappointing.

EXERCISE. Undoubtedly, physical activity should be given more emphasis in view of the steady increase in energy-saving devices in American society. A recent study of 516 adults, ages 25 to 44 years, showed that they spent 85 per cent of the day in light or very light activity and sleep.[10] Individuals in the highest category of body fat spent more time on less strenuous activities than did those in the lower categories of body fat.

Moderate exercise taken consistently and often can be an important aid in losing weight, providing that there are no contraindications to it because of disease. Exercise can result in better muscular tone and a sense of well-being. It is not necessarily accompanied by an increase in appetite, nor does a diminution of activity always lead to a decreased appetite.

The importance of exercise can be illustrated by calculating the energy equivalents of foods in terms of various kinds of activity. On the basis of a 70-kg man, Konishi has calculated the energy equivalents for 50 foods at five activity levels: reclining, walking, bicycle riding, swimming, and running.[11] Six of these foods shown in Figure 32–2 illustrate the wide ranges of time required to utilize the energy provided by various foods at sedentary to moderate activities.

HORMONES AND DRUGS. Most overweight persons have no deficiency of endocrine secretions and should not be led to believe that they have glandular

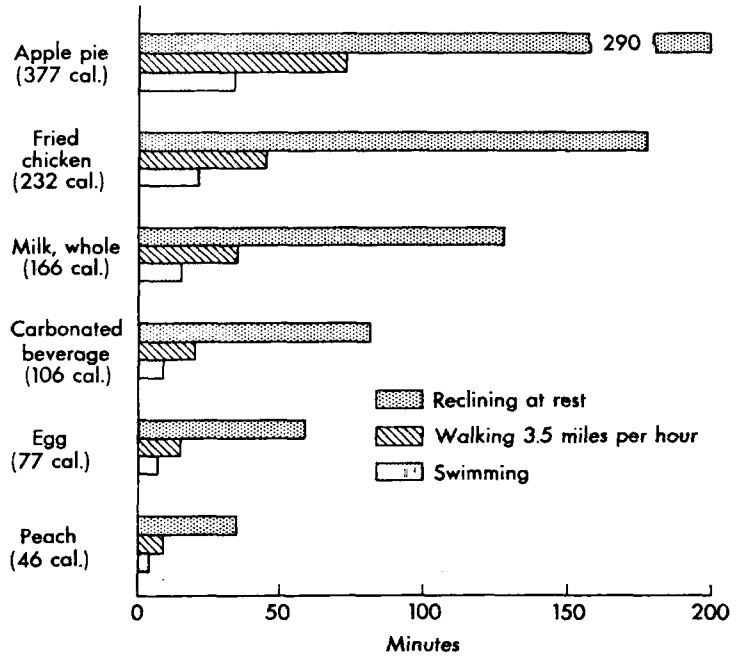


FIG. 32–2. The energy value for foods expressed as number of minutes of activity for three levels of energy expenditure. (*Data from F. Konishi*, J. Am. Dietet. A., **46**:187, 1965.)

disturbances; nor should they be exposed to the increased nervousness and irritability which results from such medication. The occasional patient with thyroid deficiency who requires thyroid extract should be treated only by a physician.

Amphetamine sulfate, sometimes prescribed by a physician because of its ability to dull the appetite, is also a stimulant. It may produce insomnia, excitability, gastrointestinal disturbances, and other toxic manifestations. Other drugs are also used to dull the appetite. Some preparations include methyl cellulose which has the ability to absorb water and to provide a feeling of satiety.

Many so-called reducing pills advertised in the press and on radio and television programs are preparations of glucose or other sugars, nonfat dry milk, and various combinations of vitamins. They have no effect whatsoever on the control of weight, but are usually sold at exorbitant prices. Some preparations contain laxative or diuretic drugs so that weight is lost, but at the expense of body water—not body fat.

Modification of the diet. The diet described in more detail in this text is representative of many widely accepted, nutritionally sound programs. It is intended to bring about steady weight loss and to establish good food habits. The diet should promote a sense of well-being and be palatable, but it is not necessary to use unusual recipes which require much preparation time or additional expense.

ENERGY. A gradual loss of 6 to 8 pounds monthly is desirable since the patient need not experience the severe hunger, nervous exhaustion, and weakness which often accompany drastic reduction regimens. Such a weight loss requires that the daily intake be reduced 800 to 1000 calories below the daily energy requirement; thus, an indvidual whose normal activity requires 2400 calories may use a 1400 to 1600 calorie diet. For moderately active individuals weight loss can be achieved at diet levels of 1200 to 1600 calories.

Diets supplying 1000 calories or less are rarely necessary except for individuals who are kept in bed. Such drastic restrictions, used far too often, are likely to be inadequate in several nutrients.

PROTEIN. The allowance of protein should be at least 1 gm per kilogram of ideal body weight, but an allowance of 1½ gm per kilogram improves the satiety value of the diet and minimizes tissue nitrogen loss. Most diets can be planned to include 70 to 100 gm protein.

FAT AND CARBOHYDRATE. The conventional diets used for many years have sharply curtailed the intake of fat and restricted the carbohydrate to moderate levels, as shown in the 1000-calorie diet listed on page 489. Some patients experience a greater sense of satisfaction when a somewhat more liberal intake of fat and a reduced carbohydrate level are employed. About half of the calories of such a diet are provided by fat.

Because some individuals may request the inclusion of alcoholic beverages, it should be remembered that each gram of alcohol yields 7 calories, and that

allowance must therefore be made in the total calories permitted each day. The beverages are used only according to the physician's orders.

MINERALS AND VITAMINS. When diets containing 1000 calories or less are prescribed, supplements of iron salts, and possibly calcium, together with a multivitamin preparation are indicated. Low-calorie diets for obese children and for pregnant women must be planned with the increased mineral and vitamin requirements in mind. For that reason the diets used are usually somewhat less stringent.

SATIETY VALUE OF THE DIET. The patient must have a sense of satisfaction and well-being, which can be effected by considering the satiety value of foods. Proteins and fats remain in the stomach longer and their use delays the return of hunger. The protein allowance should be divided approximately equally between the three meals. Thus, an egg and milk at breakfast, lean meat, cheese, or egg at lunch, and lean meat at dinner are desirable.

Some regimens employ six meals a day instead of three, stressing that some protein should be provided at each feeding.[12] Part of the success of a reducing diet depends upon learning to be content with smaller portions of food and less concentrated foods.

Planning the daily diet. The diets in Table 32–1 are on the basis of the exchange lists (Table A-4). These lists permit a flexibility of choice according to individual desires. A comparison with the basic diet on page 440 shows that the mineral and vitamin values will equal or exceed recommended allowances.

Even though these diets include 3 cups of milk, thus enhancing the calcium value, some adults might prefer to substitute meat exchanges for 1 cup of milk. One meat exchange would be used in place of 1 cup of skim milk, and 2 meat exchanges would be substituted for 1 cup of whole milk.

Table 32–1. Food Allowances for Low-Calorie Diets

	Normal Protein, Moderate Carbohydrate, Low to Moderate Fat			High Protein, Low Carbohydrate, Moderate Fat
Food for the Day	*1000 calories*	*1200 calories*	*1500 calories*	*1500 calories*
Milk, whole, cups	3 (skim)	3	3	3
Vegetable, Group A	1 cup	1 cup	1 cup	1 cup
Group B	½ cup	½ cup	½ cup	½ cup
Fruit, unsweetened, exchanges	4	3	4	2
Bread, exchanges	2	2	4	2
Meat, exchanges	5	5	5	9
Fat, exchanges	1	1	3	2
Nutritive Value				
Protein, gm	65	65	69	93
Fat, gm	30	60	70	85
Carbohydrate, gm	113	103	143	93
Calories	980	1210	1480	1510

SAMPLE MEAL PATTERNS

Normal Protein, Moderate Carbohydrate, Moderate Fat 1500 Calories	High Protein, Low Carbohydrate, Moderate Fat 1500 Calories
BREAKFAST	
Unsweetened citrus fruit—1 exchange	Unsweetened citrus fruit—1 exchange
Egg—1	Eggs—2
Bread—1 slice	Bread—1 slice
Butter—1 teaspoon	Butter—1 teaspoon
Milk, whole—1 cup	Milk, whole—1 cup
Coffee or tea	Coffee or tea
LUNCH	
Meat, poultry, or fish—2 ounces	Meat, poultry, or fish—4 ounces
Vegetable, raw or cooked, group A—1 serving	Vegetable, raw or cooked, group A—1 serving
Milk, whole—1 cup	Milk, whole—1 cup
Bread—1 slice	
Butter—1 teaspoon	
Unsweetened fruit—1 exchange	
DINNER	
Meat, poultry, or fish—2 ounces	Meat, poultry, or fish—3 ounces
Potato—1 small	Potato—1 small
Vegetable, group B—½ cup group A—1 serving	Vegetable, group B—½ cup group A—1 serving
Milk, whole—1 cup	Milk, whole—1 cup
Bread—1 slice	
Butter—1 teaspoon	Butter—1 teaspoon
Unsweetened fruit—2 exchanges	Unsweetened fruit—1 exchange
Coffee or tea, if desired	

FOODS TO RESTRICT OR AVOID. The patient who learns to select his foods in appropriate amounts from the exchange lists does not require specific lists of foods to avoid. For some persons, however, it may help to create calorie consciousness if listings of concentrated foods are provided. Some of the foods listed below are permitted in specified amounts in the exchange lists, but others are best avoided altogether.

High-fat foods: butter, cheese, chocolate, cream, ice cream, fat meat, fatty fish, or fish canned in oil, fried foods of any kind such as doughnuts and potato chips, gravies, nuts, oil, pastries, and salad dressing

High-carbohydrate foods: breads of any kind, candy, cake, cookies, corn, cereal products such as macaroni, noodles, spaghetti, pancakes, waffles, sweetened or dried fruits, legumes such as Lima beans, navy beans, dried peas, potatoes, sweet potatoes, honey, molasses, sugar, syrup, rich puddings

Beverages: all fountain drinks, including malted milks and chocolate, carbonated beverages of all kinds, rich sundaes, alcoholic drinks

DIETETIC FOODS. Instead of sugar, artificial sweetening agents such as saccharin or Sucaryl may be used in beverages, with fruits and cereals, and in a variety of low-calorie desserts. Fruits canned with artificial sweeteners are useful in providing menu variety.

The Food and Drug Administration in 1966 proposed new regulations pertaining to special foods for calorie-restricted diets. Only a food that contains not more than 15 calories in a serving and not more than 30 calories in the average day's consumption may be labeled "low-calorie." If a food is claimed to be "lower in calories" the reduction must be at least 50 per cent when compared with the same serving of an ordinary food. The regulations require that the statement "For calorie-restricted diets" appear on the label along with information pertaining to the composition of protein, fat, and carbohydrate in a specified serving. Artificial sweeteners must be prominently declared on the label of any product in which they are used.*

Dietary counseling. Leverton[13] has suggested that success in weight reduction is dependent upon two factors: (1) effective motivation, and (2) suitable knowledge.

A diet prescription will prove worthless unless the patient has some motivation for losing weight, such as the maintenance or recovery of health, the ability to win friendship, admiration, and affection, the importance of normal weight in being able to earn one's livelihood or in being considered for occupational advancement, as the case may be. The patient must have the capacity for self-discipline, patience, and perseverance. The physician, nurse, and dietitian, however, can be of immeasurable help by providing encouragement and guidance at frequent follow-up visits. Helping the patient to maintain self-esteem and treating him with dignity can scarcely be overemphasized. Chiding him, on the other hand, for his failure rarely accomplishes anything.

Keeping a weight chart with a record of progress from week to week is most helpful. It must be explained to the patient that weight losses may be irregular even though the diet is carefully kept, inasmuch as variations in water balance occur. The temporary retention of water for 2 or 3 weeks at the beginning of a reduction program may lead the patient to abandon the program if he is not aware of these irregularities.

Every patient who would reduce satisfactorily must possess knowledge of certain basic facts related to how weight may be lost while good nutrition is maintained. Leverton[13] has developed a tentative list of 11 concepts which are phrased in nontechnical language. These statements relate to the sources of energy and the use of energy. Only the first of these concepts is stated here by way of illustration: "1. The body must depend on energy from food or from body tissue for power for everything it does."† By examining the entire list the

* At the time of this writing these regulations have not been finally adopted.

† Leverton, R. M.: "Food Needs and Energy Use in Weight Reduction," *J. Am. Dietet. A.*, **49**:23, 1966.

dietitian or nurse will see that she can use them and amplify them for the patient in a number of ways.

GROUP THERAPY. The Bureau of Nutrition of New York City since 1952 has used public health methodology in the control and treatment of obesity.[5] One project included 90 obese 13- and 14-year-old boys; 55 students were placed in an experimental group, while 35 boys served as the controls. During an 18-month period changes were observed in weight, height, skinfold thickness, and physical fitness. For the experimental group, short nutrition programs were given after school at biweekly intervals with attendance being voluntary. At these meetings diet histories were obtained, a physician talked of the relationship of body weight to physical fitness, and a nutritionist emphasized nutrient and calorie values of food. The boys were given a series of exercises during gym periods and were encouraged to continue to take them at home.

At the end of the 18-month period the boys in the experimental group had gained an average of 5.8 pounds as compared with 13.5 pounds by the control group. Thus, the experimental group at the end of this period had a noticeable decrease in the proportion of overweight, the grossly obese boys benefiting the most. The performance of physical fitness tests was much better for the experimental group than for the control group. For these teen-agers it is important to point out that correction of weight status was achieved by a proper diet pattern without a specific reducing regimen.

Maintenance of weight. To lose weight is by no means easy; to maintain the desirable level of weight is even more difficult. The low-calorie diet planned with regard for the patient's pattern of living also provides the basis upon which to build the diet for maintenance. The patient must learn that a change in food habits is essential not only for weight loss, but that such a change must also continue throughout life if desirable weight is to be maintained. Thus, additions of foods should be made judiciously until weight is being kept constant at the desired level. It is important for the patient to weigh himself at weekly intervals or so in order to be sure that the foods added are in appropriate amounts.

If foods added for maintenance are also selected from the Four Food Groups, the quality of the diet with respect to protein, minerals, and vitamins is thereby enhanced. On the other hand, the additions of concentrated high-calorie foods may be more difficult to control in amounts suitable for maintenance. For example, the sedentary person of middle age must continue to forego rich desserts and sweets except on rare occasions.

UNDERWEIGHT

Causes. Underweight results when the energy intake does not fully meet the energy requirements. Not infrequently this occurs in people who are very active, tense, nervous, and who obtain too little rest. Sometimes irregular

habits of eating and poor selection of foods are responsible for an inadequate caloric intake.

Just as psychologic factors have been noted as contributing to overeating, so they may contribute to eating too little food. Some patients with mental illness reject food to such an extent that severe weight loss results; this condition is referred to as *anorexia nervosa.*

Underweight also occurs in many pathologic conditions such as fevers in which the appetite is poor but the energy requirements are increased; gastrointestinal disturbances characterized by nausea, vomiting, and diarrhea; and hyperthyroidism in which the metabolic rate is greatly accelerated.

Modifications of the diet. Before weight gain can be effected, the direct cause for the inadequate caloric intake must be sought. As in obesity, these causes in relation to the individual must be removed and a high-calorie diet provided.

ENERGY. Approximately 500 calories in excess of the daily needs will result in a weekly gain of about 1 pound. For moderately active individuals diets containing 3000 to 3500 calories will bring about effective weight gain. Somewhat higher levels are required when fever is high, or gastrointestinal disturbances are interfering with absorption, or metabolism is greatly increased.

PROTEIN. A daily intake of 100 gm protein or more is usually desirable since body protein as well as body fat must be replaced.

MINERALS AND VITAMINS. If the quality of the diet resulting in weight loss was poor, considerable body deficits of minerals and vitamins may likewise have occurred. Usually the high-calorie diet will provide liberal levels of all of these nutrients. When supplements are prescribed, it is important that the patient understand that they are in no way a substitute for the calories and protein provided by food.

Planning the daily diet. A patient cannot always adjust immediately to a higher caloric intake. It is better to begin with the patient's present intake and to improve the diet both qualitatively and quantitatively day by day until the desired caloric level is reached. Nothing is more conducive to loss of appetite than the appearance of an overloaded tray of food.

The caloric intake may be increased by using additional amounts of foods from the Four Food Groups, thus increasing the intake of protein, minerals, and vitamins. For example, 500 calories might be added to the patient's present intake as follows:

1 glass milk, ½ cup ice cream, 1 small potato, 1 small banana; *or*
2 slices bread, 2 ounces meat, 1 ounce cheese, ½ cup Lima beans.

The judicious use of cream, butter, jelly or jam, and sugars will quickly increase the caloric level, but excessive use may provoke nausea and loss of appetite.

Some patients make better progress if given small, frequent feedings; but for many patients midmorning and midafternoon feedings have been found

to interfere with the appetite for the following meal. Bedtime snacks, however, may be planned to provide 300 to 800 or so calories, thus making it possible to follow a normal pattern for the three meals.

The following list of foods illustrates one way in which the Four Food Groups may be adapted to a high-calorie level. The meal patterns outlined for the High-Protein Diet (p. 477) suggest suitable arrangements of these foods.

3 to 4 cups milk
1 cup light cream
4 to 6 ounces meat, fish, or poultry
2 eggs
4 servings vegetables including:
  1 serving green or yellow vegetable
  2 servings white or sweet potato, corn, or beans
  1 serving other vegetable
2 to 3 servings fruit, including one citrus fruit
1 serving whole-grain or enriched cereal
3 to 6 slices whole-grain or enriched bread
4 tablespoons or more butter or fortified margarine
High-calorie foods to complete the caloric requirement: cereals such as macaroni, rice, noodles, spaghetti; honey, molasses, syrups; hard candies; glucose; salad dressings; cakes; cookies, and pastry in moderation; ice cream, puddings, sauces.

PROBLEMS AND REVIEW

1. Why is obesity such a serious handicap to health?
2. Eating in excess of one's caloric requirement is the cause of all obesity. List eight situations in which overeating is especially apt to occur.
3. *Problem.* Walking at the rate of 3¾ miles per hour requires an energy expenditure of 285 calories for 1 hour by an individual who weighs 150 pounds. How many miles would an individual have to walk in order to lose 1 pound of body fat?
4. *Problem.* Jon requires 2600 calories daily but is now getting 1800 calories a day. How much weight would you expect him to lose in a month?
5. Obesity can be overcome by strict adherence to a low-calorie diet. What factors must be considered in order to obtain the patient's cooperation? What points would you consider in planning a low-calorie diet?
6. *Problem.* Plan a low-calorie diet for a woman who is 5 feet 2 inches tall and who weighs 165 pounds. Include 90 gm of protein and 1500 calories.
7. What is meant by the satiety value of foods? Which foods are high in satiety value?
8. Miss R. has adhered carefully to a 1200-calorie diet for 3 weeks but has lost no weight. What advice can you give her?
9. Mrs. A. has brought her weight within normal limits. What measures are now necessary to maintain this normal weight?
10. What is the relative importance of exercise in a low-calorie regimen? Of drugs? Of psychotherapy?
11. *Problem.* Jane, a 23-year-old girl who is 30 pounds underweight, needs some help in planning a diet which will include 3000 calories and at least 90 gm of protein. Her present daily intake averages 55 gm protein and 1800 calories. Show how she can increase her intake with a minimum of bulk. What factors may help to improve her appetite?
12. What are some of the factors which may contribute to loss of weight?
13. *Problem.* Using the meal exchange lists, calculate the protein, fat, and carbohydrate value of the list of foods suggested for weight gain on this page. How many calories are provided?
14. *Problem.* Plan three bedtime snacks which will each provide about 500 calories.

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Chapter 33

DIET IN FEVERS AND INFECTIONS

Classification of fevers. Fever is an elevation of temperature above the normal and results from an imbalance between the heat produced in the body and the heat eliminated from the body. Fevers may be (1) acute, or of relatively short duration, such as colds, tonsillitis, influenza, pneumonia, chicken pox, scarlet fever, and typhoid fever, or (2) chronic, such as tuberculosis, lasting for years. The acute phases of rheumatic fever and poliomyelitis are of short duration, but the nutritional problems may be prolonged. Some fevers are accompanied with such a high temperature that they are extremely debilitating, typhoid fever and malaria being examples.

Metabolism in fevers. The more important changes in fevers which may affect nutrition are:

1. Increased metabolic rate amounting to 7 per cent for every degree Fahrenheit rise in body temperature;
2. Decreased glycogen stores;
3. Increased protein metabolism, which is especially excessive in typhoid fever, malaria, typhus fever, and others—the additional end products of protein metabolism, excreted as urea, place a heavy burden upon the kidneys;
4. Accelerated loss of body water owing to the increased perspiration and the excretion of body wastes;
5. Increased excretion of sodium chloride and of potassium;
6. Decreased motility and reduced absorption of nutrients.

General dietary considerations. The diet in fevers depends upon the nature and severity of the existing pathologic conditions and upon the length of convalescence. In general it should meet the following requirements:

ENERGY. The caloric requirement may be increased as much as 50 per cent or even more, depending upon the temperature, the degree of destruction of tissues, and the amount of restlessness. The body's need for calories will probably not be met during the height of the fever, but a high-calorie diet with intermediate feedings should be used as soon as possible.

PROTEIN. About 100 gm protein or more is prescribed when fever is prolonged. This will be most efficiently utilized when the calorie intake is liberal

(see Chapter 31). High-protein beverages may be used as a supplement to the usual meals.

CARBOHYDRATES. Glycogen stores are replenished by a liberal intake of carbohydrates. Any sugars such as glucose, corn syrup, cane sugar, and lactose may be used. However, glucose is less sweet than some other sugars and consequently more of it can be used. Furthermore, it is a simple sugar which is absorbed into the blood stream without the necessity for enzyme action. Lactose, used by some, is relatively expensive, dissolves poorly in cold solutions, and may increase fermentation in the small intestine resulting in diarrhea.

FATS. The energy intake may be rapidly increased through the judicious use of fats, but fried foods and rich pastries may retard digestion unduly.

MINERALS. A sufficient intake of sodium chloride is accomplished by the use of salty broth and soups and by liberal sprinklings of salt on food. Generally speaking, foods are a good source of potassium, but a limited food intake might result in potassium depletion whenever fever is high and prolonged. Fruit juices and milk are relatively good sources of this element.

VITAMINS. Fevers apparently increase the requirements for vitamin A and ascorbic acid, just as the B-complex vitamins are needed at increased levels proportionate to the increase in calories; that is, 0.4 mg thiamine, 0.6 mg riboflavin, and 6.6 mg niacin equivalents per 1000 additional calories. Oral therapy with antibiotics and drugs may interfere with intestinal synthesis of some B-complex vitamins by intestinal bacteria, thus necessitating a prescription for vitamin supplements for a short time.

FLUID. Approximately 2500 to 5000 ml fluid per day are necessary, including beverages, fruit juices, soups, and water.

EASE OF DIGESTION. Bland, readily digested foods should be used to afford maximum rest to the body, and to facilitate digestion and rapid absorption. The food may be soft or of regular consistency. Although fluid diets may be used initially there are some disadvantages: (1) most fluid diets occupy bulk out of all proportion to their caloric and nutrient values, so that reinforcement of liquids is essential; (2) a liquid diet may sometimes increase abdominal distention to the point of acute discomfort, whereas solid foods may be better tolerated; (3) many patients experience less anorexia, nausea, and vomiting when they are taking solid foods.

INTERVALS OF FEEDING. Small quantities of food at intervals of 2 to 3 hours will permit adequate nutrition without overtaxing the digestive system at any one time. With improvement, many patients consume more food if given three meals and a bedtime feeding.

Diet in fevers of short duration. The duration of many fevers has been shortened by antibiotic and drug therapy, and nutritional needs are usually met without difficulty. During an acute fever the patient's appetite is often very poor, and small feedings of soft or liquid foods as desired should be offered at frequent intervals (see Chapter 29). Sufficient intake of fluids and salt is essential. When the fever is of short duration it is usually not important to

fully meet the protein and calorie requirements. If the illness persists for more than a few days, high-protein, high-calorie foods will need to be emphasized. See High-Protein, Soft, and Fluid diets (Chapter 31).

Diet in typhoid fever. Improved sanitation has greatly reduced the incidence of typhoid fever, and antibiotic therapy has shortened the acute stage of the disease. Nevertheless, short and uneventful convalescence is determined to an important degree by adequate nutrition.

The febrile period may cause loss of tissue protein amounting to as much as ½ to ¾ pound of muscle a day. The body store of glycogen is quickly depleted, and a probable upset in water balance occurs.

The intestinal tract becomes highly inflamed and irritable, and diarrhea which is a frequent complication interferes with the absorption of nutrients. The ulceration may be so severe that hemorrhage and even perforation of the intestines may occur.

The dietary considerations outlined on page 497 apply as in other fevers. Special emphasis must be placed upon a caloric intake of 3500 or more, and a protein intake in excess of 100 gm. Because of the intestinal inflammation, great care must be exercised to eliminate all irritating fibers. The high-protein fluid diet may be used as a basis in dietary planning. In addition, low-fiber foods including white breads and crackers, refined cooked and dry cereals, eggs, cheese, tender meat, fish, and poultry, potato, and plain desserts may be used. A representative meal pattern is as follows:

HIGH-PROTEIN HIGH-CALORIE LOW-FIBER DIET

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Citrus juice with glucose—1 glass	Orange juice with glucose
Cereal with cream and sugar	Cream of Wheat with cream and sugar
Egg, soft-cooked or poached	Poached egg on
White toast with butter	Buttered white toast
Beverage	Cocoa
MIDMORNING	
Milk beverage	Eggnog made with cream
LUNCHEON OR SUPPER	
Broth or strained cream soup	Cream of tomato soup
Tender meat, fish, or poultry	Roast chicken
Potato with butter	Baked potato (no skin) with butter
White bread with butter	Buttered white toast
Dessert	Vanilla ice cream
High-protein beverage	High-protein milk
MIDAFTERNOON	
Citrus juice	Orange juice
Milk dessert	Baked custard

MEAL PATTERN (Cont.)	SAMPLE MENU (Cont.)
DINNER	
Cream soup or broth	Consommé with gelatin
Egg or cheese	Soft-cooked egg
Potato or cereal	Boiled rice with sugar and cream
White bread with butter	Buttered white toast
Dessert	Tapioca cream
Milk	Milk
BEDTIME	
High-protein beverage	Chocolate malted milk
Plain pudding, bread, or crackers	Cream-cheese sandwich on white bread

Diet in rheumatic fever. Rheumatic fever is one of the leading causes of chronic illness in children. It will permanently damage the heart if it is not recognized early and treated promptly. Rheumatic fever follows streptococcus infections and is more common among poorer classes of people. However, all attempts to correlate the incidence of the disease with specific nutrient deficiencies have so far failed.

The soft and liquid diets described in Chapter 29 are suitable during the acute phase of rheumatic fever. When cortisone or ACTH therapy is used, the diet must be mildly restricted in sodium to avoid sodium retention and edema formation (see Chapter 42).

The acute stage may last only a few weeks, but absolute bed rest is essential for many weeks or months. The chief problem in nutrition is that of maintaining an adequate intake of nutrients during the prolonged period of bed rest. Because the appetite may be poor, it has been suggested[1] that cereal foods and sweets be restricted as a means of ensuring adequate intake of milk, eggs, citrus fruits, and other essential foods. The diet is planned according to the principles of the normal diet described in Chapter 24.

Diet in poliomyelitis. The prophylactic use of Sabin or Salk vaccines has resulted in rare occurrence of poliomyelitis, and the necessary nutritional considerations. Spinal poliomyelitis requires essentially the same dietary attention during the acute phase as that for other acute fevers. However, convalescence is prolonged, and tissue destruction occurs. Immobilization leads to excessive excretion of calcium and the frequent incidence of urinary calculi (see Chapter 43).

Physical handicaps may interfere seriously with the ability to manage the foods served and may lead to discouragement and poor food intake. The nurse must assume responsibility not only for helping the patient through giving him foods he can manage or in feeding him, if required, but she must also give the necessary encouragement and psychologic support which brings the patient to make every effort to help himself, difficult though it may be.

The chief dietary problem in bulbar poliomyelitis is the difficulty or failure in swallowing food and the possibility of choking or aspiration. After the

initial feedings by the parenteral route, a four-stage feeding program has been described by Seifert:*

Stage I. Tube feedings of 30 or 50 ml up to 150 or 200 ml are alternated every 2 hours with water. The tube feedings consist of skim milk-egg-sugar formulas or milk-cream-orange juice-sugar mixtures with or without added protein foods and oral fat emulsions.

Stage II. Tube feedings are continued. Ability to swallow is cautiously tested by giving 1 to 2 teaspoons of grape juice and noting whether the juice is seen in the tracheotomy opening. If swallowing is successful, broth, tea with sugar, apple juice, flavored gelatin, and diluted, strained juices are cautiously tried.

Stage III. A soft, low-fiber diet of easily digested foods is started. Tube feeding is continued until sufficient amounts of food can be swallowed. Sticky foods especially must be avoided. The foods which may be permitted include:

All foods from tube feedings in stages I and II
Beverages: tea with sugar, water, or coffee
Cereals: Cream of Wheat or farina with large amounts of sugar and a little milk
Desserts: custard, flavored gelatin, sherbet
Eggs: soft-cooked or poached
Fats: butter
Fruits: puréed, cooked, or canned (without seeds, skin or fiber) strained fruit juices
Meats: strained
Soups: bouillon or strained meat soup
Vegetables: well-cooked or puréed

Foods to avoid are fish; fried foods; milk; pastries; potatoes; raw fruits and vegetables; seeds as in berries, tomatoes; spicy or highly seasoned foods; starchy products: macaroni, rice, spaghetti; sticky foods: cheese dishes, ice cream, oatmeal; strongly flavored vegetables.

Stage IV. More solid foods, including ground meat, bread, and milk products, are introduced when the patient can take stage III without mishap. In addition to stage III, the following foods are permitted:

Breads: soda crackers, white bread, or toast with butter
Desserts: plain cornstarch puddings and ice cream
Fruits: cooked or canned applesauce, apricots, peaches, or pears
Meats: ground beef, chicken, lamb, or turkey with light gravies or mayonnaise
Milk alone or with protein supplements
Vegetables: well-cooked but not puréed asparagus, French-cut green beans, carrots, canned peas, squash, or chopped spinach

Foods to avoid are fish; potatoes; starchy products; sticky foods—casserole dishes.

* Adapted from Seifert, M. H.: "Poliomyelitis and the Relation of Diet to Its Treatment," *J. Am. Dietet. A.*, **30**:671, 1954.

...NAGALINGAM HOME SCIE...

Diet in tuberculosis. Pulmonary tuberculosis is an inflammatory disease of the lungs accompanied by a wasting of the tissues, exhaustion, cough, expectoration, and fever. In its acute form it resembles pneumonia, because the temperature is high and circulation and respiration are increased. The metabolic rate in tuberculosis is not as high as in other fevers except when the fever is high, but wasting may be considerable because of the length of the illness. A tendency to develop gastrointestinal disturbances is characteristic of the disease. The normal diet is modified as follows:

ENERGY. Since the metabolic rate is not as high as in other fevers, satisfactory weight can be maintained, as a rule, at 2500 to 3000 calories. It is not desirable to gain more than 10 per cent above the ideal weight for the body frame.

PROTEIN. A protein intake somewhat in excess of normal requirements is necessary in tuberculosis, since the serum albumin value, especially in advanced tuberculosis and in cases of long standing may be low.[2] The daily level may range from 80 to 120 gm.

MINERALS. Calcium, especially, should be provided liberally since it is essential for the healing of tuberculous lesions. At least 1 quart of milk should be taken daily.[3] The iron needs may also be increased if there has been hemorrhage.

VITAMINS. The metabolism of vitamin A is adversely affected in tuberculosis. Carotene appears to be poorly converted to vitamin A so that the diet should be planned to provide vitamin A as such.[2] The weekly inclusion of liver and dietary supplementation with vitamin A are essential.

Ascorbic acid deficiency is present even in patients with slight tuberculous involvement and becomes more marked with the progression of the disease. Increased amounts of orange juice may be given, but ascorbic acid is frequently also prescribed. Isoniazid has been found to be an effective drug in the treatment of tuberculosis, but it is also an antagonist of vitamin B_6, thereby increasing the requirement. When this therapy is used, vitamin B_6 supplementation is essential.

SELECTION OF FOODS. During the acute stage of the illness, a high-protein, high-calorie fluid diet may be given as in other acute fevers, progressing to the soft and regular diets when improvement occurs. Most patients have very poor appetites. For some a six-meal routine is best, while others eat better if they receive three meals and a bedtime feeding. The individuals responsible for planning meals should respect the patient's food idiosyncrasies. To this end, a selective menu from which the patient chooses his foods each day is helpful. Other patients may eat better when they are not consulted in advance about their diets, thus introducing an element of surprise. Needless to say, every attention must be given to making meals as appetizing in appearance and taste as possible. The high-protein and high-calorie diets described in Chapters 31 and 32 may be adapted to the individual patient's needs.

DIETARY COUNSELING. In no situation is counseling of greater value than for the patient who has recovered from tuberculosis. Wilson and her associates[4]

have pointed out that failure of the patient to secure the essentials of a good diet leads to a great increase in recurrence and repeated hospitalization. The characteristics of a normal diet, with special emphasis on a liberal milk intake, protein-rich foods, fruits and vegetables must be pointed cut. When there is financial need it is not enough to secure additional allowances to purchase the required foods, but practical measures for budgeting the food allowance must be recommended.

Emphysema is a pathologic enlargement or overdistention of the alveoli of the lung brought about by a number of causes, including bronchitis, asthma, and infection. Patients with emphysema often complain of abdominal distress, and peptic ulcers occur with frequency.

Wilson *et al.*[5] have described some of the nutritional problems associated with this condition. Shortness of breath places a severe limitation upon the ability to ingest an adequate diet, with the result that weight loss and tissue wasting are common. Not infrequently the purchase and preparation of food, or seeking a place to eat a meal, require more effort than the patient can expend. Because the patient is unable to work, there may be insufficient income to purchase adequate food. Chewing and swallowing require further effort and the patient often stops short of satisfactory intake.

A soft high-calorie diet is usually indicated. Patients are especially short of breath after a night's sleep and experience difficulty in eating breakfast.[6] Small, frequent feedings of concentrated foods should be used. Wilson found a high-protein commercial supplement to be useful because it was concentrated, palatable, easy to prepare, and easy to ingest. Too many fibrous fruits and vegetables or meats requiring much chewing may necessitate an energy expenditure beyond that justified by the nutrient values obtained. The patient will eat very slowly, and should refrain from talking while eating since the swallowing of air is responsible for much of the discomfort.

PROBLEMS AND REVIEW

1. How great is the increase in energy metabolism brought about by fever? What other changes in metabolism of nutrients take place during fever? In view of these changes criticize the commonly held belief "Starve a fever."
2. Give examples of reinforcing agents used for increasing the protein of the diet, the carbohydrate, and the fat.
3. *Problem.* Plan a diet for a child with rheumatic fever which contains 80 gm protein and 2500 calories. What principles are observed in planning a diet for such a patient?
4. What are the principles of dietary management in poliomyelitis?
5. Satisfactory dietary treatment in tuberculosis must consider very carefully the patient's attitude to his diet, since appetite is often very poor. What are the advantages and disadvantages of using a selective menu for such patients?
6. *Problem.* Plan a diet for a patient with tuberculosis which contains 100 gm protein and 3000 calories. List a number of ways in which you would try to bring about this intake of food.
7. What is the basis for recommending sodium restriction for some patients with rheumatic fever?
8. What are the problems encountered in feeding a patient with emphysema? How would you solve them?

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Chapter 34

NUTRITION IN SURGICAL CONDITIONS

Low-Residue Diet; Tube Feedings; High-Protein, High-Fat, Low-Carbohydrate Diet (for Dumping Syndrome)

Good nutrition prior to and following surgery assures fewer postoperative complications, better wound healing, shorter convalescence, and lower mortality.

Effects of surgery on the nutritive requirements. Surgery or injury brings about a greatly increased need for nutrients as a result of loss of blood, plasma, or pus from the wound surface; hemorrhage from the gastrointestinal or pulmonary tract; vomiting; and fever. During immobilization, the loss of some nutrients such as protein is accelerated.

A fairly simple operation often involves moderate deficiency in food intake for a few days following the operation. Even though some nutrients may be supplied by parenteral fluids, the full needs of the body usually cannot be met by that means alone. Moreover, when foods are permitted following surgery, the choice and amount are sometimes too limited to permit nutritive balance.

Far more serious is the problem of the patient whose poor nutritional state prior to surgery imposes a severe additional strain. Chronic infection as in bronchiectasis or heightened metabolism as in hyperthyroidism may lead to increased requirements. Poor appetite and inadequate intake of nutrients are the rule in many diseases. Especially in liver diseases and in sprue absorptive failure may be serious. Extensive losses of nutrients and fluids may have occurred through hemorrhage, vomiting, or diarrhea. The extent of the deficiency is manifested by weight loss, poor wound healing, decreased intestinal motility, anemia, edema or dehydration, and the presence of decubitus ulcers. The circulating blood volume and the concentration of the serum proteins, hemoglobin, and electrolytes may be reduced.

Nutritional considerations. The objectives in the dietary management of surgical conditions are (1) to improve the preoperative nutrition whenever the operation is not of an emergency nature, (2) to maintain correct nutrition after operation or injury insofar as possible, and (3) to avoid harm from the injudicious choice of foods.

PROTEIN. A satisfactory state of protein nutrition ensures rapid wound healing by providing the correct assortment and quantity of essential amino acids, increases the resistance to infection, exerts a protective action upon

the liver against the toxic effects of anesthesia, and reduces the possibility of edema at the site of the wound. The presence of edema is a hindrance to wound healing and, in operations on the gastrointestinal tract, may reduce motility thus leading to distention.

It is not always realistic to fully replace protein losses prior to surgery because the disease process itself may be such as to preclude a satisfactory intake of food. Improved surgical results of recent years have come about through adequate replacement of blood volume and better operative techniques rather than preoperative protein replacement. The extent to which surgery should be delayed in order to improve the nutritional state is obviously a highly individual matter.

Immediately following surgery or injury and for several days thereafter, protein catabolism is increased and patients are characteristically in negative nitrogen balance even though the protein intake might be appreciable. Such losses, paradoxically, are greatest in patients who have been well nourished and are least in those who are poorly nourished.[1]

The level of protein to be used in preoperative and postoperative diets depends upon the previous state of nutrition, the nature of the operation, and the extent of the postoperative losses. Intakes of 100 gm protein, and frequently much more, are necessary as a rule.

ENERGY. The weight status is an important pre- and postoperative consideration, for it serves as a guide to the caloric level to be recommended. Without sufficient caloric intake, tissue proteins cannot be synthesized. Excessive metabolism of body fat may lead to acidosis, while depletion of the liver glycogen may increase the likelihood of damage to the liver.

When hyperthyroidism or a fever is present, as much as 4000 calories daily may be essential to bring about weight gain. Other patients will make satisfactory progress at 2500 to 3000 calories.

Obesity constitutes a hazard in surgery. Whenever possible, it should be corrected, at least in part, by using one of the low-calorie diets (see p. 489).

MINERALS. Phosphorus and potassium are lost in proportion to the breakdown of body tissue. In addition, derangements of sodium and chloride metabolism may occur from vomiting, diarrhea, perspiration, drainage, anorexia, and diuresis or renal failure. The detection of electrolyte imbalance and appropriate parenteral fluid therapy requires careful study of clinical signs and biochemical evaluation.

If absorption has been faulty or if blood losses have been high, iron-deficiency anemia may occur. Diet alone is ineffective in its correction, but iron salts may be administered together with a liberal dietary intake of protein and ascorbic acid. Such therapy is of value in convalescence, but transfusions are usually required for severe reduction in hemoglobin level.

FLUIDS. A review of the maintenance of water balance (see p. 188) will bring to the attention of the student the large amounts of fluid lost daily by the normal individual and the several sources of water to the body. The fluid balance may be upset prior to and following surgery owing to failure to ingest

normal quantities of fluids and to increased losses from vomiting, exudates, hemorrhage, diuresis, and fever. A patient should not go to operation in a state of dehydration since the subsequent dangers of acidosis are great. When dehydration exists prior to operation parenteral fluids are administered if the patient is unable to ingest sufficient liquid by mouth. Following major surgery the fluid balance is maintained by parenteral fluids until satisfactory oral intake can be established.

VITAMINS. Ascorbic acid is especially important for wound healing and should be provided in increased amounts prior to and following surgery. Vitamin K is of concern to the surgeon since the failure to synthesize vitamin K in the small intestine, the inability to absorb it, or the defect in conversion to prothrombin is likely to result in bleeding. Hemorrhage is especially likely to occur in patients who have diseases of the liver.

Planning the preoperative diet. Patients who have lost much weight prior to surgery may benefit considerably by ingesting a high-protein, high-calorie diet (see p. 476) for even a week or two prior to surgery. The diet may be of liquid, soft, or regular consistency depending upon the nature of the pathologic condition. In addition, the maintenance of metabolic equilibrium as in diabetes or other diseases must not be overlooked.

When surgery is delayed in order to improve the nutritional status, each day's intake should represent such improvement in nutrition that the delay is justified. This necessitates constant encouragement by the nurse and dietitian; it likewise requires imagination in varying the foods offered to the patient and ingenuity in getting the patient to eat. Foods which provide a maximum amount of nutrients in a minimum volume are essential. Small feedings at frequent intervals are likely to be more effective than large meals which cannot be fully consumed.

For additional protein, milk beverages may be fortified with nonfat dry milk, whole egg, and egg whites. Strained meat in broth may be used when patients are unable to eat other meats. Fruit juices fortified with glucose, high-carbohydrate lemonade (p. 725), jelly with crackers and bread, and hard candy may be used to increase the carbohydrate intake and to facilitate storage of glycogen. Butter incorporated into foods and light cream mixed with equal amounts of milk are also useful for increasing the caloric intake. The excessive use of sugars and fats may provoke nausea, however.

Food and fluid are generally allowed until midnight just preceding the day of operation, although a light breakfast may be given when the operation is scheduled for afternoon and local anesthesia is to be used. It is essential that the stomach be empty prior to administering the anesthesia so as to reduce the incidence of vomiting and the subsequent danger of aspiration of vomitus. When an operation is to be performed on the gastrointestinal tract, a diet very low in residue (p. 508) may be ordered 2 to 3 days prior to operation. In acute abdominal conditions such as appendicitis and cholecystitis, no food is allowed by mouth until nausea, vomiting, pain, and distention have passed in order to prevent the danger of peritonitis.

Planning the postoperative diet. The patient enters a catabolic phase during the first few days following surgery and remains in negative nitrogen balance regardless of his intake of protein and calories. The degree of negative balance can be reduced at higher intake of protein and calories.

PARENTERAL FEEDINGS. The maintenance or restoration of fluid and electrolyte balance is of paramount importance during the interval when the patient is unable to ingest food or fluid by mouth. In addition to furnishing fluid and salts, the intravenous fluid often contains glucose which serves to prevent ketosis and to minimize tissue catabolism. Protein hydrolysates may also be incorporated. At best, the amounts of glucose and amino acids which may be incorporated will not meet the full nutritional requirements because of the volume of fluid and the concentration of glucose which can be given in a 24-hour period.

Intravenous fat emulsions have been used successfully by some and are believed to offer an effective way to reduce the postoperative nitrogen losses since they make possible a substantial increase in the calorie intake.[2] Others, however, point out that a number of problems must be solved before fat emulsions can be widely used.[3]

Parenteral nutrition requires a careful consideration of the nature of the illness, physical examination to evaluate subjective changes, and laboratory analyses for blood electrolytes, pH, and blood proteins. The student should be aware of the nutritional contributions made by such feedings although the details of management are beyond the scope of this text.

PROGRESSION OF ORAL FEEDING. Oral feeding cannot be resumed until the gastrointestinal secretions are being produced and peristalsis is resumed. Nothing, however, is gained by delaying feeding when such function has returned. The accumulation of gastrointestinal secretions may result in a feeling of fullness. Moreover, the wound strength is sufficient to permit digestion of food, and is, in fact, stronger than a few days later.[4]

Patients usually respond better if they are given solid foods rather than liquid foods. Initially, the feedings are small and may be restricted to a low-residue diet. See also Chapter 35. Foods which are high in protein and fat are believed to be less distending than those which are high in carbohydrate.[5] Perhaps of greater importance is the emphasis upon eating slowly and in small amounts to reduce the amount of air which is swallowed. As the patient improves, the selection of foods is that of a soft or regular diet, depending upon the nature of the surgery.

VERY LOW-RESIDUE DIET

Characteristics and general rules:

This diet is essentially fiber-free and leaves a minimum of residue in the intestinal tract. See discussion on p. 525.

If the diet is used for more than a few days, it should be supplemented with calcium, iron, and multivitamin concentrates.

As improvement takes place, the diet is liberalized by gradually adding pureed vegetables and fruits, and milk.

FOODS ALLOWED	FOODS TO AVOID
Beverages—coffee in limited amounts, tea	*Beverages*—milk and milk drinks
Breads—enriched bread or toast, crackers, plain rolls, Melba toast, zwieback	*Breads*—whole-grain breads or crackers
Cereals—corn meal, farina, strained oatmeal; corn flakes, Puffed Rice, rice flakes; macaroni, noodles, rice, spaghetti	*Cereals*—whole-grain such as wheat flakes, wheat meal
Cheese—cottage, cream, mild American in sauces	*Cheese*—sharp
Desserts—plain cake, cookies, custard, gelatin, ice cream, puddings, rennet desserts	*Desserts*—with fruit or nuts; pies and pastries. Note: milk desserts are occasionally omitted
Eggs—cooked any way except fried	
Fats—butter, cream, margarine, vegetable oils	
Fruits—strained juices only. Occasionally applesauce is given to patients with diarrhea because of its pectin content	*Fruits*—all except juices
Meats—tender or minced lean meat, fish, or poultry	*Meats*—tough; fried; fatty meats, fish, or poultry such as pork, mackerel, goose
Soups—clear: bouillon or broth without fat	*Soups*—fatty; cream; spicy
Sweets—hard candy, honey, jelly, syrup, sugar in moderation	*Sweets*—with fruit or nuts; jam, marmalade
Vegetables—tomato juice; white potato	*Vegetables*—all except tomato juice and potato
Miscellaneous—salt; spices in moderation	*Miscellaneous*—nuts, popcorn, pickles, excessive seasonings

MEAL PATTERN

BREAKFAST
Strained fruit juice
Refined cereal with cream and sugar
Egg
White toast with butter
Coffee with cream and sugar

DINNER
Strained citrus juice
Tender meat, poultry, or fish
Potato or substitute
White bread with butter
Plain dessert
Coffee or tea

LUNCHEON OR SUPPER
Broth
Tender meat, fowl, fish, or egg
Potato, rice, macaroni, or noodle
White bread with butter
Plain dessert
Coffee or tea

TUBE FEEDINGS

Feeding by tube may be required for a short period of time or indefinitely in a variety of circumstances: surgery of the mouth; gastrointestinal surgery; obstruction of the esophagus; in severe burns; in anorexia nervosa; and in the comatose patient. Ordinarily, the feedings are given by nasogastric tube, but if the esophagus is obstructed they are given through a tube inserted into an opening in the abdominal wall.

Characteristics of tube feedings. A satisfactory tube feeding must be (1) nutritionally adequate; (2) well tolerated by the patient so that vomiting is not induced; (3) easily digested with no unfavorable reactions such as distention, diarrhea, or constipation; (4) easily prepared; and (5) inexpensive.

The concentration of the feeding may be adjusted from about ⅔ to 1⅓ calories per milliliter; likewise, the protein level may be increased if needed. A concentration of about 1 calorie per milliliter is satisfactory and is less likely to produce diarrhea than those of higher concentration. About 2 liters per 24 hours is a customary volume.

Tube feedings prepared from the ordinary foods of a normal diet by using a high speed blender are generally preferred to other types of formulas. Patients accept these feedings more readily because they see that they are receiving foods that other people normally consume and are modified only in consistency. The blenderized feedings are well tolerated and are only infrequently associated with diarrhea.

Numerous commercial feedings are available to meet specific needs in terms of protein, fat, and calorie content. Likewise, recipes are available for the preparation of feedings within the hospital or home. Most of these feedings use whole or skim milk, eggs, and vitamin supplements together with some form of carbohydrate such as strained cooked cereals, sugar, or molasses. Cream and nonfat dry milk are also incorporated to increase the calorie and protein levels respectively. Planned formulas ensure constancy of composition and simplicity of preparation. They may be preferred for short term use, but blenderized feedings are more likely to be used for longer periods of time.

Blenderized feedings. Any foods which lend themselves to liquefaction in high-speed blender may be used. The following procedure is recommended.[6]

. Food is mixed with sufficient liquid in a blender to facilitate homogenization and liquefaction.

Homogenized milk should be used since plain milk will form butter.

About 4 to 5 minutes is usually required for homogenization.

he homogenate must be strained several times through a fine mesh wire emove all fibers that would clog the tube.

NATE PROCEDURE. The straining of the formula may be avoided by those foods already in a fine state of division. These would include aby foods including meats, fruits, and vegetables; strained fruit

juices; nonfat dry milk, or homogenized milk; cream; brewer's yeast or vitamin supplements. A formula providing 1 calorie per ml is given in Table 34–1. Normal daily intake would be about 2 liters.

Table 34–1. Blenderized Formula*

Ingredients	Weight	Protein	Fat	Carbohydrate
	gm	*gm*	*gm*	*gm*
Liver, strained	150	20.7	5.0	5.3
Egg, 1	54	6.1	5.5	0.3
Applesauce, strained	50	0.1	0.1	10.9
Carrots, strained	50	0.4	0.1	2.8
Orange juice, frozen, reconstituted	100	0.8	0.2	10.4
Nonfat dry milk	175	62.2	1.8	9.0
Sugar	15			14.9
Brewer's yeast, dry	2.5			1.0
Water to 1000 ml				
		90.3	12.7	136.6

* Stumpf, G. L.: *Diet Manual—University of Michigan Hospital.* The George Wahr Publishing Company, Ann Arbor, Michigan, 1963, p. 41.

Administration of tube feedings. Depending upon its nature, the feeding may be heated over hot water to body temperature, taking care that curdling does not occur with certain mixtures. Initially, small amounts of a dilute formula (50 ml) are given at hourly intervals. It is important that the feeding be given at a slow constant rate. Barron[6] recommends the use of a food pump with blenderized feedings. In patients who do not have an adequate swallowing mechanism or who are comatose, special care must be taken to avoid vomiting and aspiration of the vomitus. The patient should be positioned to prevent aspiration, and suction should be readily available at the bedside if vomiting occurs.[7]

When the small feedings are satisfactorily tolerated, the concentration and amount of the formula is gradually increased, with feedings not exceeding 12 ounces per 3- to 4-hour interval.

DIET IN SPECIFIED SURGICAL CONDITIONS

Diet following operations on the mouth, throat, or esophagus. The extraction of teeth, the period of waiting for dentures, and the time required to become accustomed to new dentures could result in nutritive inadequacy if suggestions for adequate diet are not given to the patient. For 1 or 2 days following the extraction of teeth, it may be necessary to restrict the diet to liquids taken through a drinking tube. Thereafter, any soft foods which require little if any chewing may be used for 3 weeks or longer.

Radical surgery of the mouth necessitates the use of a full fluid diet, but immediately after surgery one of the regimens for tube feeding described in the previous section may be used. Tube feeding is likewise required for an operation on the esophagus, the tube being inserted directly into the stomach.

Following tonsillectomy the patient may be given cold fluids including milk, bland fruit juices, ginger ale, plain ice cream, and sherbets. Tart fruit juices and fibrous foods must be avoided. On the second day, soft foods such as custard, plain puddings, soft eggs, warm but not hot cereals, strained cream soups, mashed potatoes, and fruit and vegetable purées may be tolerated. As a rule, the regular diet is swallowed without difficulty within the week.

Diet following gastrectomy. A number of problems arise following gastrectomy and their treatment should be anticipated. More than half of all patients who have had gastric surgery fail to regain weight to desirable levels.[8] The loss of a reservoir for food means that small feedings given at frequent intervals must be used if sufficient nutrients are to be ingested. Moreover, the absence of pepsin and hydrochloric acid entails the entire digestion of protein by the enzymes of the small intestine. Fat utilization is often impaired because of inadequate biliary and pancreatic secretions or from defective mixing of food with the digestive juices. Intestinal motility is frequently increased.

Iron is less readily absorbed and hypochromic microcytic anemia is common. In the absence of gastric juice and its intrinsic factor vitamin B_{12} cannot be absorbed from the intestine, thereby leading to macrocytic anemia in 2 to 5 years after operation unless injections of vitamin B_{12} are given.

DIETARY PROGRESSION. The oral feeding of the patient varies widely from patient to patient, but the following illustrates a typical sequence.

Day 1. 60 to 90 ml water hourly as tolerated
Day 2. 60 to 90 ml clear fluids hourly as tolerated
Day 3. 60 to 90 ml full fluids hourly as tolerated (see Chapter 29)

Lewis and her associates[9] found that patients made more satisfactory progress beginning with the fourth postoperative day when the following dietary characteristics were in effect.

1. The diet progresses from day to day according to the patient's tolerance for food.
2. The protein and fat content of the foods is emphasized by including these nutrients in the smallest practical volume.
3. The carbohydrate is kept relatively low.
4. Five to six small meals are given daily consisting of soft, low-fiber foods. Eggs, custards, thickened soups, cereals, crackers, milk, and fruit purées are used on the fourth and fifth days. The next additions are tender chicken, cottage cheese, and puréed vegetables. The selection of foods allowed for the first stage of the Bland Low-Fiber Diet (Chapter 35) or the Very Low-Residue Diet (p. 508) may be used initially. Many patients progress more satisfactorily if no liquids are taken with meals, and if the diet continues to be low in carbohydrate, especially the simple sugars.

Diet following intestinal surgery. Obstruction, persistent ileitis or diverticulitis, perforation, and malignancy are among the reasons for removal of a section of the ileum (ileectomy) or colon (colectomy). A permanent opening in the abdominal wall is provided through which the digestive wastes are eliminated. Following removal of part of the ileum and colon, the proximal end of the ileum is attached to the opening (*ileostomy*). Because the absorptive function of the colon has been eliminated by the surgery, the waste material is fluid and continuous. Fluid, sodium, and potassium losses may be considerable, fat absorption is often poor, and vitamin B_{12} absorption is reduced or absent.

A *colostomy* consists in attaching the proximal end of the resected colon to the opening in the abdominal wall. Some ability to absorb water is retained so that feces are more or less formed, and bowel regularity can be reestablished.

Following any operation upon the small intestine or colon, the initial intake is restricted to clear fluids and followed with a low-residue diet as a rule. Patients with an ileostomy are usually young and require a great deal of guidance and support from the nurse and dietitian. Gradually, they may add foods moderately low in fiber, but each food should be tested for tolerance before introducing a second. Weight loss may be considerable, and a high-protein, high-calorie diet is generally required. Vitamin B_{12} injections are required to prevent the occurrence of macrocytic anemia in later years.

Colostomy is performed more frequently on elderly persons. In time they may resume an essentially normal diet, but usually they require some counseling concerning the foods required for nutritive adequacy. They too require emotional support, as well as assurance that foods will not be harmful.

Diet following other abdominal operations. The principles outlined on page 505 pertain to the planning of diet following appendectomy, cholecystectomy, and other abdominal operations. Adynamic ileus is present longer following cholecystectomy and hysterectomy than after removal of the appendix. Patients who have had the gallbladder removed may require a low-fat diet for 3 months or longer, after which a regular diet is used.

Following peritonitis and intestinal obstruction, nothing whatever is given by mouth until gastrointestinal function has been resumed. Drainage of the stomach and upper intestine is essential until there is reduction of distention and passage of gas. This may require 4 to 6 days, during which time nutrition is maintained by complete intravenous therapy. When the patient shows tolerance for water, broth, and weak tea a very low-residue diet may be introduced cautiously.

Diet following burns. Tremendous losses of protein, salts, and fluid take place when large areas of the body have been burned. Greatly increased nutritive requirements exist for weeks or months following burns. Severe hypoproteinemia, edema at the site of injury, failure to obtain satisfactory skin growth, and gastric atony are among the nutritional problems encountered.

When vomiting and diarrhea are severe, reliance must be placed primarily on complete intravenous therapy. Tube feeding may precede oral feeding and is continued until the high nutritive requirements can be met by the usual

feeding procedures. At least 150 gm protein, and often as much as 300 gm protein, is required daily together with 3500 to 5000 calories. High-protein meals supplemented with high-protein beverages are used (see Chapter 31). Oral fat emulsions taken as a beverage or given by tube are useful in maintaining a high-caloric intake.[10] The need for as much as 1.0 gm ascorbic acid has been definitely established, while additional B-complex vitamins are also considered essential.

Diet following fractures. Following fractures there is a tremendous catabolism of protein, which may not be reversed for several weeks. Nitrogen loss is accompanied by loss of phosphorus, potassium, and sulfur. Fever and infection may further accentuate such losses

Calcium loss is also great but is not corrected by the administration of calcium. In fact, calcium therapy may lead to the formation of renal calculi and should not be attempted until the cast is removed and some mobilization is possible.

A liberal intake of protein is essential to permit restoration of the protein matrix of the bone so that calcium can be deposited. Sufficient calories to permit maximum use of the protein for synthesis should be provided.

DUMPING SYNDROME

Nature of the dumping syndrome. Following convalescence from gastric surgery a relatively high proportion of patients experience distressing symptoms about 10 to 15 minutes after eating. There is a sense of fullness in the epigastrium with weakness, nausea, pallor, sweating, and dizziness. The pulse rate increases and the patient seeks to obtain relief by lying down for a few minutes. Vomiting and diarrhea are infrequently present. Failure to gain weight is commonly observed because the patient eats less food.

The explanation for the syndrome is, in part, as follows: When a high proportion of easily hydrolyzed carbohydrate is introduced into the small intestine, a hyperosmolar mixture is produced. This is made isotonic by the withdrawal of water from the blood into the intestine. The withdrawal of fluid from the blood leads to a reduction in the blood volume and blood pressure, and signs of cardiac insufficiency appear—rapid pulse rate, weakness, and sweating. The presence of large amounts of fluid in the intestine leads to the feeling of fullness.

Modification of the diet. A number of dietary regimens developed in recent years to alleviate the symptoms of the dumping syndrome emphasize the following: (1) avoidance of sugar and concentrated forms of carbohydrate, (2) liberal protein, (3) small frequent feedings, and (4) dry meals with fluids taken only between meals.

A follow-up study of patients using the regimen described by Pittman and Robinson in 1958[11,12] has shown that those who adhered to the diet had no marked nutritional deficiencies and had, for the most part, achieved satisfac-

tory weight status. A number of patients found they could tolerate buttermilk, evaporated milk, nonfat dry milk, and simmered or boiled milk in modest quantities when taken between meals. Routine II described below was found to be the most satisfactory on a long-term basis. The authors emphasize the importance of stabilization upon a given routine before attempting to liberalize the regimen.

HIGH-PROTEIN, HIGH-FAT, LOW-CARBOHYDRATE DIET*

Characteristics and general rules:

1. Three routines are employed, with progression from one to another as the patient's condition warrants. The composition of the three routines is approximately:

	ROUTINE I	ROUTINE II	ROUTINE III
Carbohydrate, gm	0	100	100
Protein, gm	115	150	150
Fat, gm	170	225	225
Calories	2000	3000	3000
Calorie ratio:			
Carbohydrate	0	1	1
Fat	5	5	5
Protein	1.5	1.5	1.5

2. Multiple vitamin supplements are prescribed; iron may be necessary.
3. Six small dry meals are given daily; meals must be eaten regularly without omissions.
4. Liquids are taken 30 to 45 minutes after meals.
5. Carbohydrate foods are severely restricted. Those allowed must be measured accurately.
6. Liberal portions of meat are used; 1 pat margarine or butter should be eaten with each ounce of meat.
7. Foods to avoid include: milk, ice cream and other frozen desserts; sugars, sweets, candy, syrup, chocolate; gravies and rich sauces.
8. Rest before meals, eating slowly and chewing well, and relaxation are essential.

Foods allowed for three routines:

ROUTINE I.

Meat, fish, poultry—all kinds: broiled, baked, poached, stewed, grilled. Luncheon meats without cereal filler

Eggs—2 to 3: poached, scrambled, coddled, shirrred, hard-cooked

Fats—1 pat margarine or butter per ounce meat; 2 to 3 strips crisp bacon

Beverages—never at meals, but 30 to 45 minutes *after* meals: small amounts of cool water, or coffee, tea, limeade or lemonade without sugar. Use artificial sweetener

Miscellaneous—salt; lemon or lime juice on fish, etc.

ROUTINE II. All foods of Routine I plus:

Bread—enriched day-old white, toast, zwieback, soda crackers, Melba toast. Only 1 slice with each feeding

Bread substitutes—fresh Lima beans, sweet corn, cooked dried beans and

* Adapted from: Pittman, A. C., and Robinson, F. W.: "Dumping Syndrome—Control by Diet," *J. Am. Dietet. A.*, 34:596, 1958.

ROUTINE II. (*Cont.*)

peas, saltines, soda crackers, grits, noodles, macaroni, rice, spaghetti, parsnips, boiled potato, mashed potato, sweet potato. See Table A-4, Bread List, for equivalents

Cereals—thick, cooked. Only 1 serving

Fats—1 ounce whipping cream; cream cheese

Nuts, when tolerated—plain or salted; chew thoroughly

Vegetables—all kinds. Not more than one serving per meal

Miscellaneous—olives, pimiento

ROUTINE III. All foods of Routines I and II plus:

Fruits, fresh, canned, or frozen: *no sugar*. Drained of all liquid. Fruit juices may be taken only 30 to 40 minutes after meals.

Sample menu plans for patients with dumping syndrome

ROUTINE I	ROUTINE II	ROUTINE III
MORNING		
2 eggs with 2–3 pats margarine or butter (or more) 2 or more strips crisp bacon	2 scrambled eggs with 3 pats margarine or butter 2 slices crisp bacon 1 average slice bread 1 pat margarine or butter	2 scrambled eggs with 3 pats margarine or butter 2 strips crisp bacon ½ slice bread 1 pat margarine or butter ½ cup orange sections (no liquid)
MIDMORNING		
3 oz meat with 3 pats margarine or butter, if possible	2 oz meat with 1 pat margarine or butter 2 thin slices of bread for sandwich	2 oz meat with 1 pat margarine or butter 2 thin slices bread for sandwich
NOON		
2 beef patties or hamburger, steak, chops, roast with 3 pats margarine or butter (or more)	4 oz chicken with 2 pats margarine or butter ½ cup string beans with 1 pat margarine or butter 1 slice bread with 2 pats margarine or butter	4 oz chicken with 3 pats margarine or butter ½ cup string beans with 1 pat margarine or butter ½ slice bread with 1 pat margarine or butter ½ small banana
MIDAFTERNOON		
Meat or eggs with 3 pats margarine or butter	2 oz meat or 4 tbsp peanut butter with 1 pat margarine or butter 2 thin slices bread for sandwich	2 oz meat or 4 tbsp peanut butter 1 pat margarine or butter 2 thin slices bread for sandwich

ROUTINE I	ROUTINE II	ROUTINE III
EVENING		
Same as at noon	4 oz broiled fish with 2 pats margarine or butter Asparagus tips with 1 pat margarine or butter 1 average slice bread 1 pat margarine or butter	4 oz broiled fish with 3 pats margarine or butter Asparagus tips with 1 pat margarine or butter ½ slice bread ½ cup applesauce
BEDTIME		
Same as midafternoon	Same as midafternoon	Same as midafternoon

PROBLEMS AND REVIEW

1. List a number of symptoms and laboratory findings that suggest need for specific attention to dietary management prior to surgery.
2. Which nutrients are especially important in wound healing?
3. Why is a high carbohydrate intake advantageous prior to surgery?
4. List six high-protein beverages which could be used to reinforce the protein intake of a patient prior to surgery.
5. *Problem.* Study the charts of six postoperative patients and prepare a chart showing the following: nature of the surgery; orders for parenteral fluids; orders for diet. Indicate the length of time each diet was used, and explain the variations which were found.
6. *Problem.* Prepart a list of parenteral feedings used in your hospital and enumerate the chief nutritive contributions made by each.
7. What fluids would you emphasize if an order was given for increased potassium intake?
8. What is meant by a blenderized feeding? Why is such a feeding preferred to formula feeding?
9. If diarrhea occurs in a patient who is receiving a tube feeding, what adjustments might correct the problem?
10. Prepart a report of the management of diet for a patient with a gastrostomy, an ileostomy, or a colostomy.
11. What is meant by the dumping syndrome? What dietary modifications are required for patients with this condition? Explain the rationale for each change.

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UNIT X

Diet in Disturbances of the Gastrointestinal Tract

35 DIET IN DISEASES OF THE STOMACH AND DUODENUM
Bland Fiber-Restricted Diet in Three Stages

36 DIET IN DISTURBANCES OF THE SMALL INTESTINE AND COLON
High-Fiber Diet; Wheat-, Oat-, and Rye-Free Diet

37 DIET IN DISTURBANCES OF THE LIVER AND GALLBLADDER
High-Protein, Moderate-Fat, High-Carbohydrate Diet; Low-Fat Diets

Chapter 35

DIET IN DISEASES OF THE STOMACH AND DUODENUM: BLAND FIBER-RESTRICTED DIET IN THREE STAGES

Modified diets are prescribed for many functional and organic disorders of the gastrointestinal tract. Functional disturbances present no pathologic lesions and are frequently caused by errors in diet or neuroses. Pathologic lesions are present in the organic diseases such as ulcers and carcinoma. Modifications in secretory and motor activity are characteristic of both types of gastrointestinal disorders. Many factors are believed to influence the rate of secretion and the motility of the tract, although not all have been fully proven. (See Table 35–1.)

Changes in secretion and motility. An examination of the contents of the stomach under specified test conditions will reveal the extent of gastric secretion and the emptying time of the stomach.

MEASUREMENT OF GASTRIC ACIDITY. The procedure for measuring gastric acidity is outlined in the following paragraph.

In the morning before the patient has received food a tube is passed into the stomach by way of the nose or pharynx so that the contents of the stomach may be withdrawn and examined. The test meal is then given, and a stomach tube inserted again. The tube is left in place and specimens of the stomach contents are obtained at stated intervals, usually at 15-minute intervals for about 2 hours. A single specimen taken at 45 minutes following the test meal is often used in place of the fractional method. The gastric contents are measured and examined for free and total acid, for the presence of bile, mucus, pus, and blood.

Gastric analysis is often accomplished without giving a "test" meal, although a variety of so-called meals may be given. The *Ewald* meal, one of the most widely used, produces only a mild stimulation to the mucosal cells of the stomach and consists of

1 shredded wheat biscuit or 4 large soda crackers or arrowroot cookies
1½ cups water or weak tea; no cream or sugar

When hypochlorhydria is suspected, a meal which is more stimulating to the mucosal cells is given. The *Riegel* meal, for example, consists of 200 ml broth,

Table 35–1. Factors that Modify Acid Secretion and Gastrointestinal Motility and Tone

Increased Flow of Acid and Enzyme Production	Decreased Flow of Acid and Enzyme Production
1. Chemical stimulation—meat extractives, seasonings, spices, alcohol, acid foods	1. Large amounts of fat, especially as fried foods, pastries, nuts, etc.
2. Attractive, appetizing, well-liked foods	2. Large meals
3. State of happiness and contentment	3. Poor mastication of food
4. Pleasant surroundings for meals	4. Foods of poor appearance, flavor, or texture
	5. Foods acutely disliked
	6. Worry, anger, fear, pain*
Increased Tone and Motility	**Decreased Tone and Motility**
1. Warm foods	1. Cold foods
2. Liquid and soft foods	2. Dry, solid foods
3. Fibrous foods, as in certain fruits and vegetables	3. Low-fiber foods
4. High-carbohydrate low-fat intake	4. High-fat intake, especially as fried foods, pastries, etc.
5. Seasonings; concentrated sweets	5. Vitamin-B-complex deficiency, especially thiamine
6. Fear, anger, worry, nervous tension	6. Sedentary habits
	7. Fatigue
	8. Worry, anger, fear, pain

* In certain individuals these emotional disturbances may stimulate the flow of gastric juice.

150 to 200 gm broiled steak (well masticated), and 100 gm mashed potato. Histamine, a powerful stimulant to gastric secretion, is sometimes injected when other tests show a low output of acid or the absence of acid; thus, it helps to differentiate between a true and false achlorhydria.

Analyses of the gastric contents are of diagnostic value only as interpreted in the light of other findings. Many normal persons show a wide range of acid secretion.

Hyperchlorhydria means a secretion of acid in excess of normal and is often accompanied by gastric distress. Of the total acid secreted by the stomach, some combines with protein while that which remains uncombined is known as "free" hydrochloric acid. There is a great variation in the amount of acid secreted under various conditions and in different people. Many people continually secrete more gastric juice than normal and never experience any discomfort. Hyperchlorhydria may be associated with emotional or nervous upsets, or it may accompany organic disease such as peptic ulcer or cholecystitis.

Hypochlorhydria denotes a diminished amount of free acid, while in achlorhydria there is no free acid present whatsoever, although there is some peptic activity. *Achylia gastrica* refers to the absence of both free and combined acid and of enzyme activity. Hypochlorhydria may be present indefinitely in perfectly healthy people. However, when a physician finds this

condition he always tries to determine its cause, since it also accompanies diseases such as pernicious anemia and is a common finding in sprue, chronic gastritis, and pellagra. More occasionally, it also occurs in cancer, nephritis, cholecystitis, and diabetes.

MEASUREMENT OF MOTILITY. Twelve hours preceding the examination the patient is given a *motor* meal consisting of such items as rice and raisins, a meat sandwich and raisins, or stewed prunes. The fiber of these foods is readily recognized in the gastric contents of the morning of examination if there is decreased motility.

X-ray and fluoroscopic examination may be used to determine the emptying time and motility of the intestinal tract, and to locate the site of the disturbance. Prior to such study, the patient is given a *barium* or *bismuth* meal which consists of a pint of buttermilk or malted milk into which a measured amount of bismuth or barium chloride has been mixed. This feeding enables the technician to "visualize" the progress along the intestinal tract.

Gastric atony is characterized by lack of normal tone of the muscles of the stomach. The contractions are not of sufficient strength to move the food mass out of the organ at a normal rate. Larger pieces or fragments of food are not adequately disintegrated and mixed with the stomach juices.

Hyperperistalsis refers to an increased action of the musculature of the stomach and intestines. It may be brought about by excessive amounts of fibrous foods, psychologic factors such as worry or fear, or nervous stimulation.

GENERAL DIETARY CONSIDERATIONS IN DISEASES OF THE GASTROINTESTINAL TRACT

Factors in dietary management. Consideration should be given to the possible effects of the ingested food upon (1) the motility of the tract; (2) the secretory activity of the stomach, small intestine, pancreas, liver, and gallbladder; (3) the bacterial flora of the tract; (4) the comfort and ease of digestion; and (5) the maintenance and repair of the mucosal structures. Moreover, the disorder, in many instances, interferes with the completeness of digestion or the absorption of one or more nutrients so that the nutrient intake must be modified in order to meet the net requirements of the body. Diets are prescribed for such varying conditions as peptic ulcer, gastritis, diarrhea, constipation, malabsorption because of inadequate enzyme production or because of sensitivity, cirrhosis of the liver, cholecystitis, and many others.

No modified diets have been subject to more controversy than those for disturbances of the gastrointestinal tract. The foods used in diets for such conditions are often characterized as bland, nonirritating, smooth, low-fiber, nonstimulating; those contraindicated are likely to be considered as distending, gaseous, indigestible, stimulating, and so on. Traditional and liberal regimens

will be described briefly in the sections which follow, together with a discussion of the validity of some of the characteristics listed above.

Traditional diets. In 1915 Sippy[1] introduced a progressive regimen based upon small hourly milk and cream feedings which was remarkably successful in the treatment of peptic ulcers. The diet was increased in stepwise fashion over several weeks, with the first additions including eggs, refined cereals, and white toast. Gradually, puréed fruits and vegetables and ground meats were introduced. The patient was given antacid therapy between feedings so that stomach contents were continuously neutralized. The benefits of the diet were attributed by clinicians to the neutralizing effect of milk, the suppression of gastric secretion in the presence of fats, and the soothing effect of milk and cream upon the surface of the ulcer. Such assumptions have not been established by research.

Numerous modifications of the Sippy regimen have been developed since the diet was first described. These have applied not only to the management of peptic ulcer, but also to other disorders of the gastrointestinal tract. Generally speaking, the diets were described as *bland,* although sometimes the disease name or a physician's name was used in the nomenclature. The selection of foods was limited to items believed to be mechanically, chemically, and thermally nonirritating, and included milk and cream, breads and cereals, eggs, mild cheeses, cooked pureed fruits and vegetables, and ground meat usually introduced at a later stage. Any items believed to stimulate the flow of gastric juice, or to produce mechanical irritation to the lesion in the stomach, duodenum, or intestine were contraindicated: strongly flavored vegetables, highly seasoned foods, meat extractives, fried foods, and so on.

The traditional regimens have been criticized for several reasons. First, puréed fruits and vegetables and ground meats which lack seasonings are so unappetizing in appearance and flavor that patients often refuse to eat them, thus failing to receive the nutritional benefits from these foods. Second, early stages of diet as used for peptic ulcer, in addition to being exceedingly monotonous, usually failed to provide adequate levels of the very nutrients most urgently needed for wound healing and well being of the patient—namely, protein, ascorbic acid, and iron. Finally, at least some clinicians in recent years have favored the theory that the excessive use of milk and cream feedings leads to elevation of the blood lipids, more rapid blood clotting time, and increased tendency to thrombosis.

Trends to more liberal diets. One of the first to use a somewhat more liberal approach to dietary management was Meulengracht[2,3] who prescribed for patients with bleeding ulcers small two-hourly feedings of foods, most of which were puréed, but which also included tender meats from the beginning of treatment. Today, many clinicians subscribe to diets which are essentially normal in fiber and flavor.

A joint committee of the American Dietetic Association and the Council on Foods and Nutrition of the American Medical Association has reviewed

the rationale for diet in gastrointestinal diseases.[4] They pointed out that many of the dietary recommendations used over the years were not based on the results of objective research, nor were they consistent with what is known of gastrointestinal function and the fate of foods within the tract. They especially emphasized the need for further investigation. Experiments have often been conducted only on animals which have been given large amounts of a single food. That the effects on humans consuming mixed diets containing the food in question might be quite different is often forgotten. In view of the paucity of information on many points of food selection, they did not recommend that all traditional diets be abandoned, but rather that more searching take place for a sound rationale of diet. A flexible rather than rigid, often ritualistic, approach to management is encouraged.

The influence of foods on gastric acidity. Most foods have a pH between 5 and 7, even orange juice being less acid than gastric juice. No food is sufficiently acid to have any adverse effect on a gastric lesion, although citrus juices and fruits might cause some discomfort to a lesion of the mouth, or esophagus, or the achlorhydric stomach.[4]

Gastric secretion is initiated by the sight, smell, and taste of food. As food enters the stomach, the secretion continues and reaches its height sometime later. Protein foods provoke a greater secretion of acid than do carbohydrates and fats.

Protein foods are effective buffers, and hence there is less free acid to erode the lesion when protein is fed. Milk has some buffering effect, but other protein foods appear to be more effective. Admittedly, most patients with peptic ulcer have progressed well on diets in which milk feedings were used for their neutralizing effect. Regardless of buffering activity, the effect is only temporary, and within ½ to 2 hours following a meal the amount of free acid again is high. No diet alone will maintain a 24-hour neutralization of gastric contents.

Fats have an inhibitory effect on gastric secretion. The entrance of fats into the duodenum stimulates the production of enterogastrone, a hormone, which in turn retards gastric secretion and likewise reduces gastric motility. No evidence supports the superiority of cream over other fats in this regard.

Caffeine and alcohol are well known for their effect in stimulating the flow of acid. Spices are commonly mentioned in this respect, but the experimental evidence on humans does not support this. Schneider and his associates[5] tested the possible irritant effects of many spices and herbs on patients with active and healing ulcers. They noted subjective reactions of the patients and made gastroscopic observations of the gastric mucosa. The patient's reactions, the rate of healing of the ulcer, and the appearance of the mucosa were not altered by allspice, caraway seeds, cinnamon, mace, paprika, thyme, or sage when given with foods. Slight reddening of the mucosa and some symptoms of gastric discomfort were noted with chili powder, cloves, mustard seeds, nutmeg, and black pepper. The elimination of most spices in favor of foods very bland in flavor therefore seems unnecessary.

nervous factors in turn may lead to hypersecretion and hypermotility of the stomach. Individuals of a nervous temperament not only develop ulcers in the first place but are likely to have flare-ups when undergoing strong emotional stress, even after the ulcer has healed. The fact that peptic ulcer has its greatest incidence between 20 and 40 years of age suggests an important link between the stresses of life and the occurrence of the ulcer.

The nervous control of the vascular system in the gastric or duodenal walls may be so disturbed that there is a diminution in the blood supply to the mucosa of the stomach and duodenum. The acid of the stomach brings about erosion and eventually ulceration.

Symptoms and clinical findings. The diagnosis of peptic ulcer is based upon the patient's symptoms, the results of gastric analysis, gastroscopy, and x-rays. Most patients with ulcers present the following signs.

1. Gastric tone is increased, with deep hunger contractions occurring when the stomach is empty. Characteristic gnawing pains make their appearance 2 or 3 hours after meals or in the middle of the night. Relief is usually prompt when one takes food or alkalies.

2. The presence of unneutralized acid and hypermotility is believed to be responsible for the pain. The volume and concentration of hydrochloric acid are usually increased in duodenal ulcer, but may be normal in gastric ulcer.

3. Distention follows ingestion of quantities of fluid or solid food in the majority of patients.

Various deficiency manifestations are often encountered. Gastrointestinal diseases are second only to a faulty food intake as a cause of protein deficiency.[9] The patient very often has a moderately low, and at times a very low, serum protein level. In addition to the usual implications of protein deficiency (see Chapter 31), such low levels of protein are incompatible with rapid healing of the ulcer. Even when healing does occur, the ulcer breaks open with the least irritation.

Loss of weight and iron-deficiency anemia are common. The intake of thiamine, niacin, and ascorbic acid tends to be low when vegetables have been restricted for a long time.

In some patients the first indication of an ulcer may be hemorrhage. In other patients the ulcer may erode through (perforate) the gastrointestinal wall, thus necessitating immediate surgery. The possibility that the lesion is malignant must always be kept in mind when the ulcer occurs in the stomach. X-ray and the rate of response to healing by conservative measures are important in differentiating between benign and malignant lesions.

Rationale for treatment. Treatment of the patient rather than the ulcer is the keystone to success. Especially important is consideration of good physical and mental hygiene. Improvement may be rapid if the patient can be relieved of worry, anxiety, or other factors which create nervous tension. On the other hand, the failure to help the patient in dealing constructively with his day-to-day problems may nullify the beneficial effects which might be expected from

the dietary program. Many patients require complete bed rest for a time. Others can be satisfactorily treated while continuing light employment.

Antacids are prescribed to aid in neutralizing the gastric contents; *anticholinergic* drugs reduce the secretion of gastric juice; and *antispasmodics* reduce gastrointestinal activity.

Modification of the diet. Nutritive adequacy of the diet, frequent small feedings, and a pleasant environment for enjoyment of meals are factors of dietary management on which there is general agreement. The selection of specific foods to meet these needs is the point on which clinicians often disagree.

ADEQUACY OF DIET. Many patients with peptic ulcer require a diet which provides levels of nutrients above the Recommended Dietary Allowances in order to correct nutritional deficiencies which have resulted from the preceding weeks or months of faulty diet, and to provide the nutrients essential for rapid healing of the lesions—especially protein and ascorbic acid. No diet should be employed for any length of time if it fails to provide the full nutritive needs of the patient, for this is far more damaging than is a diet which includes foods so commonly omitted.

MEAL INTERVALS. The presence of food in the stomach reduces the corrosive action of the acid. Although protein foods stimulate acid production to a greater degree than some other foods, they are also more effective in buffering the acid. This effect is only temporary, however, and therefore frequent feedings are essential. Feedings at two-hour intervals are often used initially, although six feedings a day suffice for most patients. One of the important aspects of diet for these patients is establishing a pattern of regularity, since many patients may previously have had highly irregular meal schedules.

SIZE OF FEEDINGS. At any given time the feedings should be small, but the 24-hour intake should satisfy the recommended allowances for nutrients. Initially, 6 to 8 cunces may be given, or even less, but most patients can begin therapy with 10 to 12 ounces of food.

PROGRESSION OF DIET. Since many patients have had poor food habits in the past, much is often gained by setting up a progression for diet such as the one outlined below. Other equally satisfactory stages could be set up, keeping in mind that the emphasis is upon the liberalization of choice of foods rather than upon foods to be avoided. Much latitude is allowed for patient's likes and dislikes, and for the omission of foods which give either real or imagined distress to the patient.

BLAND FIBER-RESTRICTED DIET IN THREE STAGES

Characteristics and general rules:

The stages of diet are set up for gradual progression in quantity of food eaten at a meal, in fiber content, and in selection of foods.

The selection of foods includes those mild in flavor, and which infrequently bring forth complaints of intolerance. The lists should not be considered as restrictive, inasmuch as food tolerance is a highly individual matter. Additions or subtractions should be made according to individual need.

For patients with peptic ulcer, frequent feedings are essential. The six-meal sample menus listed below could be rearranged for two-hourly feedings of smaller size, if the physician believes this to be necessary.

FOOD SELECTION FOR THREE STAGES OF DIET

STAGES I AND II	STAGE III
	All foods of Stages I and II plus the following:
Beverages—milk and fruit juices	*Beverages*—decaffeinated coffee; 1 cup regular coffee with half milk, if desired; weak tea
Breads—enriched white bread or toast; saltines; soda crackers; Melba toast; zwieback	*Breads*—rye without seeds; fine whole-wheat
Cereals—corn flakes, corn meal, farina, hominy grits, oatmeal, Puffed Rice, rice flakes; macaroni, noodles, rice, spaghetti	*Cereals*—all except coarse bran
Cheese—mild American in sauces; cream; cottage	*Cheeses*—all
Desserts—plain cake and cookies; custard; fruit whip; gelatin; plain ice cream; bread, cornstarch, rice, or tapioca puddings without raisins or nuts	
Eggs—any way except fried	*Eggs*—including fried
Fats—butter, cream, margarine, smooth peanut butter, cooking fat, vegetable oils	*Fats*—mayonnaise and salad dressings
Fruits—fruit juices; avocado, banana, grapefruit and orange sections; baked apple without skin, applesauce; canned apricots, cherries, peaches, pears	*Fruits*—raw apple, cherries, peaches, pears, plums; stewed apricots and prunes
Meat—tender or ground. Baked, broiled, creamed, roasted, stewed: beef, chicken, fish, lamb, liver, pork, sweetbreads, turkey, veal	
Milk—in all forms	
Seasonings—salt, sugar, flavoring extracts	*Seasonings*—allspice, cinnamon, mace, paprika, sage, thyme
Soups—cream	*Soups*—fish chowders
Vegetables—cooked; asparagus tips, green and wax beans, beets, carrots, white potato, winter squash, spinach, sweet potato	*Vegetables*—lettuce and other tender salad greens; celery; tomatoes; any others as tolerated

MEAL PATTERNS FOR STAGES I AND II

	STAGE I (10–12 oz per meal)	STAGE II (approximately 12–16 ounces)
On awaking	Milk—8 oz	Milk—8 oz
Breakfast	Cereal—4 oz Milk—4 oz Sugar Egg—1 White toast—1 slice Butter	Cooked or dry cereal Milk Sugar Egg Enriched toast Butter Fruit juice or fruit
Midmorning	Milk beverage—8 oz Crackers, custard, plain pudding, gelatin—3 oz	Milk beverage—8 oz Crackers, custard, plain pudding, gelatin
Luncheon	Cream soup—4 oz Crackers—2 Egg—1; or mild cheese—1 oz; or tender meat—1 oz White bread or toast—1 slice Butter Dessert—3 to 4 oz Citrus juice—3 oz	Cream soup Crackers Meat, fish, poultry, eggs, or cheese—2 to 3 ounces Potato or substitute White bread or toast Butter Dessert Fruit Milk
Midafternoon	Milk beverage—8 oz Crackers, custard, plain pudding, gelatin—3 oz	Milk beverage or small meat sandwich Plain dessert
Dinner	Egg, soft cheese, or tender meat—1 oz Potato or substitute—3 oz Toast or bread—1 slice Butter Fruit—3 oz Milk or cream soup—4 oz	Meat, fish, poultry, eggs, or cheese—3 ounces Potato or substitute Cooked vegetable Bread or roll Butter Fruit or dessert Milk
Evening	Milk beverage—8 oz Crackers or dessert—3 oz	Milk beverage or small meat sandwich Crackers or plain dessert

A TYPICAL DAY'S MENU FOR STAGE III

BREAKFAST
Stewed apricots
Oatmeal with milk and sugar
Soft-cooked egg
Enriched toast with butter
Coffee with half milk—1 cup

MIDMORNING
Milk—8 oz
Saltines—4

LUNCHEON
Cream of asparagus soup
Baked rice with cheese
Buttered peas
Lettuce and sliced tomatoes with mayonnaise
Rye bread and butter
Vanilla ice cream
Milk

MIDAFTERNOON
Chicken sandwich
Jello

DINNER
Broiled lamb chop
Mashed potato
Diced buttered beets
Dinner roll with butter
Sliced peaches (fresh, frozen, or canned)
Milk

EVENING NOURISHMENT
Malted milk
Sugar cookies

Modification of diet in bleeding ulcer. The use of food in the treatment of bleeding ulcers is based on the principle of reducing the number and violence of stomach contractions by providing small, frequent feedings of easily digested foods. The gastric juice is given something other than the ulcer on which to act, thus permitting a clot to form.

Just how soon food may be given cannot be exactly stated. If the patient complains of nausea, or is vomiting, nothing can be gained by immediate feeding; but if the patient has a desire for food and has no gastric distress, he may benefit from prompt feeding.

Meulengracht[2] and others[3] have reported a marked reduction in mortality when patients were fed promptly at 2-hour intervals with milk, eggs, pureed fruits and vegetables, bread and butter, and pudding. After the first 2 days, ground meats are allowed.

Stage I of the diets described above may be used initially, with feedings at two-hour intervals. With improvement the patient progresses gradually to stages II and III.

Dietary counseling. Regardless of the regimen prescribed, careful counseling of the patient is essential. The emphasis should be placed on foods which may be used rather than on foods to avoid. A consideration of the patient's cultural pattern in planning the diet to be followed at home will help to ensure adherence to a desirable diet.

While a rigid diet which does not consider individual likes will not be followed fo any length of time, there is, on the other hand, value in recommend-

ing dietary discipline with respect to nutritive adequacy, regularity of mealtimes, frequent feedings, and moderation in the amounts of food eaten.

Emphasis must always be given to the importance of eating meals in a pleasant environment with a calm, happy frame of mind. Rest before and after meals—even a few minutes—is conducive to greater enjoyment of meals. Foods should be properly chewed and eaten slowly, rather than with haste. Family problems or any irritating subjects should not be discussed at mealtime.

Ulcers have a tendency to flare up even after complete healing has taken place. Alvarez[10] has emphasized the importance of prompt and strenuous treatment after psychic strain in order to avoid flare-ups. The stomach tends to be empty of food but full of highly acid gastric juice from 10 P.M. to 3 A.M. and it is likely that this is the period when the greater part of the injury to the gastric and duodenal mucosa occurs. Following any emotional strain such as grief or worry it is advisable to partake of food every 2 hours from dinnertime until 2 or 3 o'clock in the morning.

INDIGESTION

Nausea, regurgitation, heartburn, abdominal pain, a feeling of fullness and distention, and flatulence are frequent complaints by many people. These symptoms may occur in organic disorders or they may be related to dietary errors.

Indigestion is of neurogenic origin in a large proportion of patients, many of whom are subject to the whims of faddism. Others have permitted themselves to fall into poor food habits. Each patient must be counseled individually so that the dietary regimen corrects the preceding errors. If the disorder is of functional origin, a normal nutritionally adequate diet is ordered. Patients need specific instructions on the characteristics of the normal diet, with emphasis being placed upon the following: choice of foods from all food groups, rather than overemphasis upon a specific food or omission of another; a regular schedule of meal hours; adequate time to eat meals; rest after meals; and avoidance of emotionally upsetting situations.

GASTRITIS

Gastritis is an acute or chronic inflammation of the mucous membrane of the stomach.

Acute gastritis. This condition may be caused by the ingestion of poisons such as strong alkali, acid, or drugs, alcohol, or dietary excesses. When it occurs, the stomach should be freed of the offending substance as soon as possible by lavage or by induced vomiting. No food is given for 1 or 2 days in order to permit adequate rest for the stomach. Even water is restricted to small

amounts of hot water, or bits of cracked ice. After 24 to 48 hou be started by giving teaspoonful amounts of foods allowed on a fu every half hour as tolerated (p. 446). Foods are increased in amo variety very gradually until the patient is able to take a full soft diet. latter may need to be continued for a week or more.

Chronic gastritis. Like acute gastritis, chronic gastritis may be the result of toxic drugs, excessive alcohol, or dietary errors such as overeating, rapid eating, large amounts of fibrous foods, or highly seasoned foods. It may also accompany such disorders as carcinoma, ulcers, cirrhosis, nephritis, myocardial failure, and tuberculosis, to mention but a few. The usual symptoms include poor appetite, distention, gastric distress, and hypoacidity, although hyperacidity occasionally is found.

The dietary management in gastritis is directed toward relieving the underlying symptoms. Usually, small frequent feedings selected from stage I (see p. 530) may be initiated with progression to larger feedings and wider choice of foods as the patient's tolerance permits. If hypoacidity prevails, some restriction of fats may be indicated to avoid excessive reduction in motility.

CANCER OF THE STOMACH

If a diagnosis of cancer is made early enough, surgery may lead to complete cure. Unfortunately, symptoms such as poor appetite, indigestion, fatigue, nausea, vomiting, and weight loss which bring the patient to the doctor may not appear until the cancer is moderately far advanced. Moreover, these symptoms are common to many disorders, and a positive diagnosis can be established only with x-ray, and sometimes surgical exploration is necessary.

Modification of the diet. Following gastrectomy the postoperative regimen (see p. 512) should be used. Meals, of necessity, must be small and easily digested. A certain proportion of patients may have the dumping syndrome following surgery and should be given the diet recommended on page 515.

When operation is inadvisable for one reason or another, the prime consideration is the comfort of the patient. Anorexia is such a common finding that every effort should be made to comply with the patient's inclinations. In general, the diet should consist of soft, low-fiber foods given in small frequent feedings. Since hypochlorhydria is usually present, fats are preferably kept at a minimum.

PROBLEMS AND REVIEW

1. List some of the nutritional disturbances which may develop when the stomach and intestinal tract are impaired.
2. Give examples of gastric disorders of functional origin; of those which are organic in nature.
3. Name at least five dietary factors which might lead to the development of indigestion.

[redacted]sses of foods are most likely to stimulate acid secretion? Which ones [redacted] secretion? Which are most effective in the neutralization of acid? Which [redacted] likely to increase motility of the gastrointestinal tract?

[redacted]he use of each of the following illustrates a principle in the dietary treatment of [redacted]tic ulcer. Identify the principles involved for each:

a. milk and cream
b. orange juice at the end of the meal, but not between meals
c. tender meat, fish, poultry
d. feedings at 2-hour intervals
e. omission of coffee and tea

6. *Problem.* Plan a diet for a man with a healed peptic ulcer who works from 7 A.M. to 3 P.M. in a factory. It is necessary for him to carry his meals to work. Show the hours at which he should plan to eat.

7. *Problem.* List five food combinations which would be suitable for between-meal feedings for an individual who must carry meals to work.

8. What possible role may diet play in causing or relieving the emotional stress to which some patients with peptic ulcer may be subjected?

9. It is sometimes said: "Once an ulcer; always an ulcer." What prophylactic measures can be taken to avoid recurrence?

10. What objections can you see to nomenclature such as this: progressive ulcer diet; ambulatory ulcer diet?

11. Compare the traditional and liberal approaches to dietary management of diseases of the gastrointestinal tract. On which characteristics is there essential agreement? How would you characterize the regimens used in the hospital with which you are associated?

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Chapter 36

DIET IN DISTURBANCES OF THE SMALL INTESTINE AND COLON
High-Fiber Diet, Wheat-, Oat-, and Rye-Free Diet

DIARRHEA

Classification. Diarrhea is a morbid frequency of bowel evacuation, the stools being fluid in nature. It may be acute or chronic in character. Diarrhea is only a symptom and may be classified as functional or organic in origin.

Functional diarrheas may occur in numerous situations, for example, as the result of an irritant to the normal individual; excessive putrefaction or fermentation in the tract through alteration of the bacterial flora; a sensitivity to a specific food substance; nutritional deficiency as in pellagra; in association with achlorhydria; as a result of metabolic imbalance as in burns or uremia; as a manifestation of emotional instability, and many others.

Organic diarrhea may be caused by bacteria as in bacillary dysentery or typhoid fever, protozoa as in amebic dysentery, and poisons. Likewise, diarrhea is a manifestation of malabsorption lesions which have been classified in three groups by Gardner:[1] (1) anatomical, as in gastric resection or diverticula; (2) mucosal, as in childhood or adult celiac disease; and (3) enzymatic, as in pancreatic deficiency.

Nutritional considerations in diarrheas. Because of their chronic nature, organic diarrheas often present serious problems in the maintenance of satisfactory nutrition. Some of them are discussed in the following paragraphs.

FLUIDS. Large amounts of fluid may be lost, and a liberal intake is therefore essential. Such losses may be serious even for an acute diarrhea in an infant or in a debilitated elderly individual. In these situations parenteral fluids are often given.

ELECTROLYTES. Fluids in the bowel contain appreciable amounts of sodium and potassium in order to maintain normal tonicity. When large amounts of fluid are lost, the potassium losses may be especially serious. Potassium depletion may lead to loss of appetite, vomiting, a marked feeling of listlessness, and loss of muscular tone of the gastrointestinal tract. Foods which contain generous amounts of potassium such as fruit juices and broth should be included. (See Chapter 43.)

NUTRIENT MALABSORPTION. The absorption of all nutrients is reduced in diarrhea. Unless the protein intake is increased to 100 gm or more daily, the tissue proteins will become depleted and the blood proteins will be reduced with all the attendant problems of protein deficiency. Considerable amounts of fat are lost in such disorders as sprue and pancreatic deficiency. The calorie intake often needs to be maintained at 3000 or more.

Iron deficiency is a prominent finding in patients with chronic diarrhea owing to the increased losses of iron in the feces, the occasional blood losses, and the reduced intake of iron-rich foods because of fear that some foods may aggravate an existing lesion. Patients often show remarkable improvement when given supplemental iron therapy.

Vitamin deficiencies are frequent in chronic diarrheas, again being related to the decreased intake of vitamins and the increased requirements because of losses in the stools. When antibiotic therapy is used, a temporary reduction of synthesis of some B-complex vitamins also occurs. Vitamin B_{12}, folic acid, and niacin deficiencies have been observed in various diarrheas.

Modification of diet in acute diarrhea. Certainly the patient is more comfortable for the first 12 to 24 hours following an acute episode if his intake is restricted to an abundance of clear fluids together with some toast. Thereafter, the diet usually progresses to a soft or regular regimen.

REGIONAL ILEITIS

Symptoms and clinical findings. Regional ileitis (regional enteritis) is an inflammatory disease of the lower ileum, although other parts of the intestine may be involved. All structures of the intestinal wall are affected by edema, cellular infiltration, fibrosis, and ulcerations.

The patient usually complains of anorexia, abdominal cramps, fever, weight loss, and diarrhea. Anemia and other signs of malnutrition are common. The disease is characterized by exacerbations and remissions. Acute ileitis may subside, but in chronic ileitis the intestinal lumen becomes narrowed, inelastic, and may, on occasion, be obstructed so that surgical intervention is necessary.

Modification of the diet. Since malnutrition is a prominent feature, it is important that the patient eat well. The acutely ill patient may be given the Very Low-Residue Diet initially (see p. 508) followed by the High-Protein Diet (Chapter 31). Vitamin supplements are usually indicated.

DIVERTICULOSIS AND DIVERTICULITIS

Diverticulosis consists of the presence of diverticula or small, mucosal sacs which protrude from the intestinal lumen, usually the colon, through the bowel wall. Their presence does not produce symptoms until they become inflamed.

Diverticulitis is the inflammatory condition which is characterized by such symptoms as nausea, vomiting, fever, abdominal tenderness, distention, pain, and intestinal spasm. The inflammatory process may lead to intestinal obstruction or perforation, thus necessitating surgery.

During the acute episodes nothing except water and clear fluids is given by mouth. The Full Fluid Diet (p. 446) or Very Low-Residue Diet (p. 508) may then be used. Patients with chronic diverticulitis should continue to use a diet moderately restricted in fiber. The selection of foods for Bland Diets I–III (Chapter 35) is appropriate.

ULCERATIVE COLITIS

Symptoms and clinical findings. Ulcerative colitis is a chronic inflammatory condition in which the whole or part of the large intestine is involved. The exact cause is unknown, but infections are frequent. There appears to be a close correlation between the severity of the disease and the presence of psychogenic factors. Many of the patients are nervous, irritable, apprehensive, introspective, and emotionally unstable. Food allergy may account for the occurrence of the condition in some patients, with milk being an especially frequent offender.[2] Eggs, wheat, beef, coffee, fruit, and condiments have also been established as allergens in some.

The patient looks sick and is chronically ill. He has little appetite and has lost much weight. In fact, the poor appetite together with the persistent diarrhea may result in multiple deficiencies which constitute the major problem in treatment. The patient also complains of fever, mild to severe abdominal cramps, distention, flatulence, diarrhea which at times is severe, and the appearance of blood, pus, and mucus in the stools. The mucosa of the colon becomes hyperactive and fragile so that it bleeds easily; eventually it may ulcerate and perforate.

Modification of the diet. Customarily the diet is planned to supply sufficient nutrients to reinstate and maintain normal nutrition and to avoid injury to the colon. The following modifications are usually necessary.

PROTEIN. About 100 to 150 gm protein are essential to replace losses which have occurred. Meat, eggs, and milk should be provided in abundance. Sometimes patients do not seem to tolerate pasteurized whole milk in which case homogenized, boiled, skim, or evaporated milk may be substituted. Some patients tolerate milk and cheese in prepared dishes such as creamed vegetables, cream soups, and puddings. If none of these forms of milk can be used, the diet must provide especially liberal amounts of meat, fish, poultry, and eggs.

ENERGY. About 3000 calories or more are necessary to compensate for the loss of nutrients in the stool and the consequent great weight loss.

MINERALS. Anemia is a common finding in colitis so that supplements of

iron salts may be prescribed. Whenever milk is not tolerated, it is also necessary to prescribe calcium salts.

VITAMINS. Some of the deficiency symptoms seen in patients with ulcerative colitis are the result of poor dietary intake together with excessive gastrointestinal losses. When they occur, or whenever the diet itself is restricted, multivitamin supplements should be prescribed.

FIBER. The Very Low-Residue Diet (Chapter 34) may be used initially with gradual transition to a bland high-protein diet.

Management of the diet. No factor in treatment is more important than that of diet. It requires the continuous individualized attention of the dietitian and nurse. Wolf[3] believes that it is more important to help the patient to adjust to his day-to-day problems than to prescribe a severely restricted dietary regimen. Patients receiving consideration in their adjustment to life but using a normal diet improved to a greater degree than did those who were treated with the usual dietary regimen unaccompanied by psychologic assistance. Wolf states further that undue restriction may lead to malnutrition and to resentment, but he also recognizes that a carefully balanced diet associated with a "certain amount of ritual" may be psychologically advantageous for the overmeticulous patient.

The soft and regular high-protein diets described in Chapter 31 suggest typical meal patterns for these patients. Many patients have poor appetites so that individual consideration must be given to frequency of meals. For some, six feedings or more daily will be preferable, while others may have a more satisfactory intake with three meals and a bedtime feeding. The following meal pattern is characterized by its high-protein content and a moderate reduction in fiber content.

HIGH-PRO

ME	SAMPLE MENU
or seeds	Sliced bananas with milk
rained cereal	Cream of Wheat with cream and sugar
m and sugar for cereal	
2	Soft-cooked eggs—2
d toast with butter or margarine	Enriched toast with butter or margarine
age	Coffee with cream and sugar
LUNCHEON OR SUPPER	
Soup, clear or creamed	Strained cream of mushroom soup
Meat, fish, poultry, egg, or cheese—large serving	Broiled beef patties—2
Potato or substitute	Buttered noodles
Cooked vegetable	Julienne green beans

MEAL PATTERN (Cont.)	SAMPLE MENU (Cont.)
Enriched bread with butter or margarine	Enriched bread with butter or margarine
Fruit without fiber	Orange sections
	Sugar cookies
Milk	Milk
DINNER	
Citrus fruit or tomato juice	Tomato juice
Tender meat, fish, or poultry—4 oz	Baked breast of chicken
Potato without skin	Mashed potato with butter
Vegetable	Buttered carrots
Enriched bread with butter or margarine	Dinner roll with butter or margarine
Dessert	Tapioca cream
Milk	Milk
EVENING NOURISHMENT	
Enriched bread-meat, egg, or cheese sandwich	Sliced roast beef sandwich
Milk beverage	High-protein eggnog
Custard or pudding	Chocolate pudding

ATONIC CONSTIPATION

Constipation is the infrequent or difficult passage of feces. However, it cannot be exactly defined, for certain variations in the frequency of bowel movement and completeness of evacuation are entirely physiologic. Most people have a bowel movement daily, but for some individuals an evacuation every second or third day is entirely normal. The m[redacted]portant factor for well-being is the maintenance of elimination at re[redacted]according to the individual.

Constipation may be temporary because [redacted] illness, a change in habits of living, or nervous strain. [redacted] of living corrects such constipation without difficulty. O[redacted]ht be chronic with a change in the musculature of the intes[redacted] result from an organic disorder such as obstruction, tumor, [redacted] or it might be functional in nature. The determination of the caus[redacted] important so that appropriate treatment can be instituted. Attenti[redacted] may be beneficial in *atonic* and *spastic* constipation (see Irritable Co[redacted] consideration of other factors in the pattern of living is also essential.

Causes. The following paragraphs describe some of the most importa[redacted] functional causes of constipation.

1. Poor personal hygiene in which one neglects to respond to the urge for defecation, or fails to maintain regular habits of evacuation.

2. A diet containing too little fiber and consisting largely of concentrated and refined foods which leave little if any residue upon reaching the colon.

3. Irregular meals, too little rest and relaxation, and a hurried pattern of living.

4. Lack of exercise which leads to reduction in muscular tone of the intestine and inability to move the fecal mass into and along the colon at the normal rate.

5. Excessive and long-continued use of laxatives and enemas often resorted to by people who are unduly conscious about evacuation, with the result that in time the normal colon becomes irritated and sensitive.

6. Nervous disturbances of various sorts. Excitement developed by mental patients at times prevents the bowel from emptying itself for several days or more. Nervous contractions of the musculature may be caused by irritation and brought about by overstimulation.

Bed patients, invalids such as arthritics, the aged, and other sedentary individuals are most likely to be affected by atonic constipation. The intestinal walls lack muscle tone so that peristaltic action is impaired and the digestive wastes cannot move down the tract at a normal rate.

Treatment. In the correction of atonic constipation emphasis must be placed on good health habits; that is, a regular time for elimination, adequate rest and relaxation, exercise if possible, regular time for meals, adequate intake of fluids (8 to 10 glasses a day), and a diet providing a sufficient amount of fiber to stimulate the intestinal mucosa and to provide bulk to the intestinal contents.

The normal or house diet is suitable for the correction of atonic constipation. When the diet is planned to include the normal allowances of raw and cooked fruits and vegetables it will provide cellulose to equal or exceed the estimated requirement of 5 to 6 gm fiber per day. The fiber may be increased in the following ways without changing the diet from its normal pattern:

Use whole-grain cereals and breads instead of refined cereal foods.
Include one or two salads daily, emphasizing raw fruits and vegetables.
Eat whole fruits, including their skins, rather than peeling them or using juices only; for example, raw apple with skin, or orange with white membrane.
Use stewed fruits and juices such as stewed prunes, prune juice, apricots, figs.
Bran may be used occasionally. The possibility of excessive bran being irritating to the intestinal tract causing an obstruction must not be overlooked.

Patients are often helped by taking a glass or so of water, hot or cold, with or without lemon, according to their preference, before breakfast.

The physician may sometimes prescribe agar-agar, a type of seaweed that is not affected by intestinal enzymes and that absorbs water thus giving the necessary bulk. It may be given as a special preparation or it may be sprinkled dry on the cereal at breakfast. Mineral oil is also prescribed quite frequently, usually to be taken at bedtime. The excessive use of mineral oil or its use in conjunction with meals as in salad dressings is undesirable because of the interference with the absorption of the fat-soluble vitamins.

IRRITABLE COLON

Irritable colon refers to abnormal motor activity of the colon in the absence of organic lesions and is characterized by abdominal distress and constipation or diarrhea. It is known by a variety of terms:[4] spastic, mucous, or cathartic colitis; functional, spastic, or unhappy colon; gastric or intestinal neurosis. This condition probably accounts for 50 to 70 per cent of all gastrointestinal complaints.

Etiology. Many factors contribute to this functional abnormality, among them the excessive use of laxatives and cathartics; excessive amounts of coffee and coarse, fibrous, or laxative foods; antibiotic therapy; enteric infections; and poor hygiene with respect to sleep, work, fluid intake, and evacuation.[4] Emotional upsets are a frequent cause of this disturbance. It is well known that sudden fear will produce hypermotility, cramping, and diarrhea in many persons, but these symptoms disappear promptly. Some people, however, who have never learned to deal with the normal anxieties and frustrations of life, and others who may have tensions over many years are especially sensitive to gastrointestinal neurosis.

Symptoms and clinical findings. The patient may complain of belching, heartburn, a sense of fullness, distention, mild or severe cramping pain, and flatulence. Loss of appetite, nausea, vomiting, headache, palpitation, and nervousness are often encountered. The peristaltic movements are increased resulting in intermittent spasms and irregular movement of the food mass. The stools are usually dry, hard, small, and frequently combined with mucus.

Treatment. As in atonic constipation, emphasis must be placed on good habits of personal hygiene, rest, relaxation, freedom from nervous upsets, and ample intake of water. Some bulk in the diet is essential, but the fiber should be soft and nonirritating. The Soft Diet (Chapter 29) is suitable for these patients.

INTESTINAL OBSTRUCTION

The movement of the intestinal contents may be impaired or prevented by many causes such as tumors, impaction of material in the intestine, or paralytic ileus following surgery. As a rule, the obstruction must be removed by surgical intervention before an adequate diet can be administered. The postoperative diet should be fiber-free (see p. 508) for a period of time, following which a soft diet may be ordered.

PANCREATIC DISORDERS

Acute pancreatitis. A high percentage of cases of acute pancreatitis are associated with biliary disease. The inflammation is associated with severe

epigastric pain, nausea, vomiting, fever, decrease in peristalsis, increased pulse rate, and, in some instances, by circulatory collapse. Nothing is given by mouth until the acute symptoms have subsided. Then a clear fluid, full fluid, and bland, low-fiber diet may be used in sequence.

Chronic pancreatitis is usually caused by repeated attacks of acute pancreatitis. The episodes of severe pain occur as in the acute pancreatitis. The functioning of the pancreatic glands may be disturbed, leading to inadequate production of digestive enzymes. As a result, the stools become bulky and foul, and contain undigested fat (steatorrhea), increased amounts of nitrogen, and sometimes carbohydrate. Loss of weight follows and the decreased absorption of minerals and vitamins may lead to multiple deficiency signs.

During an exacerbation the patient is treated as for acute pancreatitis. Between attacks the diet should be high in carbohydrate and protein, and low in fat.[5] Pancreatin is administered with each meal to facilitate the absorption of fat. Bland, fiber-restricted diets (Chapter 35) are suitable for patients with chronic pancreatitis except that the fat content must be reduced by the following measures:

Skim milk is substituted for whole milk.
Only lean meats, poultry, and fish are used.
All table and cooking fats are eliminated.
Foods prepared with fat are eliminated; creamed sauces and soups, cakes (except angel and sponge), cookies, fried foods, ice cream, pastries, pies, whole-milk puddings, etc.

Six small meals are usually preferable since the appetite is poor. Multivitamin supplementation is usually indicated.

In some patients with pancreatitis, the islet tissue is affected so that the typical symptoms of diabetes follow. In these instances the dietary considerations for diabetes are then followed (see Chapter 38) with suitable adjustments for fat and fiber content.

SPRUE

Etiology and incidence. The cause of sprue is not known. Tropical sprue which occurs abruptly and is endemic in certain tropical areas is considered by some to be a nutritional deficiency disease, a concept favored by the fact that the administration of folic acid produces remarkably rapid improvement. However, the disease frequently occurs in only one member of a family, all of whom are consuming the same diet. Nontropical sprue occurs sporadically in Europe, Africa, South America, and the United States and is rarely associated with a poor diet. A significant number of patients appear to be sensitive to two protein fractions in wheat, namely gluten and gliadin.

Symptoms and clinical findings. Sprue bears a number of similarities to celiac disease; in fact, celiac disease in children may disappear only to have

the symptoms recur later in adult life. Diarrhea, steatorrhea (fatty stools), and abdominal distention are striking features of the disease. The usual symptoms and laboratory findings include:

1. Weakness, apathy, listlessness
2. Sore tongue (glossitis); anorexia
3. Impaired motility of the gastrointestinal tract; abdominal distention; occasional cramps
4. Muscle wasting and rapid weight loss to the point of emaciation as a result of the poor appetite and the faulty absorption
5. Diarrhea in which the stools are bulky, foul, frothy, with excessive excretion of fats and fatty acids
6. Macrocytic anemia; iron absorption often impaired also
7. Impaired absorption of all of the fat-soluble vitamins. Low prothrombin levels in the blood lead to the danger of severe hemorrhage
8. Excessive calcium loss together with impaired vitamin-D absorption results in hypocalcemia, occasionally tetany, bone pain, osteomalacia
9. Carbohydrate absorption is interfered with as evidenced by a flat glucose tolerance curve
10. Hypofunction of the adrenal cortex; increased pigmentation of exposed areas of the trunk and extremities.

Modification of the diet. Dramatic response is obtained in tropical sprue with folic acid, either alone or in combination with a diet such as the one described below. These specific therapeutic agents produce a rapid regeneration of hemoglobin and red blood cells, the glossitis and diarrhea quickly subside, absorption becomes more nearly normal, the appetite returns and may be even ravenous, and weight gain is marked.

For some unknown reason, the vitamins and liver extract are somewhat less effective in nontropical sprue. In refractory cases prompt remissions have been obtained with ACTH and cortisone,[6] but such therapy does not replace diet. For both tropical and nontropical sprue the following dietary considerations are important.

PROTEIN. A high-protein intake—120 gm or more—is essential to replace the wasted tissues. The proteins of lean meat, poultry, fish, cottage cheese, egg whites, nonfat dry milk, and fresh skim milk are well utilized.

FAT. Most patients benefit by a restriction of fats to those which are easily digested, at least in the initial stages of treatment. Even though a level of 25 gm fat may be used initially, as a rule the patient can tolerate 50 to 100 gm fat after a short period of time.

CARBOHYDRATE. Because of the faulty absorption of carbohydrate, it has been common practice in the past to restrict carbohydrates to those from fruits, fruit juices, low-starch vegetables, simple sugars, and Melba toast. However, the elimination of gluten from the diet, as described below, has resulted in marked improvement without the drastic restriction in sugars and starches.

GLUTEN. When certain protein fractions—gluten and gliadin—are eliminated many patients show striking improvement. The gluten-rich sources include wheat, oats, rye, and barley.

MINERALS. In addition to a liberal allowance of milk, calcium salts are sometimes prescribed to overcome the excessive loss which has occurred in the stools. Iron salts are necessary if there is an hypochromic anemia. Potassium deficiency may be present when the patient has been eating poorly, in which event the physician makes an appropriate prescription.

VITAMINS. In addition to folic acid or vitamin B_{12}, it is necessary to prescribe supplements of the fat-soluble and water-soluble vitamins.

TEXTURE AND FLAVOR. The reduction in gastrointestinal motility and the ever-present distention usually require that strongly flavored vegetables and other gas-forming foods be avoided, at least initially. The fiber content may be reduced by using only cooked fruits and vegetables at first, and eliminating the skins and seeds of foods.

The diet described in the following section is adapted from the plan described by Mike.[7]

WHEAT-, OAT-, AND RYE-FREE DIET

Characteristics and general rules:

This diet excludes all products containing wheat, rye, oats, and barley. Read all labels carefully.

Aqueous multivitamins are usually prescribed in addition to the diet.

The diet may be progressed gradually; that is, small amounts of unsaturated fats may be used at first, adding harder fats later. Fiber may be reduced initially by using only cooked fruits and vegetables. Strongly flavored vegetables may be poorly tolerated at first.

Include these foods, or their nutritive equivalents, daily:

4 cups milk
6–8 ounces (cooked weight) lean meat, fish, or poultry
1 egg
4 vegetables including:
- 1 dark green or deep yellow
- 1 potato
- 2 other vegetables
- Other to be served raw, if tolerated

3 fruits including:
- 1–2 servings citrus fruit or other good source ascorbic acid
- 1–2 other fruits

4 servings bread and cereals: corn, rice, soybean
NO WHEAT, RYE, OATS, BARLEY
2 tablespoons fat
Additional calories are provided by using more of the foods listed, desserts, soups, sweets

Nutritive value of listed foods: protein, 105 gm; fat, 110 gm; carbohydrate, 200 gm; calories, 2200. Minerals and vitamins in excess of recommended allowances.

FOODS ALLOWED	FOODS TO AVOID
Beverages—carbonated, cocoa, coffee, fruit juices, milk, tea	*Beverages*—ale, beer, instant coffee containing cereal, malted milk, Postum, products containing cereal
Breads—corn bread, muffins, and pone with no wheat flour; breads made with corn meal, cornstarch, Lima bean, potato, rice, soybean flours	*Breads*—all containing any wheat, rye, oats, or barley; bread crumbs, muffins, pancakes, rolls, rusks, waffles, zwieback; all commercial yeast and quick bread mixes; all crackers, pretzels, Ry-Krisp
Cereals—cooked corn meal, Cream of Rice, hominy or grits, rice; ready-to-eat: corn or rice cereals such as corn flakes, rice flakes, Puffed Rice	*Cereals*—cooked or ready-to-eat breakfast cereals containing wheat,* oats; barley, macaroni, noodles, pasta, spaghetti, wheat germ
Cheese—cottage; later, cream cheese	
Desserts—custard, fruit ice, fruit whips, plain or fruit ice cream (homemade), plain or fruit gelatin, meringues; homemade puddings—cornstarch, rice, tapioca; rennet desserts; sherbet; cakes and cookies made with allowed flours	*Desserts*—cake, cookies, doughnuts, pastries, pie; bisques, commercial ice cream, ice cream cones; prepared mixes containing wheat, rye, oats, or barley; puddings thickened with wheat flour
Eggs—as desired	
Fats—oil: corn, cottonseed, olive, sesame, soybean; French dressing, pure mayonnaise, salad dressing with cornstarch thickening Later addition: butter, cream, margarine, peanut oil, vegetable shortening	*Fats*—bacon, lard, suet, salad dressing with flour thickening
Flour—corn meal, Lima bean, potato, rice, soybean	*Flour*—barley, oat, rye, wheat—bread, cake, entire wheat, graham, self-rising, whole-wheat, wheat germ
Fruits—all cooked, canned, and juices; fresh and frozen as tolerated, avoiding skin and seeds initially	*Fruits*—prunes, plums, and their juices; those with skins and seeds at first
Meat—all lean meats, poultry, fish: baked, broiled, roasted, stewed	*Meat*—breaded, creamed, croquettes, luncheon meats unless pure meat, meat loaf, stuffings with bread, scrapple, thickened stew Fat meats such as corned beef, duck, frankfurters, goose, ham, luncheon meats, pork, sausage Fatty fish such as herring, mackerel, sardines, swordfish, or canned in heavy oil
Milk—all kinds	
Soups—broth, bouillon, cream if thickened with cornstarch, vegetable	*Soups*—thickened with flour; containing barley, noodles, etc.
Sweets—candy, honey, jam, jelly, marmalade, marshmallows, molasses, syrup, sugar	*Sweets*—candies with high fat content, nuts; candies containing wheat products

* A listing of trade products containing wheat is provided in Chapter 45, page 676.

FOODS ALLOWED	FOODS TO AVOID
Vegetables—cooked or canned: buttered; fresh as tolerated	*Vegetables*—creamed if thickened with wheat, oat, rye, or barley products Strongly flavored if they produce discomfort: baked beans, broccoli, Brussels sprouts, cabbage, cauliflower, corn, cucumber, lentils, onions, peppers, radishes, turnips
Miscellaneous—gravy and sauces thickened with cornstarch; olives, peanut butter, pickles, popcorn, potato chips	*Miscellaneous*—gravies and sauces thickened with flours not permitted

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Fruit, preferably citrus or good source of ascorbic acid	Tomato juice
Rice or corn cereal	Rice Krispies
Milk, sugar	Milk, sugar
Bread: rice or corn	Southern corn muffins
Butter or margarine	Butter or margarine
Jelly, if desired	Currant jelly
Eggs	Scrambled eggs
Beverage	Coffee, with cream, sugar
LUNCHEON OR SUPPER	
Meat, poultry, or fish; or cheese; eggs (no thickened casserole dishes)	Beef stew (not thickened) Beef cubes Potato Carrots Onions
Potato, or substitute, or vegetable	
Salad—vegetable or fruit, if tolerated	Tossed green salad French dressing
Bread: rice or corn	Rice flour bread
Butter or margarine	Butter or margarine
Milk	Milk
Dessert or fruit	Vanilla cornstarch pudding with sliced frozen peaches
DINNER	
Meat, poultry, or fish	Broiled lamb patties (all meat) Mint jelly
Potato or rice	Rice with saffron seasoning
Cooked vegetable	Buttered asparagus
Salad, if tolerated	Celery and olives
Bread, corn or rice, if desired	
Butter	
Milk	Milk
Dessert or fruit	Lemon meringue pudding (thickened with cornstarch)
Tea or coffee	Coffee with cream, sugar

PROBLEMS AND REVIEW

1. Discuss the role of diet in the incidence of diseases of the small intestine and colon.
2. What is the relationship of psychologic factors to the occurrence of gastrointestinal disorders? Cite examples.
3. What do the terms *fiber* and *residue* mean?
4. What are the characteristics of a very low-residue diet? In which respects is the diet inadequate?
5. The physician has indicated that a patient with ulcerative colitis may select his diet according to his tolerance. As a nurse, what problems are you likely to encounter with such a patient? What dietary instruction is necessary when the patient goes home?
6. *Problem.* Plan a day's menu for a patient with chronic ulcerative colitis, allowing at least 125 gm protein. Restrict the milk to that used in prepared foods. What are the reasons for each modification you have made from the normal diet?
7. What are the outstanding characteristics of atonic constipation? What are the chief causes? What type of individual is likely to develop atonic constipation?
8. *Problem.* Write a menu for a normal diet for 1 day which places emphasis on fiber.
9. What factors, other than diet, must be considered in the treatment of constipation?
10. What diet would you recommend for a person with an irritable colon?
11. What is gluten? Gliadin? Why are these substances contraindicated for some patients with sprue? What changes would be necessary in the diet you ate yesterday to make it free of gluten and gliadin?

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Chapter 37

DIET IN DISTURBANCES OF THE LIVER AND GALLBLADDER
High-Protein, Moderate-Fat, High-Carbohydrate Diet; Low-Fat Diets

Functions of the liver. No organ of the body is concerned with so many different functions as the liver. It manufactures vital body substances, stores, modifies, and dispatches food materials, protects the body from poisons, and performs a variety of other functions not fully understood.

PROTEIN METABOLISM. The liver maintains appreciable protein reserves which are readily released for the maintenance of the serum protein level. Body proteins are synthesized from the amino acids brought to the liver. The blood concentration of amino acids is controlled by the liver in that excess acids not needed for tissue synthesis are deaminized and thus made available for energy. The resulting ammonia is converted to urea and the remainder of the amino acid molecule yields glucose or fatty acids.

CARBOHYDRATE METABOLISM. The liver is the chief storehouse of carbohydrate in the body, with ¼ to ½ pound of glycogen representing a normal amount. When the various simple sugars reach the liver from the portal circulation, they may be converted to glucose for immediate use or they may be manufactured into glycogen. Thus, the liver plays an important role in the regulation of the blood sugar level.

LIPID METABOLISM. The liver does not normally store fat, but it plays an essential role in the continual and rapid turnover of fats. It converts fatty acids into phospholipids for the more ready transportation of fats in the circulation; it synthesizes fats from fatty acids, carbohydrates, and deaminized amino acids; it synthesizes cholesterol; it oxidizes fatty acids to provide energy; and it converts excess cholesterol into bile salts. The normal and rapid turnover of fats in the liver requires certain lipotropic factors such as choline and methionine (see pp. 93 and 180).

MINERAL AND VITAMIN METABOLISM. Relatively large reserves of iron and copper exist in the liver. The worn-out red blood cells are broken down so that the iron can be used over again.

About 95 per cent of the body's store of vitamin A and a considerable proportion of vitamin D are kept in the liver. Lesser reserves of vitamin B_{12}, other B-complex vitamins, ascorbic acid, and vitamin K are likewise present.

Vitamin K is converted to prothrombin in the liver, and to some extent carotene may be converted to vitamin A.

MANUFACTURE OF BILE. Bile is manufactured continuously by the liver and is carried by the many bile ducts to the hepatic duct and thence to the cystic duct for concentration and storage in the gallbladder. Approximately 500 to 1000 ml of bile are secreted daily. Bile salts, bile acids, bile pigments, and cholesterol are the more important constituents of this secretion.

The bile salts possess the capacity to lower surface tension. This property accounts for the emulsification of fats and thus the more efficient action of lipase in the intestine. The bile salts also render fats and fat-soluble vitamins more soluble and thus aid in the absorption of these substances from the intestine. Bile salts are a stimulus to the further production of bile in the liver.

The bile is a channel for the excretion of waste products. The bile pigments, bilirubin and biliverdin, are the result of hemoglobin disintegration. Excess cholesterol is also disposed of in this manner.

OTHER FUNCTIONS. The liver plays a role in the regulation of blood coagulation in that it synthesizes fibrinogen, a protein essential for the clotting process, and heparin, an anticoagulant substance. Its function in converting vitamin K to prothrombin, another substance required for blood clotting, has been mentioned previously.

The liver effectively detoxifies substances which are toxic end products of digestion because of bacterial action, and likewise protects the body from the toxic effects of certain drugs such as sulfa drugs, arsenic, mercury, and others, provided the intake of carbohydrate and protein has been satisfactory. The ammonia resulting from bacterial decomposition in the intestine and from deaminization of the amino acids is a toxic substance to the body which is rendered harmless by the elaboration of urea by the liver.

DISEASES OF THE LIVER

Jaundice is a symptom common to many diseases of the liver and biliary tract and consists of a yellow pigmentation of the skin and body tissues because of the accumulation of bile pigments in the blood. *Obstructive jaundice* results from the interference of the flow of bile by stones, tumors, or inflammation of the mucosa of the ducts. *Hemolytic jaundice* results from an abnormally large destruction of blood cells such as occurs in yellow fever, pernicious anemia, etc. *Toxic jaundice* originates from poisons, drugs, or virus infections.

HEPATITIS

Hepatitis is an inflammation of the liver which may be caused by infectious agents such as viruses and bacteria, or toxic drugs such as arsenicals, or sol-

vents such as carbon tetrachloride. Necrosis or rapid destruction of the liver cells occurs.

Infectious hepatitis, also known as viral hepatitis and formerly called catarrhal jaundice, assumed epidemic proportions in the armed forces of World War II. Outbreaks occur especially in young people from time to time. The infection is caused by a virus readily transmitted through contaminated food or water. Homologous serum jaundice is similar to infectious hepatitis and results from transfusions of blood from a donor who is a carrier of the virus, or from improperly sterilized needles used for inoculations.

Hepatitis is usually characterized by marked anorexia, fever, headache, rapid and often marked weight loss, loss of muscle tone, jaundice, and abdominal discomfort. The disease may continue for 4 to 8 weeks.

Modification of the diet. The objectives of the diet are to avoid further injury and strain to the liver, and to aid in the regeneration of liver tissue. With a liberal diet and adequate rest permanent liver damage can be avoided.

ENERGY. About 3000 to 4000 calories daily may be required to counteract weight loss, and to assist in maximum utilization of protein.

PROTEIN. A liberal protein intake is essential for the maintenance and repair of the liver tissue itself and to furnish lipotropic factors for the utilization of fat. Usually an intake of 1½ to 2 gm per kilogram body weight or 100 to 150 gm daily will prove to be a satisfactory allowance.

CARBOHYDRATE. Large amounts of carbohydrate exert a protein-sparing effect and supply the bulk of the caloric need. Moreover, a liberal carbohydrate intake ensures a large reserve of glycogen which aids in the maintenance of hepatic function and the protection of the liver against injury. An intake of 300 to 400 gm daily should be encouraged.

FAT. Several studies[1,2] have shown that patients on high-protein, high-carbohydrate diets with relatively liberal intakes of fat (150 gm) had better appetites, gained weight, and improved more rapidly than did patients on equally high-protein intakes but with limited amounts of fat (50 gm daily). The authors believe that the greater improvement was the result of the higher caloric intake and the consequent nutritional betterment rather than the result of fat intake as such. The liberal fat intake provided a more palatable diet as well as an increased caloric level without undue amounts of bulky foods. The fats of whole milk, cream, butter, margarine, cooking fats, and vegetable oils are easily utilized and should be used in sufficient amounts to enhance the palatability of the diet. Thus, 100 to 150 gm fat daily may be incorporated.

CONSISTENCY. A liquid-to-soft diet may be used during the acute illness, progressing to a wider choice of foods with convalescence.

Management of the diet. Since anorexia is characteristic of the disease, good cookery and attractive food service must be emphasized. Three meals of small-to-moderate size may be offered to the patient when high-protein beverages are used as supplements between meals and at bedtime. A considerable amount of persuasion is often needed to get the patient to eat. Some years ago

Berger[3] found that moderate amounts of spices, condiments, relishes, catsup, and pickles aided in stimulating the appetite.

HIGH-PROTEIN, MODERATE-FAT, HIGH-CARBOHYDRATE DIET

Characteristics and general rules:

The caloric level may be increased by adding high-carbohydrate foods. Small amounts of cream and ice cream may be used when tolerated.

The protein intake may be increased by adding nonfat dry milk to liquid milk. See page 724 for high-protein beverages.

Modifications in fiber and consistency may be made by applying restrictions concerning the Soft Diet (Chap. 29) to the foods listed below.

Six or more small feedings may be preferred when there is lack of appetite.

When sodium restriction is ordered, all food must be prepared without salt. Low-sodium milk should replace part or all of the prescribed milk. See Sodium-Restricted Diets, Chapter 42.

Include these foods daily:

1 quart milk
8 ounces lean meat, poultry, or fish
1 egg
4 servings vegetables including:
  2 servings potato or substitute
  1 serving green leafy or yellow vegetable
  1–2 servings other vegetable
  One vegetable to be raw each day
3 servings fruit including:
  1 serving citrus fruit or other good source of ascorbic acid
  2 servings other fruit
1 serving enriched or whole-grain cereal
6 slices enriched or whole-grain bread
2 tablespoons butter or fortified margarine
4 tablespoons sugar, jelly, marmalade, or jam
Additional foods to further increase the carbohydrate as the take them

Nutritive value of basic pattern above: protein, 135 gm; hydrate, 236 gm; calories, 2590; calcium, 2.53 gm; iron, 1 18,770 I.U.; thiamine, 2.11 mg; riboflavin, 3.39 mg; niacir acid, 159 mg.

TYPICAL FOOD SELECTION

Beverages—carbonated beverages, milk and milk drinks, coffee, tea, fruit juices, cocoa flavoring
Breads and cereals—all kinds
Cheese—cottage, cream, mild Cheddar
Desserts—angel cake, plain cake and cookies, custard, plain or fruit gelatin, fruit whip, fr and cereal plain ice c
Eggs—any v
Fat—butter cookin
Fruit

TYPICAL FOOD SELECTION (*Cont.*)

Meat—lean beef, chicken, fish, lamb, liver, pork, turkey
Potato or substitute—hominy, macaroni, noodles, rice, spaghetti, sweet potato
Seasonings—salt, spices, vinegar (in moderation)
Soups—clear and cream
Sweets—honey, jam, jelly, sugar, sugar candy, syrups
Vegetables—all

FOODS TO AVOID. No foods are specifically contraindicated. Many patients complain of intolerance to the following groups of foods: strongly flavored vegetables; rich desserts; fried and fatty foods; chocolate; nuts; and highly seasoned foods. Although such complaints cannot always be explained on a physiologic basis, nothing is gained by giving the offending foods to the patient. See Chapter 35 for full discussion.

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Fruit	Half grapefruit
Cereal with milk and sugar	Wheatena with milk and sugar
Egg	Scrambled egg
Whole-grain or enriched toast—2 slices	Whole-wheat toast
Butter or margarine—2 teaspoons	Butter
Marmalade—1 tablespoon	Orange marmalade
Beverage with cream and sugar	Coffee with cream and sugar
ON OR SUPPER	
or poultry—4 ounces	Broiled whitefish
ute	Escalloped potatoes
e	Buttered asparagus
	Celery and carrot strips
riched bread—2 slices	Whole-wheat bread
e—2 teaspoons	Butter
n	Grape jelly
	Sliced banana
	Milk
N	
milk	High-protein milk with strawberry flavor
wl—4 ounces	Roast beef
	Mashed potato
	Baked acorn squash
ad—2 slices	Dinner rolls
poons	Butter
	Apple jelly
	Raspberry sherbet
	Milk
	High-protein milk flavored with caramel
	Bread and jelly sandwich

CIRRHOSIS OF THE LIVER

Cirrhosis is a chronic disease of the liver in which increased fibrous connective tissue replaces the functioning liver cells. Among the causes are infectious hepatitis, chronic alcoholism, hepatotoxic agents, and prolonged stasis of the biliary tract from gallstones. Patients with portal cirrhosis (Laennec's cirrhosis; "alcoholic" cirrhosis) respond most favorably to diet. Alcoholism accounts for a large proportion of these patients. Although the alcohol consumed furnishes the bulk of the caloric intake, other nutrients are seriously lacking in the extremely poor food intake. The malnutrition which ensues, rather than the alcohol, per se, is believed to be responsible for the accumulation of fat in the liver, destruction of the liver cells, and the proliferation of fibrous tissue.

Symptoms and clinical findings. The onset of cirrhosis may be gradual with gastrointestinal disturbances such as anorexia, nausea, vomiting, pain, and distention. As the disease progresses, jaundice and other serious changes occur.

ASCITES is the accumulation of fluid in the abdominal cavity and results when the portal circulation is impaired and portal hypertension is present. Low blood protein levels, especially a lowered albumin level, may also contribute to ascites and peripheral edema.

ESOPHAGEAL VARICES (varicose veins) and distended abdominal veins may follow impairment of the portal circulation. Hemorrhage is then an ever-present danger and may be provoked by roughage of any kind. The hemorrhage itself may be fatal, or the blood may provide for the accumulation of ammonia and subsequent hepatic coma.

Modification of the diet. If diet therapy is initiated early in the course of the disease, regeneration of liver cells occurs with considerable subjective improvement. The diet outlined above for infectious hepatitis is satisfactory for such patients. When cirrhosis is more advanced, the following further considerations must be given to dietary planning.

PROTEIN. Although a liberal protein intake may be advantageous to most patients, considerable caution should be exercised since hepatic coma is a possible danger in advanced cirrhosis. A diet providing the recommended allowances of protein—1 gm per kilogram body weight—is considered suitable by some clinicians, while 1½ to 2 gm protein per kilogram are recommended by others. Protein should be immediately and drastically curtailed if the patient has signs of impending coma.

VITAMINS. The diet itself, when well taken, includes a liberal allowance of all vitamins (see p. 553). When malnutrition has been present for some time, multivitamin supplements may be prescribed for a few weeks.

SODIUM. A sodium-restricted diet is prescribed together with other measures to improve sodium excretion if ascites and peripheral edema are present. A diet restricted to as little as 200 mg sodium has been shown to be effective;[4] however, such restriction necessitates the substitution of low-sodium milk for

regular milk, and careful planning of the protein intake. See Chapter 42 for full details concerning the planning of such a diet.

CONSISTENCY. In early stages of cirrhosis no change in fiber content is usually necessary, but a smooth or even liquid diet is essential if esophageal varices are present.

HEPATIC COMA

Hepatic coma is a neurologic disorder which may occur as a complication in acute hepatitis or in cirrhosis. It may be initiated by a variety of factors such as an acute infection, a gastrointestinal hemorrhage, trauma or surgery, a transfusion reaction, acute alcoholism, or following paracentesis. Although it is undoubtedly a complex syndrome, one common explanation given is that of ammonia intoxication. If liver cells are sufficiently damaged, as in severe hepatitis, or if the portal circulation bypasses the liver cells, as in advanced cirrhosis, ammonia gains access to the general circulation.

Symptoms. The brain tissue is especially sensitive to ammonia. The patient with impending coma shows signs of drowsiness, confusion, and disorientation and may have a flapping tremor of the arms and legs when they are extended. He lapses into sleep, fails to respond to stimuli, and may have convulsions. The breath has a fecal odor—*fetor hepaticus*. Death rapidly ensues unless prompt treatment is initiated.

Modification of the diet. The fundamental principle in the dietary management of hepatic coma is to restrict protein metabolism to a minimum thereby reducing the amount of ammonia produced. This means that catabolism of tissue proteins must also be avoided.

ENERGY. About 1500–2000 calories daily are sufficient to keep body tissue breakdown to a minimum. Carbohydrates and fats provide all of the energy at first.

PROTEIN. A protein-free diet is recommended at first by some, while others permit 20 to 30 gm protein daily. When improvement occurs, the protein intake is increased by 10 or 20 gm daily until a normal allowance of 1 gm per kilogram is reached. With each addition the patient is carefully watched; any signs of returning coma must be met with continued curtailment of protein.

Levels of 40 to 50 gm protein daily may be used for long periods of time without detriment to nutritional status if the diet is otherwise adequate. Davidson states that protein intakes as low as 30 gm daily will permit nitrogen balance if the quality of the protein is good and if the caloric intake is adequate.[4]

Management of the diet. These patients are usually difficult to feed because of anorexia and widely varying patterns of behavior ranging from irritability and sometimes hyperexcitability to drowsiness and confusion. The protein-free diet consisting of commercial sugar-fat emulsions, a butter-sugar

mixture, or glucose in beverages or fruit juices may be used initially through oral or tube feeding. The details of such a regimen are described in Chapter 43. With improvements, the diets providing 20, 40, and 60 gm protein (see p. 646) may be gradually introduced.

DISEASES OF THE GALLBLADDER

Function of the gallbladder. The gallbladder concentrates bile from the liver and serves as a storehouse for it. The presence of fat in the duodenum stimulates the secretion of the hormone cholecystokinin, which is released into the blood stream. The hormone brings about the contraction of the gallbladder and the consequent emptying of bile into the common duct and thence into the small intestine.

Symptoms and clinical findings. Cholecystitis is an inflammation of the gall bladder; cholelithiasis consists in the formation of stones which may block the ducts and thus impede the flow of bile. Gallstones consist of cholesterol, bile pigments, and other substances which have precipitated out of the bile. When the gallbladder is inflamed or stones cause obstruction, any contraction of the gallbladder will lead to pain, sometimes very severe. Thus, it is understandable that the ingestion of fatty foods will cause discomfort. The patient experiences a sense of fullness and often complains of distention, especially after eating certain strongly flavored vegetables, legumes, melons, and berries. The association of discomfort with these foods has been questioned, however, and patients with gallbladder disease were found to have no higher incidence of specific intolerance than those without gastrointestinal disorders.[5] Fat digestion in the small intestine may be impaired when there is a diminished flow of bile.

Modification of the diet. The objectives in diet therapy of gallbladder disease are to provide adequate nutrition and to reduce the discomfort by giving a low-fat diet restricted in coarse fiber.

ENERGY. Many patients with gallbladder disease are overweight and should be given a low-calorie diet (see Chapter 32). With restriction of fat, carbohydrates are used more liberally to furnish the needed calories.

FAT. Drastic restriction of fat—20 to 30 gm daily—is indicated during acute attacks. On a maintenance basis, most patients can tolerate 50 to 60 gm fat daily, thus permitting some fat for a more palatable diet.

CHOLESTEROL. Gallstones contain appreciable amounts of cholesterol, but it is unlikely that restriction of cholesterol in the diet has any appreciable effect on reducing cholesterol formation.[6] Physiologically, acetate units for the construction of cholesterol may be derived from the metabolism of carbohydrates and amino acids, as well as fats. The body synthesizes each day several times as much cholesterol as that contained in the average diet

A reduction in cholesterol content of the diet entails the omission of eggs,

liver and other organ meats, and the restriction of whole milk, cream, and butter. See Table A–7 for cholesterol content of foods.

Management of the diet. The sharp curtailment of fat in the diet necessitates modified methods of food preparation. Any meats must be trimmed of all visible fat, and must be prepared by broiling, roasting, or stewing. The drippings from meat may not be used. Herbs and spices in moderation may be used as flavoring aids for the preparation of vegetables; see suggested combinations in the recipe section, Appendix. Jelly may be used on breads instead of table spread. Food allowances for two levels of fat restrictions are shown in Table 37–1.

Table 37–1. Food Allowances for Two Levels of Fat Restriction
(Approximately 1500 Calories)

	20 gm Fat	50 gm Fat
Milk, skim	2 cups	2 cups
Meat, fish, poultry (*lean*)	6 ounces*	6 ounces*
Eggs (3 per week)	½	½
Vegetables		
Dark-green leafy or deep yellow	1 serving	1 serving
Potato	1 serving	1 serving
Other	1 or more servings	1 or more servings
Fruits		
Citrus	1 serving	1 serving
Other	3 servings	3 servings
Breads and cereals		
Cereals	1 serving	1 serving
Breads	6 slices	3 slices
Fats, vegetable	none	6 teaspoons
Sweets	3 tablespoons	2 tablespoons
Total fat, gm	20	20
Cholesterol, mg	270†	270†
Protein, gm	85	80
Calories (approximate)	1500	1500

* Only lean cuts of meat, fish, poultry may be used. Each ounce is equivalent to 8 gm protein and 3 gm fat.

† Cholesterol level would be reduced to about half this level if eggs were not used. If butter is used instead of vegetable fat, the cholesterol level would be increased.

FOODS ALLOWED

Beverages—whole milk, only 2 cups; skim milk as desired; coffee, coffee substitute, tea; fruit juices

Breads—all kinds except those with added fat

Cereals—all cooked or dry breakfast cereals, except possibly bran; macaroni, noodles, rice, spaghetti

FOODS TO AVOID

Beverages—with cream; soda-fountain beverages with milk, cream, or ice cream

Breads—griddle cakes; sweet rolls with fat; French toast

FOODS ALLOWED	FOODS TO AVOID
Cheese—cottage only	*Cheese*—all whole-milk cheeses, both hard and soft
Desserts—angel cake; fruit whip; fruit pudding; gelatin; ices and sherbets; milk and cereal puddings using part of milk allowance	*Desserts*—any containing chocolate, cream, nuts, or fats: cookies, cake, doughnuts, ice cream, pastries, pies, rich puddings
Eggs—3 per week	*Eggs*—fried
Fats—vegetable oil or margarine	*Fats*—cooking fats, cream, salad dressings
Fruits—all kinds when tolerated	*Fruits*—avocado; raw apple, berries, melons may not be tolerated
Meats—broiled, baked, roasted, or stewed without fat: lean beef, chicken, lamb, pork, veal, fish	*Meats*—fatty meats, poultry, or fish: bacon, corned beef, duck, goose, ham, fish canned in oil, mackerel, pork, sausage; organ meats Smoked and spiced meats if they are poorly tolerated
Seasonings—in moderation: salt, pepper, spices, herbs, flavoring extracts	*Seasonings*—sometimes not tolerated: pepper; curries; meat sauces; excessive spices; vinegar
Soups—clear	*Soups*—cream, unless made with milk and fat allowance
Sweets—all kinds: hard candy, jam, jelly, marmalade, sugars	*Sweets*—candy with chocolate and nuts
Vegetables—all kinds when well tolerated; cooked without added butter, or cream	*Vegetables*—strongly flavored may be poorly tolerated: broccoli, Brussels sprouts, cabbage, cauliflower, cucumber, onion, peppers, radish, turnips; dried cooked peas and beans
	Miscellaneous—fried foods; gravies; nuts; olives; peanut butter; pickles; popcorn; relishes

MEAL PATTERN (20 gm fat)	SAMPLE MENU
BREAKFAST	
Fruit	Stewed apricots
Cereal with skim milk and sugar	Corn flakes with skim milk and sugar
Egg—1 only (3 per week)	Poached egg
Enriched or whole-grain toast	Whole-wheat toast with jelly
Jelly	
Beverage with milk and sugar	Coffee with milk and sugar
LUNCHEON OR SUPPER	
Lean meat, fish, poultry, or cottage cheese	Tomato bouillon
Potato or substitute	Fruit salad plate:
Vegetable	Cottage cheese
Salad; no oil dressing	Sliced orange
	Tokay grapes
	Pear
	Romaine
Enriched or whole-grain bread	Sliced chicken sandwich

MEAL PATTERN (20 gm fat) (Cont.)	SAMPLE MENU (Cont.)
Dessert or fruit	Vanilla blanc mange (using milk allowance)
Milk, skim—½ cup	Tea with milk, sugar
DINNER	
Lean meat, poultry, or fish	Roast lamb, trimmed of fat
Potato or substitute	Boiled new potatoes; no added fat
Vegetable	Zucchini squash
Enriched or whole-grain bread	Parkerhouse roll
Jelly	Jelly
Dessert or fruit	Angel cake with sliced peaches
Milk, skim—1 glass	Milk, skim—1 glass

Diet following cholecystectomy. Following removal of the gallbladder, the low-fat diet described above may be used for a number of months. When the irritation has subsided, the individual is able to consume a normal diet.

PROBLEMS AND REVIEW

1. Discuss in detail the functions of the liver in digestion, metabolism, storage, manufacture, regulation, and detoxication.
2. What are the functions of bile?
3. Of what importance is the gallbladder?
4. What reasons can you give for the best use of a high-protein, high-carbohydrate, moderate-fat diet in hepatitis?
5. What additional considerations apply in the planning of diet for a patient with cirrhosis of the liver?
6. *Problem.* For a patient with cirrhosis of the liver plan a soft diet which includes 100 gm protein, 120 gm fat, and 350 gm carbohydrate.
7. Under what circumstances would sodium restriction be required? What changes would be necessary to adapt the diet in Problem 6 to 250 mg sodium daily?
8. What is hepatic coma? Why is a protein-free or low-protein diet ordered? Why is an adequate caloric intake so essential?
9. *Problem.* Write menus for 1 day for a patient with impending hepatic coma, keeping the protein restricted to 20 gm.
10. What is the rationale for the use of a low-fat diet in gallbladder disease?
11. If cholesterol restriction is ordered for a patient with gallbladder disease, what foods should be omitted?
12. Why are these foods often contraindicated for patients with gallbladder disease: cabbage, raspberries, baked beans, chile con carne?
13. *Problem.* Plan a diet for 1 day which is suitable for a patient who is overweight, who has gallbladder disease, and for whom a 25-gm fat level has been ordered.

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UNIT XI
Diet in Metabolic and Nervous Disorders

Chapter

38 DIABETES MELLITUS

39 VARIOUS METABOLIC DISORDERS
Low-Purine Diet

40 NUTRITION IN NERVOUS DISTURBANCES
Ketogenic Diet

Chapter 38

DIABETES MELLITUS

Nature of diabetes. Diabetes mellitus is a disease of metabolism characterized by the lessened ability, or the complete inability, of the tissues to utilize carbohydrate, and by the striking changes in the metabolism of fat and protein. Excessive urination, glycosuria, and hyperglycemia are cardinal findings.

Insulin, one of the hormones manufactured by the cells of the islands of Langerhans in the pancreas, is intimately concerned with the metabolism of carbohydrate. As the glucose level of the blood increases, insulin is released into the circulation and functions in the conversion of glucose to glycogen in the liver and for the later oxidation of glucose in the tissues. Some patients produce too little insulin to meet metabolic needs; others require some stimulation of the pancreas before enough insulin can be produced; still others produce insulin but for some reason it is not available for glycogenesis.

The metabolism of fats is markedly altered in diabetes mellitus. The rate of fatty acid synthesis is decreased while the oxidation of fatty acids is accelerated. Because the ability to dispose of the end products of fatty acids is reduced, an accumulation of ketones brings about a lowering of the blood pH with a consequent acidosis.

A number of hormones influence metabolism. The anterior pituitary and adrenal cortical hormones exert an effect on carbohydrate metabolism which is antagonistic to that produced by insulin (see Figure 38–1). An overproduction of these hormones results in hyperglycemia, glycosuria, and ketosis and may thus produce the diabetic state just as a deficiency of insulin will produce diabetes. The anterior pituitary also produces hormones that govern the action of the adrenal and thyroid glands, and thus carbohydrate metabolism is indirectly influenced. The relationships of the several hormones to the etiology of diabetes are not fully understood.

Incidence. About 4 million persons in the United States today have diabetes mellitus, and of that number 1.6 million are unaware that they have the disease. One adult in 50 is afflicted, while only 1 in 2500 children and young adults is so affected.[1] Diabetes ranks seventh as a cause of death, with cardio-

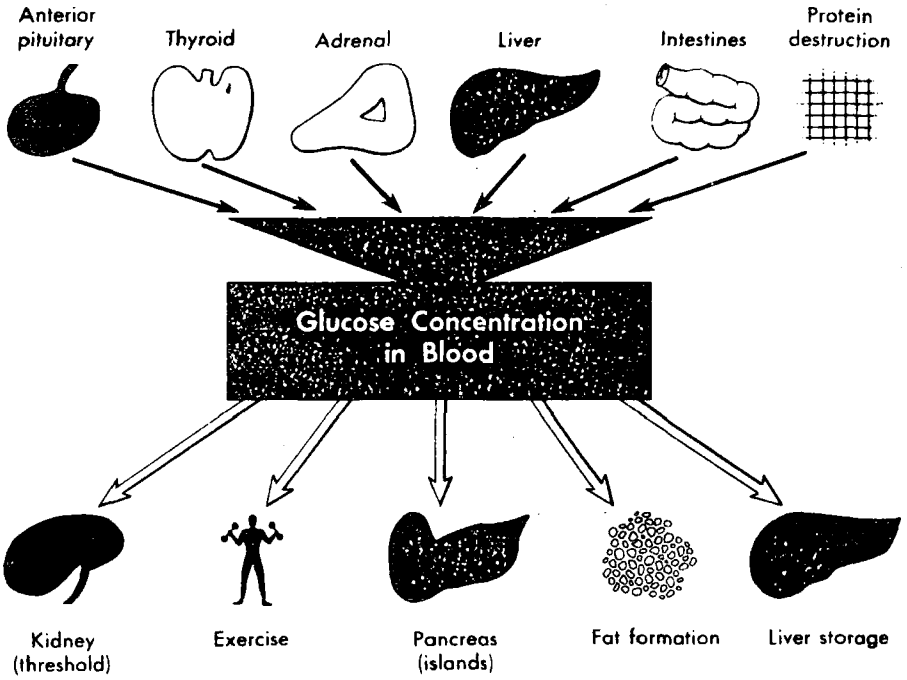


FIG. 38–1. Factors influencing the level of blood sugar. Excessive secretory activity of anterior pituitary, adrenal cortex, or thyroid may, by stimulating glucose formation and reducing glucose utilization, raise the blood sugar to levels that increase greatly the demands on the pancreas. Should such hyperfunction persist or be unduly prolonged, the islands of Langerhans may fail and permanent diabetes may result. The pathogenic influence of a high blood sugar level may be interrupted when hyperglycemia is controlled by insulin. (*Courtesy, the Lilly Research Laboratories, Indianapolis.*)

vascular diseases being the principal complicating factors. Women are more susceptible than men.

Of all obese adults, one fourth are believed to have latent diabetes, and a large number of elderly persons also have abnormal glucose tolerances. Thus, according to Hodges,[2] if one includes all persons with recognized diabetes, those with latent diabetes, and those with unrecognized signs, it is likely that 10 per cent of the population is affected.

Heredity and diabetes. A predisposition to diabetes is inherited as a mendelian recessive character; that is, if two diabetic persons marry, all of their children will be diabetic if they live long enough. If a diabetic marries a diabetic carrier, half of the children will be potential diabetics; if a diabetic marries one who is neither a diabetic nor a diabetic carrier, none of the children will have diabetes. (See Figure 38–2.)

Because diabetes is an inborn error of metabolism it exists from the time of conception, although the recognized biochemical and physical signs make their appearance at varying times in the life cycle.

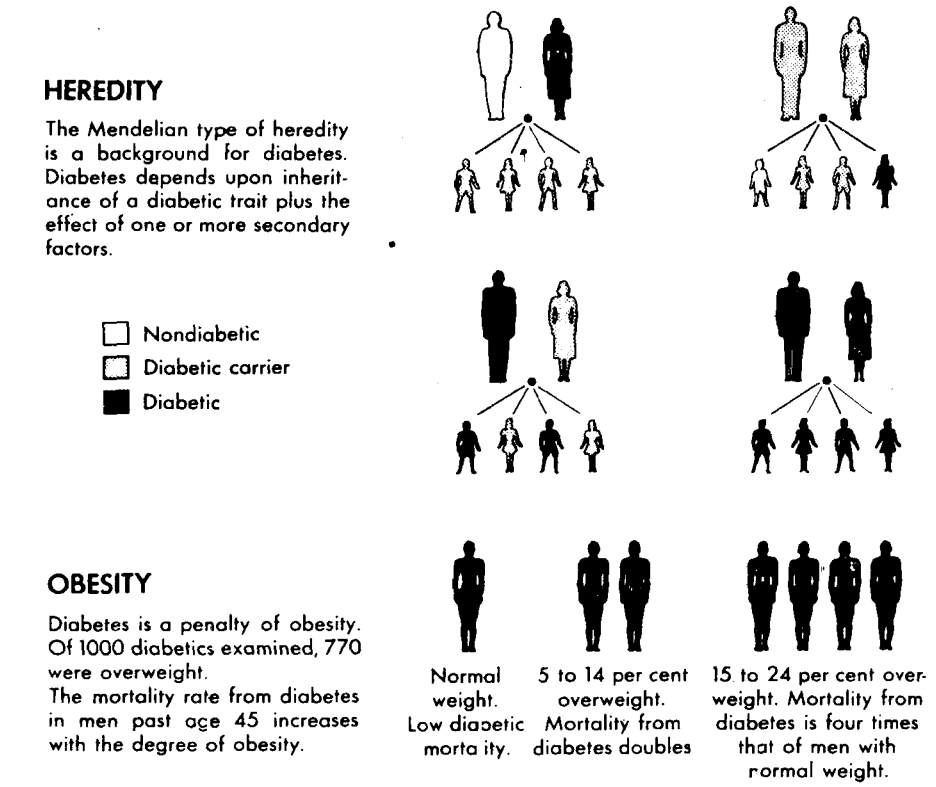


FIG. 38–2. Heredity and obesity contribute to the onset of diabetes. (*Courtesy, the Lilly Research Laboratories, Indianapolis.*)

Prediabetes. Much research is being conducted to determine the physical and biochemical characteristics of persons from families in which there is a diabetic individual. Hopefully, such characteristics might lead to an earlier detection of the disease and the possibility of reducing or avoiding the incidence of complications.

Prediabetes has been defined as "that period in a patient's life from birth until recognition of carbohydrate intolerance by the latest available technique."* Women who have large babies (10 pounds or more) are known to have a much higher rate of diabetes in later years than women with babies of

* Review: "Coronary Disease and Preclinical Diabetes," *Nutrition Rev.*, **23**:323, 1965.

lesser weight, even though no abnormal gluc
of giving birth. Likewise, the large babies a
development of diabetes than are those of
variety of unexplained symptoms such as
and neuritis often show abnormal glucose tol

Prediabetes is suggested by changes in the
as those obtained by biopsy from the earlob
activity of the blood serum, by an elevation
reduction of the release of complexed insuli

Types of diabetes. Two main types of
juvenile and adult or maturity-onset. Juver
quent occurrence and is seen prior to age 20
the abnormality of carbohydrate metabolis
required. The patients are sensitive to insulin
fluctuate from diabetic coma on the one ha
Most juvenile diabetics are of normal weight
in more detail in Chapter 46.

The adult type of diabetes occurs after a
dence, especially during the 50's and 60's.
obese individuals is far greater than it is
weight or slightly underweight (see Figure
of the adults in Joslin's diabetic clinic had p
cent or more. The patients are not depen
trolled by diet alone or by diet plus one of t
of them produce sufficient insulin through
the oral compounds; others produce sufficie
form which is reactive with glucose.

Symptoms. The disturbed metabolism
ing characteristic symptoms of the disease.

POLYURIA, or a frequent urination and a
results when glucose passes through the k

POLYDIPSIA, or excessive thirst, is expla
in the urine and the need for replacement i

POLYPHAGIA, or increased appetite, resu
for nourishment of the body cells.

DEHYDRATION is occasioned by the exces
balance it by water intake.

GENERAL WEAKNESS AND LOSS OF WEI
and the subsequent breakdown of body tiss

DECREASED RESISTANCE TO INFECTION
and tuberculosis, becomes apparent in un
diabetes.

DECREASED ABILITY OF THE TISSUES TO
and poor fluid balance.

s peripheral neuritis, retinitis, atherosclerosis
ies, and vascular changes in the kidneys are
lly those which have been poorly controlled.
ımulation of lower fatty acids in the blood
ıd even death.

osis of diabetes mellitus is based upon the
/ith the results of several laboratory tests.
ıd treatment has been instituted, a patient is
cretion of sugar and of ketones so that he
o which he is controlling his diabetes. Such
ıs of test strips of paper impregnated with
e of the glucose or acetoacetic acid, as the

f sugar in the urine, should be regarded as
ıerwise. Situations in which sugar is present
le pentosuria as the result of the body's
wn as pentose; lactosuria in nursing moth-
a dietary loads of carbohydrate; and renal
of the ability of the tubules to reabsorb
n in some cases of hyperthyroidism and

by determination of the concentration of
ing blood sugar of more than 140 mg per

tones, occurs when fatty acids are incom-
tection of acetoacetic acid is a simple and

a measure of the ability of the body to
Jnder the conditions of the test, a normal
gar about ½ hour after ingestion of the
rns to the normal level in 2 hours. If the
g per 100 ml and fails to return to normal
s is presumed to be present. (See Figure

ıal metabolic rate in diabetic patients is
severe, uncontrolled patients who have
In order to understand the changes in
ılism in diabetes, the student should first
e nutrients (see Chapters 5, 6, and 7).
ıe normal fasting glucose concentration
ıl. If there is too little insulin being pro-
glycogen in the liver, and the uptake of
ın will be decreased. Consequently, the
creases markedly as the sugars are ab-

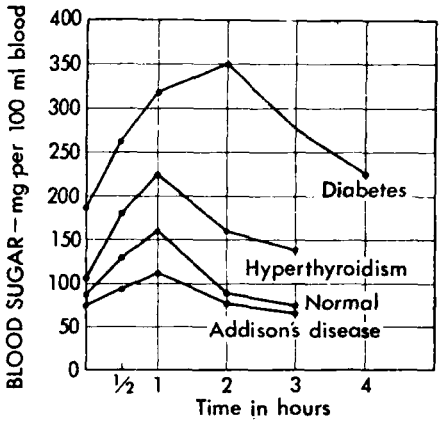


FIG. 38–3. Glucose-tolerance curves in various metabolic disorders.

sorbed from the intestine or may be derived from the breakdown of dietary or body proteins and fats. When the renal threshold is reached (about 170 mg per 100 ml blood) sugar begins to appear in the urine. In severe diabetes, the fasting blood sugar may reach 400 mg per 100 ml or more.

FAT METABOLISM. In diabetes, fatty acid synthesis is decreased and fatty acid oxidation increased.[4] When the glycogen stores are depleted the liver releases into the bloodstream larger amounts of the ketone bodies (acetone, beta-hydroxybutyric acid, and acetoacetic acid) but these cannot be disposed of rapidly enough. Acetoacetic acid and beta-hydroxybutyric acid are fairly strong acids and significant amounts of basic elements combined with them are lost in the urine. The depletion of body base leads ultimately to acidosis.

Atherosclerosis appears at an early age in diabetics and progresses more rapidly than in nondiabetic individuals. This condition and the attendant cardiovascular diseases are associated with high blood lipid levels including triglycerides and cholesterol. Whether the elevated lipid levels and their apparent association with cardiovascular disease constitute an inherent trait of the diabetic or are the result of the manner of dietary treatment or both has not been determined.[2]

PROTEIN METABOLISM. Protein tissues, as well as fatty tissues, are broken down when carbohydrate is not normally metabolized. The resulting amino acids are deaminized and the nonnitrogenous part of the molecule would normally be utilized as glucose or fatty acids. In the diabetic, the breakdown of protein leads to further increase of glucose in the circulation and of incompletely oxidized fatty acids. About 58 per cent of the amino acids are potential sources of glucose, but so high a rate of conversion is not usually realized.[5]

Rationale for dietary management. The goals to be achieved in the management of the diabetic individual must be related to each situation. A realistic goal for an 80-year-old would be quite unsatisfactory for the young diabetic. Likewise, careful control to reduce the degree of atherosclerosis in the young individual is likely to be of little consequence for the elderly person. Stone has

described a concept of therapy which includes these aims:[4] (1) prevention of acidosis and shock, (2) relief of symptoms as thirst, polyuria, (3) positive good health, and (4) normal blood glucose levels. A fifth aim might relate to a goal such as the maintenance of nearly normal lipid levels, or some other characteristic which promotes long life and healthful living. As a very minimum, the first three goals are essential for any satisfactory regimen.

Viewpoints differ somewhat concerning the degree of dietary control that is necessary. Three points of view have been summarized by Cohen.[6]

CHEMICAL CONTROL. A measured diet and insulin dosage are carefully regulated so that the blood sugar is kept within normal limits and the urine is free or nearly free of sugar at all times. Such control is believed to reduce the incidence and severity of degenerative complications. One criticism sometimes leveled against it is that the treatment may tend to be directed to the diabetes and not to the person as a whole.

CLINICAL CONTROL. Hyperglycemia and glycosuria are disregarded, and insulin is used to control ketosis. The diet differs little if any from that of normal persons and is controlled only to the point of maintenance of normal weight. Some physicians use these so-called "free" diets in the most liberal sense, but others restrict concentrated carbohydrate foods, especially those from sources contributing no other nutrients. Those who favor clinical control believe that the patient has an increased sense of well-being and that the degenerative complications are not more frequent.

INTERMEDIATE CONTROL. The majority of physicians adopt a regimen which falls between the preceding two. The objectives are: (1) to treat the patient as an individual and not on the basis of his diabetes alone; (2) to provide adequate nutrition for the maintenance of normal weight, a sense of well-being, and a life of usefulness; (3) to keep the blood sugar almost at normal levels for a large part of the day by using insulin as needed but avoiding hypoglycemia; (4) to keep the urine sugar-free or with only traces of sugar for most of the day.

Daughaday[5] cites three arguments for a controlled diabetic diet: (1) its educational value in helping the patient to understand his disease and the need for optimum nutrition; (2) 30 to 40 per cent of all diabetic patients do not need insulin if their diets are controlled; and (3) dietary control with insulin permits correlation of the diet with the type of insulin so that a normal blood sugar is achieved without too much risk of insulin shock.

The diabetic patient must observe dietary restriction for the remainder of his life. Such regulation, when properly made, permits the patient to lead an essentially normal life. However, great care must be taken that this diet always provides the elements of good nutrition. Each diabetic diet is specific for the individual concerned.

ENERGY. The caloric allowance is essentially the same as that for normal individuals of the same activity, size, and sex. Obese individuals should be placed on a low-calorie diet until the desirable weight for height and age is

attained. Such weight loss in middle-aged obese patients very often leads to return of normal glucose tolerance.

One approach to planning the calorie level is to determine the patients' present food intake and to use it as a guide for the calculated diet. The patient's continuing weight status determines whether the diet, in fact, is satisfactory in its calorie level—assuming, of course, that the patient is adhering to it. A convenient guide for planning the energy level is as follows:

	CALORIES PER POUND (DESIRABLE WEIGHT)
For weight loss	8 to 12
For a bed patient	12
For light work	14
For medium work	16
For heavy work	18

PROTEIN. About 1 to 1½ gm protein per kilogram (½ to ⅔ gm per pound) of desirable body weight is a satisfactory protein allowance. The higher level of protein is typical of American dietaries and lends satiety value to the diet. Growing children, pregnant and lactating women, and those who have had substantial weight losses should have a liberal intake of protein.

CARBOHYDRATE AND FAT. Customarily, diabetic diets have been restricted in carbohydrate with the remaining calories being provided by fat. As a consequence the proportion of fat has been relatively high, but in line, nevertheless, with the typical fat intake of Americans. A level of 100 gm carbohydrate is satisfactory for preventing ketosis, but typical diabetic diets contain 200 gm or more. The diet plans prepared by a committee of the American Dietetic Association[7] range in carbohydrate levels from 125 to 370 gm, and in fat levels from 50 to 165 gm. These plans have proven to be satisfactory in achieving relief from symptoms and in meeting nutritional needs for positive health.

Japanese diabetics fare equally well with diets that provide not more than 30 gm fat and 350 gm carbohydrate. These intakes are typical of the Japanese dietary, rather than being specifically designed for the diabetic. Of some importance is the lesser incidence of acidosis and vascular complications and the lower death rate among Japanese diabetics in comparison with American diabetics.[2]

The insulin requirement is not proportionately increased when the carbohydrate level of the diet is increased, but is more directly correlated with the total calorie requirement.[2] Thus, to restrict carbohydrate on the basis of the insulin requirement scarcely seems justified.

The very low-fat, high-carbohydrate diets which [illegible]re satisfactory for the Japanese dietary are likely to meet with little suc[illegible]in the management of the American diabetic since the dietary patterns [illegible]l require major adjustments from those to which the patient is accusto[illegible]he pragmatic approach

would suggest that carbohydrate and fat levels permitted in the diabetic diet might well be those of the normal diet, but that the choice of fat could be modified. Thus, the intake of saturated fatty acids would be reduced by using lean meats, skim milk, and avoiding butter, cream, etc. The intake of poly-unsaturated fatty acids would be increased by using vegetable oils and special margarines. See Chapter 41 for a full discussion of fat-controlled diets.

Calculation of the diabetic diet prescription. The obese adult diabetic is regulated by diet alone, although some may also require an oral hypoglycemic agent. As diabetes becomes more severe, insulin is required. Juvenile patients require insulin, and in some diabetic control is achieved more satisfactorily when both insulin and phenformin* are used with the diet.

The physician bases his diabetic diet prescription upon the following criteria.

1. The history of the patient and his family.
2. Sex, age, weight, height, and activity of the patient.
3. Type of diabetes—mild or severe.
4. Type of insulin, if required.
5. Nutritional requirements.
6. Usual meal patterns.

An illustration is here given of the manner in which a diabetic prescription may be calculated. Let us assume that a diet is to be planned for a secretary who is 25 years old and 66 inches tall. According to the table of heights and weights (Table A–15) her desirable weight is 128 pounds (medium frame).

1. *Calories:* 14 calories per pound of desirable body weight
   $128 \times 14 = 1792$ calories per day.
2. *Protein:* 0.5 to 0.67 gm per pound of desirable body weight
   $128 \times 0.6 = 77$ gm protein per day.
3. *Nonprotein calories:* $1792 - 308 = 1484$ calories to be divided between carbohydrate and fat.
4. *Carbohydrate:* allow 40 to 60 per cent of nonprotein calories
   50 per cent of 1484 calories = 742 calories
   $742 \div 4 = 185.5$ gm carbohydrate per day.
5. *Fat calories:* total calories − calories from protein and carbohydrate
   $1792 - (308 + 742) = 742$ calories.
6. *Fat:* fat calories ÷ 9
   $742 \div 9 = 82.4$ gm fat per day.

By rounding off the numbers the prescription becomes: carbohydrate, 185 gm; protein, 75 gm, and fat, 80 gm.

If the fat level had been restricted to 50 gm per day, the prescription for the above patient would be completed as follows:

Carbohydrate ca *ies:* total calories − calories from protein and fat
$1792 - (308 + 450) = 1034$
Carbohydrate: 1[illegible] $= 258.5$ gm

* DBI, U.S. Vitamin P[illegible] [illegible]cal Corporation, New York City.

The prescription would become: carbohydrate, 260 gm; protein, 75 gm; and fat, 50 gm.

Distribution of carbohydrate. The meal distribution of carbohydrate is determined according to the type of insulin being used and is modified according to each patient's needs in order to achieve the best possible regulation of carbohydrate utilization. Whenever no insulin is being given, the carbohydrate is divided, as a rule, into three equal parts. In many patients the blood sugar tends to be higher in the morning, in which case a smaller amount of carbohydrate—⅕ to ¼ of the total—may be given for breakfast with larger amounts at noon and night.

Regular insulin is now rarely used alone except for emergencies such as diabetic coma and surgery. It is sometimes given together with one of the more slowly acting insulins. When it is used alone, the larger amounts of carbohydrate will be included at the meal or meals immediately following the insulin injection.

Several slowly acting insulins are now widely used. Because the duration of action is prolonged for 18 to 24 hours or longer, a portion of the carbohydrate—usually 20 to 40 gm—is reserved for a bedtime feeding. This carbohydrate must be in slowly available form, and should be accompanied by a portion of the day's protein. After the bedtime carbohydrate has been subtracted from the day's allowance, the remainder of the carbohydrate is distributed to correspond to the peak activity and the duration of the activity of the insulin that is being used (see p. 578). The table which follows illustrates approximately how the carbohydrate might be divided with the several types of insulin.

Table 38–1. Typical Meal Distributions of Carbohydrate

Type of Insulin	Breakfast	Noon	Mid-afternoon	Evening	Bedtime* gm
None	1/3	1/3		1/3	Usually
	1/5	2/5		2/5	none
Regular (before breakfast and dinner)	2/5	1/5		2/5	Usually none
Protamine zinc	1/5	2/5		2/5	20–40
Protamine zinc with regular at breakfast	1/3	1/3		1/3	20–40
Isophane (NPH); or lente	1/3	1/3		1/3	20–40
	1/5	2/5		2/5	20–40
Globin	2/10	3/10	1/10	4/10	

* The bedtime carbohydrate is subtracted from the day's total allowance. Then the meal fractions are applied to the remainder of the carbohydrate.

Planning the meal pattern. The calculation of the diet prescription and the distribution of the carbohydrate are the physician's responsibility. The dietitian

and the nurse must translate these factors into terms of common foods which will also assure the patient a sufficient amount of the essential minerals and vitamins. There are a number of points to keep in mind while planning the diet. (See Tables 38–2 and

1. The diet should be worked out with the patient so that it can be adjusted to his pattern of living. This requires consideration of the patient's economic status, the availability and cost of food, national, religious, and social customs, personal idiosyncrasies, occupation, facilities for preparing or obtaining meals, and so on.

The diabetic diet need not be an expensive one, and, ideally, it should be so planned that it fits in with the menus of the rest of the family. However, if the family dietary pattern is a poor one, the entire family will benefit when

Table 38–2. Calculation of a Diabetic Diet*

Carbohydrate: 185 gm Protein: 75 gm Fat: 80 gm

List	Food	Measure	Weight gm	Carbohydrate gm	Protein gm	Fat gm
1	Milk	3 cups	720	36	24	30
2	Vegetable					
	group A	up to 1 cup		—	—	—
	group B	½ cup	100	7	2	—
3	Fruit	4 exchanges	varies	40	—	—
				83		
4	Bread	7 exchanges	varies	105	14	—
					40	
5	Meat	5 exchanges	varies	—	35	25
						55
6	Fat	5 exchanges	varies	—	—	25
				188	75	80

185 gm carbohydrate prescribed total
83 gm carbohydrate from milk, vegetables, and fruit
102 gm carbohydrate to be supplied from bread exchanges
102 ÷ 15 = 7 bread exchanges
75 gm protein prescribed total
40 gm protein from milk, vegetable, and bread exchanges
35 gm protein to be supplied from meat exchanges
35 ÷ 7 = 5 meat exchanges
80 gm fat prescribed total
55 gm fat from milk and meat exchanges
25 gm fat to be supplied from fat exchanges
25 ÷ 5 = 5 fat exchanges

* The composition of food groups and lists of food exchanges are given in Table A–4 of the Appendix.

the basic food groups become the center about which the meals are planned. Every effort should be made to regard the patient as a "normal" individual

who does not require many special foods and who does not deprive other members of the family.

2. Adequacy of the diet for minerals and vitamins is most easily assured if one includes the minimum amounts of the Four Food Groups.

3. The foods selected must satisfy the demands of the normal appetite. Most diabetic diet prescriptions today are sufficiently liberal so that this is not a major problem. However, the lack of satiety value in a diet often leads patients to break their diets. Including some of the protein and fat into each of the meals helps to provide more satisfying meals.

4. The exchange lists of foods (Table A-4) recommended by the joint committee of the American Dietetic Association, the American Diabetes Association, and the U.S. Public Health Service are used in the majority of hospitals in this country. The use of these lists for dietary calculation permits reasonable dietary constancy from day to day and considerable flexibility in meal planning. See Chapter 30 for further description of these lists.

5. The calculated daily totals for carbohydrate, protein, and fat should be within 2 to 3 gm of the prescribed totals. The meal allowance for carbohydrate can be adjusted to within 7 or 8 gm. It is not advisable to use fractions of any of the exchanges since awkward amounts of food may be involved.

6. The meal distribution of protein and fat should be arranged for maximum flexibility in menu planning. To illustrate, the inclusion of milk at breakfast permits either cereal or bread to be selected from the bread exchanges; meat exchanges are wisely divided among the three meals with somewhat larger amounts being allocated to the dinner.

7. For greatest ease in planning the dietary pattern follow these steps: Include the necessary amounts of milk, vegetables, fruit, and bread so that the carbohydrate total for the day is correct; subtract the protein value of the milk, vegetables, and bread from the day's protein allowance; calculate the number of meat exchanges required to fill the prescribed protein total; subtract the fat value of the milk and meat exchanges from the day's fat allowance; calculate the number of fat exchanges required to fill the prescribed fat total. These steps are illustrated in the calculation shown in Table 38–2.

8. Patients frequently ask about the use of dietetic foods. They will find water-packed fruits to be useful in meal planning when fresh fruits are unavailable or may be expensive. These fruits are now available in most groceries and are not much more expensive than the usual sweetened canned fruits. Many of these products are now packed with artificial sweeteners added.

Other dietetic foods are not necessary in the diabetic diet of today which follows so closely the selection of foods for the general population. Many of these foods are expensive, they add little by way of palatability, they emphasize that the patient is "different," and their composition is variable. For example, gluten bread is lower in carbohydrate than regular br[illegible]but its protein finally is broken down to provide appreciable quantities of [illegible]ble glucose. Dietetic candies, cookies, and cakes likewise must be [illegible]the dietary pattern if they are used.

Table 38–3. Meal Pattern and Sample Menu

Carbohydrate division: breakfast, 55 gm; luncheon, 55 gm; dinner, 55 gm; bedtime, 25 gm

Meal Pattern	Exchanges	Carbohydrate gm	Sample Menu	Measure	Weight gm
Breakfast			**Breakfast**		
Fruit, list 3	1	10	Orange	1 small	100
Meat, list 5	1	—	Egg, poached	1	
Bread, list 4	2	30	Whole-wheat toast	1 slice	25
			Wheat flakes	¾ cup	20
Milk, list 1	1	12	Milk	1 cup	240
Fat, list 6	1	—	Butter	1 teaspoon	5
Coffee or tea			Coffee: *no sugar*		
		52			
Luncheon			**Luncheon**		
Meat, list 5	1	—	Cheese sandwich		
Bread, list 4	2	30	Cheese	1 ounce	30
Fat, list 6	2	—	Rye bread	2 slices	50
			Butter	1 teaspoon	5
Vegetable, group A, list 2		—	Sliced tomatoes on lettuce	medium salad	
			French dressing	1 tablespoon	15
Milk, list 1	1	12	Milk	1 cup	240
Fruit, list 3	1	10	Fresh blackberries	1 cup	150
		52			
Dinner			**Dinner**		
Meat, list 5	2	—	Chopped round steak	2 ounces	60
Bread, list 4	2	30	Potato, mashed	½ cup	100
			Roll	1, 2 inch diameter	30
Fat, list 6	1	—	Butter	1 teaspoon	5
Vegetable, group B, list 2	1	7	Parsley carrots	½ cup	100
Fruit, list 3	2	20	Cantaloupe	¼, 6 inch diameter	200
Coffee or tea			Tea with lemon		
		57			
Bedtime			**Bedtime**		
Milk, list 1	1	12	Milk	1 cup	240
Bread, list 4	1	15	Sardines	5	20
Meat, list 5	1	—	Peanut butter	2 tablespoons	30
Fat, list 6	1	—	Butter	1 teaspoon	5
		27			
Total Carbohydrate		88			

9. Patients who find it difficult to adjust to a diabetic diet may find artificial sweetening agents to be useful. Saccharin is about as sweet as sugar, while Sucaryl has about 30 times the sweetening power of cane sugar. Both products are available in pill or liquid form. Individuals usually show marked preference for one or the other.

INSULIN AND ORAL COMPOUNDS

When the body does not manufacture enough insulin, it must be supplied by injection. Insulin, which has revolutionized the treatment of diabetes, was discovered by Banting and Best of Toronto, Canada, in 1921. It is protein in nature and identification of its chemical structure has established that it contains most of the naturally occurring amino acids. It is now prepared from beef, pork, and sheep pancreas.

Insulin unitage. Insulin is measured in units, 1 unit being the activity of 0.125 mg of the international standard. The assay of insulin is based on the lowering of the blood sugar of a fasting rabbit weighing 2 kg from the normal level to 45 mg per 100 ml. One unit of insulin will oxidize approximately 1½ to 2 gm of glucose, but there is wide variability.

Insulin is generally supplied in solution of 40 units per cubic centimeter (U-40) or 80 units per cubic centimeter (U-80). Thus, U-80 is twice as strong as U-40. (See Figure 38–4.)

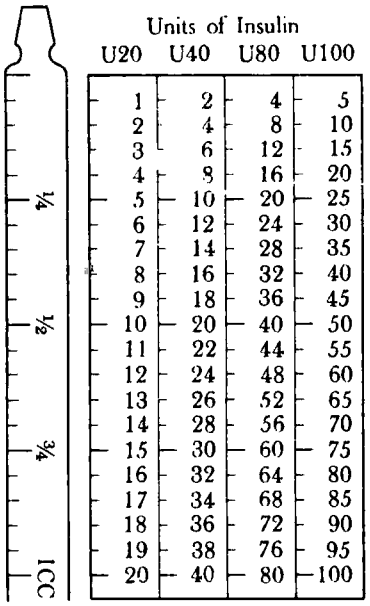


FIG. 38–4. Measures for various strengths of insulin.. (*Courtesy, Dr. R. M. Wilder, The Mayo Clinic, Rochester, Minn.*)

n. The five main types of insulin and their mode of action [illegible] Table 38–4. Depot insulins are those in which the active principle in a solution which is absorbed slowly. Lente insulin does not contain and is the insulin of choice for patients who have allergic reactions to es of insulins. Lente insulins have prolonged action, semilente having he shortest duration and ultralente the greatest duration.

Table 38–4. Types of Insulin and Their Action*

Types	Onset *hours*	Peak Action *hours*	Duration *hours*
1. Plain or crystalline	1	2–3	6–8
Depot insulins			
2. Globin zinc	1–2	8–16	18–24
3. Protamine zinc	4–6	16–24	24–36 or longer
4. NPH or Isophane	1–2	10–20	28–30
5. Lente			
a. Lente (Standard) or insulin zinc suspension	1–2	10–20	28–30
b. Ultralente			
c. Semilente			

* Adapted from *Diabetes Mellitus. A Guide for Nurses.* U.S. Public Health Service Pub. No. 861, U.S. Department of Health, Education, and Welfare, Washington, D.C., 1962, p. 16.

Oral compounds. Two groups of oral drugs are now in use, namely, the sulfonylureas and the biguanides. These compounds are not insulin and do not have the same action as insulin when it is injected.

Among the sulfonylurea compounds are tolbutamide (Orinase*), chlorpropamide (Diabinese†), and acetohexamide (Dymelor‡). These drugs are effective in lowering the blood sugar and in reducing the glycosuria. They appear to stimulate the production or release of insulin by the pancreas. A secondary action may be the inhibition of glucose formation from liver glycogen.

Phenformin (DBI§) is a phenethylbiguanide which has hypoglycemic activity. It appears to increase the uptake of glucose in the peripheral tissues but does not influence insulin production by the pancreas.

The oral compounds find their use in the management of maturity-onset diabetes which cannot be controlled by diet alone. The oral compounds should never be regarded as a substitute for a controlled diet, and they should not be used in complications of diabetes such as acidosis and coma. They are not satisfactory for the juvenile, unstable, severe diabetic.

* Orinase, The Upjohn Company, Kalamazoo, Michigan.
† Diabinese, Chas. Pfizer & Co., Inc., New York City.
‡ Dymelor®, Eli Lilly Company, Indianapolis, Indiana.
§ DBI, U.S. Vitamin Pharmaceutical Corporation, New York City.

EDUCATION OF THE PATIENT

The ultimate success of the treatment of diabetes is dependent upon the intelligent cooperation of the patient himself. The better informed the patient is with regard to the nature of his disease, its treatment, and possible complications, the greater are the chances that he will enjoy a normal span of life with gainful occupation and enjoyable leisure. The education of the patient requires patience and skill on the part of physician, nurse, and dietitian. Each has a role to play in providing instruction that is adequate but not overwhelming.

The new diabetic who is initially stabilized while in a hospital has an opportunity to learn a great deal about his treatment providing that professional personnel accept responsibility for instruction. Every meal illustrates the use of the exchange lists, and the patient should be guided by the nurse and dietitian to see how each food item fits into his dietary plan.

Dietary counseling. The patient should be taught (1) the reasons for a specified diet, (2) the size of portions which may be used, and (3) the substitutions which are possible on the diet. He must be convinced of the importance of maintenance of normal weight, and that foods should be eaten in the kinds and amounts prescribed.

Standardization of portions in the hospital is exceedingly important and weighing of diabetic diets may be the only way to achieve this. However, it is neither necessary nor desirable for the patient to weigh his food at home. Standard measuring cups and spoons are sufficiently accurate for measuring the diet at home; in time the patient learns to judge the correct size of serving portions.

Nothing favors breaking a diet so much as serving the same foods over and over again. Patients need to learn to select the correct foods from the exchange lists so that their menus may be varied. At the beginning of dietary instruction, it is not advisable to select foods which require recipe computation. Later on, they may be able to adapt simple recipes from a cookbook or to use cookbooks written for the diabetic. A number of teaching aids are listed in the references at the end of this chapter.

Other factors requiring emphasis. In addition to dietary instruction, the patient needs to be taught (1) the method of insulin administration and the regulation of dosage, (2) the method of testing the urine, (3) the importance of adequate rest, well-regulated exercise, and good hygiene with special emphasis on foot care, and (4) the dangers, symptoms, and necessary procedures for the control of diabetic coma or insulin shock. Diabetics should make every effort to maintain a calm, contented life, learning how to cope with daily stresses without undue emotional strain.

COMPLICATIONS OF DIABETES

Insulin shock. The symptoms of hypoglycemia or insulin shock are caused by an overdose of insulin, a decrease in the available glucose because of delay in eating, omission of food, or loss of food by vomiting and diarrhea, or an increase in exercise without accompanying modification of the insulin dosage.

The patient going into insulin shock becomes uneasy, nervous, weak, and hungry. He is pale, his skin is moist, and he perspires excessively. He may complain of trembling, dizziness, faintness, headache, and double vision. His movements may be uncoordinated. Emotional instability may be indicated by crying, by hilarious behavior, or by belligerency. Occasionally, there may be nausea and vomiting or convulsions. Without treatment stupor follows and death is impending. Laboratory studies show a blood sugar below 70 mg per 100 ml for mild symptoms and below 50 mg for stupor. The second urine specimen is negative for sugar and acetone.

Orange juice or other fruit juices, sugar, candy, syrup, honey, or any readily available carbohydrate may be given. If absorption is normal, recovery follows in a few minutes. If there is stupor, intravenous glucose is necessary. Most patients are now using one or another of the slowly acting insulins, in which case reactions may recur after a few hours. To avoid such subsequent reactions, it is necessary to follow the initial carbohydrate therapy in 1 or 2 hours and at later intervals with foods containing carbohydrate which is slowly absorbed—such as in milk and bread.

The patient must be impressed with the importance of balance between his diet and insulin dosage and the importance of close adherence to the physician's orders. He should always carry some sugar or hard candy to avert symptoms when they are still mild.

Diabetic acidosis and coma. A dreaded complication in diabetes is the state of coma which is brought about by acidosis. Diabetic coma often originates because the patient consumed additional foods for which his insulin did not provide, or because he failed to take the correct amount of insulin or omitted it entirely. The presence of diabetes is first detected in some persons who were not aware of the disease until coma occurred. Infection is an especially sinister influence since even a mild infection reduces the carbohydrate tolerance and severe acidosis may sometimes occur before the insulin dosage has been appropriately increased. Trauma of any kind, whether an injury or surgery, aggravates the diabetes so that acidosis is more likely.

Some of the signs of diabetic acidosis and coma are similar to those of insulin shock, and a differentiation cannot be made without information concerning the patient prior to the onset of the symptoms, together with blood and urine studies. The patient complains of feeling ill and weak; he may have a headache, anorexia, nausea and vomiting, abdominal pain, and aches and

pains elsewhere. His skin is hot, flushed, and dry; his mouth is dry and he is thirsty. An acetone odor on the breath, painful, rapid breathing, and drowsiness are typical signs. Symptoms of shock, unconsciousness, and death follow unless prompt measures are taken. Sugar, acetone, and acetoacetic acid are present in the urine, the blood glucose is elevated to very high levels, and the blood carbon dioxide content is decreased.

When early signs of ketosis are present, small repeated doses of insulin are given together with small carbohydrate feedings. Diabetic coma, however, is a medical emergency best treated in a hospital where close nursing care can be given. The physician directs the therapy which includes large doses of regular insulin with smaller doses repeated as needed every hour or so until the urine sugar is reduced and the blood sugar is lowered to less than 200 mg per 100 ml; saline infusions for the correction of dehydration; gastric lavage if the patient has been vomiting; and alkali therapy for the correction of the severe acidosis.

When the urine sugar decreases and the blood sugar begins to fall, glucose is given by infusion in order to avoid subsequent hypoglycemic reactions. As soon as fluids can be taken orally, the patient is given fruit juices, gruels, ginger ale, tea, and broth. All of these are useful for their fluid content; fruit juice, ginger ale, and gruels provide carbohydrate; broth and gruels contain sodium chloride; and fruit juices, broth, and gruels contribute potassium. These fluids may be given in amounts of 100 ml, more or less, every hour or so during the first day. By the second day, the patient is usually able to take a soft diet which is calculated to contain 100 to 200 gm carbohydrate, and by the third day he may take the diet which meets his particular requirements.

Diabetes and surgery. The diabetic patient as well as the nondiabetic individual should have a good store of glycogen in order best to withstand surgical procedures. That reserve can be assured only (1) if sufficient foods of high carbohydrate content are given up to 12 hours before operation and (2) if insulin is supplied in great enough amounts to oxidize the carbohydrate. It is advisable to give fluids in abundance. In emergency operations where coma and acidosis impend, it is usually necessary to give parenteral glucose and saline.

Carbohydrate feedings should begin within 3 hours after operation, as a rule. These may be in the form of glucose and saline infusions. When liquids may be taken by mouth, orange juice, or ginger ale may be used at first. As soon as full liquids or a soft diet is permitted, the diet may be calculated to meet the protein and fat as well as carbohydrate allowances.

Infection. Any infection intensifies diabetes, because the carbohydrate tolerance is lowered. A mild diabetic may become a severe case, and in untreated diabetes infections may precipitate coma. If a patient who is not taking insulin develops an infection, the physician usually orders insulin, at least temporarily, until the infection subsides. The diet may be changed to a fluid and soft consistency as the situation demands.

Diabetes in pregnancy. The diabetic woman who is pregnant requires an increase in her diet during the last half of pregnancy and corresponding adjustment of insulin dosage. The nutritive requirements are similar to those of the nondiabetic woman who is pregnant. Diabetes increases the hazards of pregnancy because of dangers of glycogen depletion, hypoglycemia, acidosis, and infection. The diabetic mother, as a rule, is not able to produce enough milk for her baby and should not be encouraged to nurse her infant because of the additional strain on her body.

For a discussion of diabetes in childhood, see Chapter 46.

PROBLEMS AND REVIEW

1. What is diabetes mellitus? latent diabetes? prediabetes?
2. Name the important predisposing factors in diabetes.
3. What are the outstanding symptoms of diabetes? What laboratory tests may aid in diagnosis?
4. How is the metabolism of each of these factors altered in diabetes: total energy metabolism; protein; carbohydrate; fat?
5. On the basis of the modified metabolism in diabetes, what should be the objectives for treatment? What changes would you make in the diet with respect to each nutrient?
6. List eight points to observe in the planning of the diabetic diet.
7. Compare the types of insulin commonly used for treatment of diabetes.
8. What is meant by U-40? U-80?
9. What are the characteristic symptoms of overdosage of insulin?
10. What treatment is effective for insulin shock?
11. When are oral compounds desirable in diabetic therapy? When is their use contraindicated?
12. What features distinguish insulin shock from acidosis?
13. How is acidosis treated?
14. What factors are important for reducing the incidence of acidosis and of insulin shock?
15. What modification of the diabetic diet would be necessary for each of the following circumstances: for a child of 7 years; for a patient who has hyperthyroidism; for a woman who is 5 months pregnant; for a person who is to have an operation in 2 days; for a patient who has just had a cholecystectomy?
16. Be able to define or explain each of the following: hypoglycemia; hyperglycemia; glycosuria; renal threshold; glucose tolerance; available glucose of a diet; ketogenic factors in a diet; ketone body; carbohydrate classification of fruits and vegetables; clinical control; chemical control; free diet.
17. *Problem.* Plan a prescription and a diet for a man who works in a factory and who must carry his lunch. He is 69 inches tall and weighs 220 pounds. He is 45 years old.
18. *Problem.* Outline a plan of instruction for a patient such as the one described in Problem 17.
19. *Problem.* Show how carbohydrate might be distributed for the various meals, using each of the f of insulin: regular; protamine zinc; globin; lente; isophane.
20. Some clini ans recomm ow in saturated fat and high in polyunsaturated fat for patients with diabetes. antages are claimed for such modification? What change would you make in th e diet calculation on page 574 in order to increase the proportion of polyunsaturate atty acids?
21. What recommendations could you make to an individual who has a diabetic relative so that he might avoid or delay the onset of symptoms of diabetes?

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Chapter 39

VARIOUS METABOLIC DISORDERS
Low-Purine Diet

Many diseases for which dietary modification is an effective part of treatment are deviations of normal metabolic pathways in the body. They occur because of abnormal production of one or more hormones, a deficiency of an enzyme, or a modification of excretion. Those which are discussed in this chapter fall into one or another of these categories but otherwise bear little, if any, relation to each other.

SPONTANEOUS HYPOGLYCEMIA

Types of hypoglycemia. Spontaneous hypoglycemia is a symptom of disordered carbohydrate metabolism which may be of functional or organic origin. The symptoms are characteristic of those described for insulin shock (see p. 580). The patient becomes weak, nervous, extremely hungry, perspires freely, trembles, and may even lose consciousness. Convulsions occur occasionally.

On the basis of dietary management, hypoglycemias fall into two groups, namely, (1) stimulative and (2) fasting.[1] Tumors of the islet cells of Langerhans also lead to overproduction of insulin, but surgery rather than dietary management is essential.

FUNCTIONAL HYPERINSULINISM

Nature of hypoglycemia. Functional hyperinsulinism is a stimulative type of hypoglycemia in which there is no known organic lesion. Under the stimulus of carbohydrate the islet cells respond to a greater than normal degree with the following characteristics of the blood sugar: (1) a normal fasting blood sugar; (2) hypoglycemia 2 to 4 hours after meals, especially in the forenoon and late afternoon; (3) no hypoglycemia following fasting or the omission of meals; and (4) a glucose tolerance curve (see Figure 38–3) which shows a

normal fasting sugar, initially elevated glucose level after taking the glucose, and a sharp fall to very low sugar levels.

A condition similar to functional hyperinsulinism occurs when nutrients are absorbed at an extremely rapid rate, for example, following gastroenterostomy or gastrectomy. In such situations the food reaches the small intestine much more rapidly than is normal, is very quickly absorbed, and the sudden elevation of the blood sugar serves as an extra stimulus to the islet cells and a subsequent hypoglycemia. See Chapter 34 for description of the dumping syndrome.

Modification of the diet. A diet prescription to meet each patient's needs is calculated according to the following principles.

CARBOHYDRATE. Because the carbohydrate serves as a stimulus to further insulin secretion and is provocative of the hypoglycemic attack, it is usually restricted to levels below 100 gm. The initial diet may be planned to contain 75 gm carbohydrate with further reduction to 50 gm if the patient shows no improvement.[2]

PROTEIN. A high-protein diet, 120 to 140 gm, has been advocated,[3] since there is no appreciable increase in the blood sugar level following high-protein meals even though protein furnishes approximately 50 per cent of its weight in available glucose. This available glucose is released to the blood stream so gradually that there is little stimulation to the islands of Langerhans.

FAT. When the levels of carbohydrate and protein have been established, the remaining calories are obtained from fat. Because the carbohydrate is so severely restricted, the fat level is, of necessity, high.

Planning the diet. The exchange lists (see Table A-4) may be used for calculation of the diet prescription. Since carbohydrates are drastically restricted, it becomes apparent that the bread exchanges will usually be omitted. In order to include adequate amounts of fruits and vegetables, milk is limited to 2 or 3 cups; children should receive calcium supplements. Vegetables from the 2A list are calculated to provide 2 gm protein and 3 gm carbohydrate per 100 gm.

In order that absorption from the intestine will be gradual, the daily allowances of protein and fat, as well as carbohydrate, are divided into three approximately equal parts. Midmorning, midafternoon, and bedtime feedings are often desirable, in which case part of the food planned for the preceding meal can be used for the interval feeding. Carbohydrate-containing foods must be carefully measured.

ADRENOCORTICAL INSUFFICIENCY

Addison's disease is a comparatively rare condition resulting from an impairment of the functioning of the adrenal cortex because of atrophy of unknown origin, or, in some instances, because of tuberculosis.[4] Sometimes

adrenalectomy is necessary because of cancer, in which event the resultant metabolic effects are those of Addison's disease. Since the pituitary governs the activity of the adrenal cortex, hypophysectomy will also lead to characteristic symptoms of adrenal insufficiency.

Metabolic effects and related symptoms. The symptoms of insufficiency are directly related to the absence of hormones produced by the adrenal cortex.

GLUCOCORTICOIDS. The principal action of these hormones, chiefly cortisol, is upon the regulation of the metabolism of carbohydrate, protein, and fat. Upon stimulation of cortisol, the liver forms glycogen from the amino acids supplied by the tissues. The hormone increases the rate of protein catabolism, and decreases the permeability of the muscle cells to amino acids. On the other hand, the permeability of the liver cells is increased and liver proteins increase. The glucocorticoids also influence the deposition of fatty tissue or the mobilization of fats.

In the absence of glucocorticoids rapid glycogen depletion occurs, followed by hypoglycemia a few hours after meals. Such hypoglycemia may be severe in a patient who has had no food for 10 or 12 hours. A glucose tolerance test shows a lower maximum blood sugar, and a more rapid return to normal fasting levels than is obtained in normal individuals (see Figure 38–3).

The production of glucocorticoids by the adrenal gland is governed by the adrenocorticotropic hormone (ACTH) of the pituitary. In the event hypophysectomy is performed, the adrenal cortex atrophies and glucocorticoids are not produced, just as they are not elaborated in Addison's disease.

MINERALOCORTICOIDS, of which aldosterone is of primary importance, are concerned with maintaining electrolyte homeostasis, especially for sodium and potassium. The production is regulated by the levels of sodium and potassium in the circulation. Aldosterone production leads to increased retention of sodium and greater excretion of potassium. Unlike the glucocorticoids, aldosterone production is not influenced by the pituitary. A deficiency of aldosterone, as seen in Addison's disease, leads to excessive excretion of sodium and increased retention of potassium. With the large salt loss much water is also excreted, thus leading to dehydration, hemoconcentration, reduced blood volume, and hypotension. In severe deficiency the patient experiences profound weakness and may have a craving for salt.

ANDROGENIC HORMONES stimulate protein synthesis. In their absence tissue wasting, weight loss, reduction of muscle strength, and fatigue are present.

Patients with adrenal insufficiency frequently experience anorexia, nausea, vomiting, abdominal discomfort, and diarrhea. Most of the patients have an increased pigmentation of the skin, often that of a deep tan or bronze. This results from the excessive production of *melanophore-stimulating hormone* by the pituitary when the adrenal steroids are lacking to exert an inhibitory effect.

Modification of the diet. Mild degrees of insufficiency are often satisfactorily treated by giving a higher salt intake, and by increasing the number of

meals to five or six a day.[4] As the deficiency becomes more severe cortisone may be given to control the hypoglycemia, and, to some extent, to increase sodium retention. An increase in the salt intake is usually needed.[4]

Patients with severe insufficiency are treated with injections of deoxycorticosterone (DOCA) or by implantation of pellets of the synthetic hormone. The mineral metabolism is thereby controlled so that no change is usually required in the sodium and potassium levels of the diet.

A diet high in protein and relatively low in carbohydrate reduces the stimulation of insulin and helps to avoid the episodes of hypoglycemia. Meals should be given at frequent intervals—allowing between-meal feedings and a late bedtime feeding. Each of the feedings should include protein in order to reduce the rate of carbohydrate absorption. Simple carbohydrates—candy, sugar, and other sweets—are best avoided because of their rapid digestion and absorption, and their stimulation of excessive insulin production.

METABOLIC EFFECTS OF ADRENOCORTICAL THERAPY

The adrenocorticotropic hormone of the anterior pituitary gland (ACTH) and the steroids of the adrenal cortex are used for the treatment of a wide variety of diseases such as arthritis, allergies, skin disturbances, adrenal insufficiency, many gastrointestinal diseases, and others. Although the various products used may vary somewhat in the degree of their effects on metabolism, it is important to be aware of possible nutritional implications of long-continued use of these hormones.

WATER AND ELECTROLYTE METABOLISM. Adrenocortical steroids in excess lead to retention of sodium and water and loss of potassium. Some sodium restriction is necessary for many patients. Usually, it is sufficient to avoid salty foods and to use no salt at the table, but a 1000 mg sodium diet may occasionally be required (see Chapter 43). When the patient is eating well, the amounts of potassium in the diet are liberal. Foods especially high in potassium include broth, fruit juices, fruits, vegetables, whole-grain cereals, and meats.

PROTEIN METABOLISM. A negative nitrogen balance may result when large doses of cortisone are used. This can be prevented when the diet is sufficiently liberal in carbohydrate to exert maximum protein-sparing effect and when high-protein intakes are emphasized.

CARBOHYDRATE METABOLISM. Cortisone therapy increases the storage of glycogen by increasing the amount of glycogen formation from protein. There also appears to be an insensitivity to insulin, as indicated by hyperglycemia and glycosuria. In diabetic patients who are also receiving cortisone, additional insulin may be required.

GASTROINTESTINAL SYSTEM. Hydrochloric acid secretion is increased following adrenocortical steroid therapy, and peptic ulceration may develop. In

such a situation, the dietary modification described for peptic ulcer should be used (see Chapter 35).

HYPERTHYROIDISM

Symptoms and clinical findings. Hyperthyroidism is a disturbance in which there is an excessive secretion of the thyroid gland with a consequent increase in the metabolic rate. The disease is also known as exophthalmic goiter, thyrotoxicosis, Graves' disease, or Basedow's disease. The chief symptoms are weight loss sometimes to the point of emaciation, excessive nervousness, prominence of the eyes, and a generally enlarged thyroid gland. The appetite is often increased, weakness may be marked, and signs of cardiac failure may be present.

Metabolism. All of the metabolic processes in the body are accelerated in hyperthyroidism.

ENERGY. The basal metabolic rate may be increased by as much as 50 per cent, and frequently more. Serum protein-bound iodine values are elevated. Moreover, the patient tends to be restless so that the total energy metabolism is further increased.

PROTEIN. The increased rate of nitrogen metabolism may lead to destruction of tissue proteins. Unless both protein and caloric levels are adequate, loss of weight may be rapid.

GLYCOGEN. When the level of calories is insufficient, the liver store of glycogen is rapidly depleted. This is specially serious just prior to surgery since postoperative shock is more likely.

MINERALS. The excretion of calcium and phosphorus is greatly increased in hyperthyroidism. Osteoporosis leading to osteomalacia and fractures has been observed.[5]

VITAMINS. The B-complex vitamins are used at an accelerated rate in accordance with the increased energy metabolism. The utilization of vitamin A and ascorbic acid is also speeded up.

Modification of the diet. Antithyroid compounds are now widely used to relieve the symptoms of hyperthyroidism, and in more severe instances to prepare the patient for surgery. These drugs reduce the basal metabolic rate to normal, but a liberal diet is still indicated because patients have usually experienced severe malnutrition prior to therapy.

Until normal nutrition is restored, approximately 4000 to 5000 calories and 100 to 125 gm protein should be allowed (see High-Calorie Diet, Chapter 32). Calcium intakes of 2 to 3 gm daily are desirable together with supplements of vitamin D.[5] The calcium may be provided as calcium salts in addition to the liberal use of milk. The diet itself will include generous allowances of vitamin A, the B complex, and ascorbic acid, but supplements are often prescribed.

HYPOTHYROIDISM

Hypothyroidism, or decreased production of the thyroid hormone, is known as myxedema when severe in the adult, or cretinism when its symptoms become apparent shortly after birth (see Chapter 9). Myxedema is characterized by a lowered rate of energy metabolism—often 30 to 40 per cent below normal, muscular flabbiness, puffy face, eyelids, and hands, sensitivity to cold, marked fatigue with slight exertion, and a personality change including apathy and dullness. The patient frequently responds to therapy with desiccated thyroid.

Obesity is an occasional problem in patients with hypothyroidism since they may continue in their earlier patterns of eating even though the energy metabolism has been significantly reduced. In other patients the appetite may be so poor that undernutrition results.

JOINT DISEASES

Many joint diseases are grouped under the common terms "arthritis" and "rheumatism." They are characterized by inflammation of the joints, stiffness, pain, and, in some diseases, by deformities. They may be acute or chronic in nature. Some of them are progressive, but there are frequent spontaneous remissions and exacerbations. Others run a self-limiting course.

Rheumatic fever is a special threat to the child or young adult because inadequate treatment may permanently damage the heart (see p. 500). The metabolic error in gout, sometimes referred to as acute or gouty arthritis, has been identified as an abnormal uric acid utilization and will be discussed later in this chapter.

More than 13 million noninstitutionalized persons in the United States are believed to be afflicted by some form of arthritis, of whom 40 per cent are 65 years or older.[6] Of the many forms of arthritis, two types are predominant. Rheumatoid arthritis is seen more frequently in young adults, especially women, and is characterized by pain, stiffness, fatigue, deformity which may be severe, and limited function. Osteoarthritis or degenerative arthritis is more common than rheumatoid arthritis and is of greater frequency beyond the age of 50 years. The stiffness of the joints is characteristic and accompanying pain may be severe.

One would suspect some metabolic aberration in the connective tissue of patients suffering with rheumatoid arthritis or osteoarthritis. Probably few diseases have had more theories offered concerning their cause and treatment. Controlled studies on the effects of high and low levels of protein, fat, carbohydrate, acid-producing foods, ascorbic acid, and vitamin D have failed to provide any basis for explaining the cause or the treatment of patients with these diseases. Many fad diets which have been not only ineffective but also

harmful have been unethically promoted for persons looking for some miraculous cure. That nutritional factors are concerned with either the causation or the treatment of the arthritis itself has not been established [7]

The supportive role of diet. While no specific nutrients are implicated in the treatment of arthritis, the overall care of the patient should include emphasis on the importance of adequate nutrition. When patients are of normal weight and in good nutritional status, the normal or house diet is suitable.

Many patients with rheumatoid arthritis have lost weight and are obviously malnourished. For them, a high-protein, high-calorie diet (see p. 476) is indicated until a normal nutritional status has been achieved. Such a diet will provide the desired liberal levels of minerals and vitamins, although supplements are sometimes also prescribed.

Obesity, a more common problem in osteoarthritis than in rheumatoid arthritis, must be avoided inasmuch as extra weight places additional stress on the weight-bearing joints (see Chapter 32 for low-calorie diets).

Steroid therapy is widely used for the treatment of these diseases. If there is a slight excess, some retention of sodium may occur and the patient may need to restrict his intake of salty foods and in some instances adhere to a sodium-restricted diet (see p. 636 and Chapter 42). Continued steroid therapy may adversely affect calcium balance, leading to gradual bone demineralization and bone fracture. Contrary to many popular ideas about the need to limit milk, the patient should have a liberal intake of calcium to compensate for such possible negative balances.

A booklet for lay persons *Diet and Arthritis* has recently been prepared by a joint committee of the American Dietetic Association, the Arthritis Foundation, and the Diabetes and Arthritis Branch of the U.S. Public Health Service. It is intended to acquaint people with the nutritional problems in arthritis and to refute the many fad ideas held by older persons especially with reference to the treatment of arthritis.[8]

GOUT

Gout is a hereditary disease occurring especially in males and characterized by a disturbed purine metabolism which leads to the deposition of sodium urate (tophi) in and about the joints. Painful attacks recur from time to time. Overeating and excessive drinking of alcoholic beverages are no longer accepted as etiologic factors. Allergy has been suggested as a predisposing factor, since certain individuals have been found to develop acute attacks of gout upon eating certain foods regardless of their purine content.[9]

Nature and occurrence of uric acid. Cellular material of both plant and animal origin contains *nucleoproteins*. Glandular organs such as liver, pancreas, and kidney are among the richest sources, while meats and the embryo or germ of grains and legumes, together with the growing parts of young plants,

also furnish appreciable amounts. During digestion nucleoproteins are first split into proteins and nucleic acid. Further cleavage of nucleic acid leads to several products, one group of which are the purines. The latter in turn are oxidized to uric acid, probably by the liver.

In addition to the uric acid available from the metabolism of nucleic acid, the body can synthesize purines from the simplest carbon and nitrogen compounds such as carbon dioxide, acetic acid, and glycine. Thus any substances from which these materials originate, namely carbohydrate, fat, and protein, give rise to a considerable production of uric acid. Even in the fasting state there is a constant production of uric acid from cellular breakdown.

The liver and tissues store uric acid and its precursors for variable lengths of time and release them later. As a normal constituent of urine, uric acid represents a part of the daily nitrogenous excretion. Some uric acid is also excreted via the bile into the intestinal tract.

Symptoms and clinical findings in gout. Purine metabolism in gout is disturbed for some reason not clearly understood, with the result that the levels of uric acid in the blood are much larger than in the normal individual. The gouty patient converts a greater proportion of dietary components to uric acid, whereas the normal person would convert the same nitrogenous constituents to urea. Instead of being excreted, the uric acid is deposited as urates in the cartilage, kidneys, and soft tissues.

Gout occurs in both acute and chronic forms, the acute attacks being sometimes referred to as acute arthritis. The chief symptom of acute gout is the inflammation of the joint which occurs suddenly with pain which is frequently severe. The metatarsal, knee, and toe joints are most frequently affected. The joint becomes red and tender, and the swelling increases rapidly. In acute gout the attacks are usually of short duration but recur at varying intervals of time. In chronic gout, deformity is often present, and inflammation of the joints is more or less constant.

Modification of the diet. Drugs such as colchicine are used for the joint pain, while others such as probenecid are given to increase the excretion of uric acid. The effectiveness of drug therapy, together with the realization that uric acid can be formed from simple carbon and nitrogen compounds, has minimized the emphasis on exogenous purine restriction. Some individuals progress equally well without dietary modification when appropriate drug therapy is used. Moreover, drastic dietary restrictions have little possibility of being adhered to over the course of years.

In full recognition of the limitations of dietary effectiveness, it is, nevertheless, pertinent to give consideration to the following principles in considering the individual patient.

PURINES. Although drugs are effective in bringing about the elimination of uric acid, many physicians prescribe a diet practically free of purines during an acute attack. This requires a selection of foods from group I of Table 39–1. During interval treatment, 2 to 3 ounces of fish, poultry, or meat, other than glandular meats, may be permitted three to five times a week.

Coffee and tea contain methylated purines which are oxidized to methyl uric acid. The latter is apparently excreted in the urine and not deposited in the tissues. Hence, the customary omission of coffee and tea on low-purine diets may impose an unnecessary hardship.

ENERGY. Since obesity has adverse effects on general health as well as on the gout, the overweight individual should gradually lose weight. A 1200- to 1500-calorie diet, rather than more restricted levels, is desirable so that weight loss will not result in too rapid metabolism of fatty tissues.

PROTEIN. Because the nitrogen for the purine nucleus is supplied by protein, the intake of proteins may be restricted to maintenance levels, that is, to 1 gm per kilogram of body weight.[10]

FAT. The incidence of acute attacks of gout seems to increase with increased metabolism of fats.[10,11] Such attacks have been quite generally observed when considerable amounts of adipose tissue were being used during periods of too rapid weight reduction or during inadequate food intake as in acute illness. Gradual weight reduction, as pointed out above, is important. During any illness when food intake is poor, it is essential that high-carbohydrate fluids be given in order that adipose tissue is not excessively metabolized.

A high dietary level of fat could also provoke the attacks, but it is improbable that the amount of fat in a well-balanced diet is great enough to have such an effect. Some physicians limit fat to 60 gm per day.

CARBOHYDRATE. When the appropriate fat and protein levels have been established, the caloric balance is maintained through the use of carbohydrate.

Planning the diet. Foods are classified according to their richness in purine content as shown in Table 39–1. The Low-Purine Diet given below meets the specifications for maintenance of nutrition, but it may need to be restricted in calories for some individuals.

Table 39–1. Purine Content of Foods per 100 Grams

Group I (0–15 milligrams)	Group II (50–150 milligrams)	Group III (150 milligrams and over)
Vegetables	Meats	Sweetbreads
Fruits	Poultry*	Anchovies
Milk	Fish	Sardines
Cheese	Sea food	Liver
Eggs	Beans, dry	Kidney
Breads and cereals	Peas, dry,	Meat extracts
Fish roe*	Lentils	Gravies*
Caviar*	Spinach	Brains*
Gelatin*	Oatmeal*	
Butter and other fats*		
Nuts*		
Sugar, sweets*		

* Adapted from Turner, D.: *Handbook of Diet Therapy*, 3rd ed. University of Chicago Press, Chicago, 1959, p. 100. Starred items are additions to Turner's list.

LOW-PURINE DIET

General rules:

For a diet essentially free of exogenous purines, use foods only from Group I.
For a low-purine level, allow 3 to 5 small servings of lean meat, poultry, and fish from Group II each week.
If a low-fat regimen is ordered, the butter may be omitted, and skim milk may be substituted for the whole milk.

Include these foods daily:

3 cups milk
2 eggs
1–2 ounces cheese; allow 2 to 3 ounces lean beef, veal, lamb, poultry, or fish 3 to 5 times a week during interval therapy
3–4 servings vegetables including:
1 medium potato
1–2 servings green leafy or yellow vegetable
1 serving other vegetable
2–3 servings fruit including:
1 serving citrus fruit
1–2 servings other fruits
1 serving enriched cereal
4–6 slices enriched bread
2 tablespoons butter or fortified margarine

Additional calories are provided as needed by increasing the amount of potato, potato substitutes such as macaroni, rice, noodles, bread, sugars, sweets, fruits, and vegetables.

Nutritive value of basic foods above: Calories, 1850; protein, 68 gm; fat, 80 gm; carbohydrate, 220 gm; calcium, 1400 mg; iron, 11.3 mg; vitamin A, 11,350 I.U.; thiamine, 1.3 mg; riboflavin, 2.3 mg; niacin, 10 mg; ascorbic acid, 145 mg.

FOODS TO AVOID

All foods high in purines (see Group III, Table 39–1)
Condiments and excessive seasoning
Alcohol

For low-fat diets:
Pastries and rich desserts
Cream and ice cream
Fried foods
Eggs not to exceed 2 daily; hard cheese not to exceed 1 ounce. Severe restriction may require the omission of eggs, whole milk, cheese, and butter. Skim milk and cottage cheese must then be used in ample amounts to provide the necessary protein.

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Fruit	Half grapefruit
Cereal (except oatmeal) with milk and sugar	Rice Krispies with milk and sugar
Enriched white toast	Buttered toast
Butter — 1 teaspoon	
Egg	Scrambled egg
Beverage	Coffee with milk and sugar
LUNCHEON OR SUPPER	
Egg or cheese	Jelly omelet
Potato, macaroni, spaghetti, rice, or noodles	Boiled rice
Vegetable	Broiled tomato
Salad	Half peach with cottage cheese on lettuce
Bread with butter	Bread with 1 teaspoon butter
Fruit	
Milk	Milk—1 glass
DINNER	
Egg or cheese; small serving meat, if allowed	Cheese soufflé
Potato	Baked potato
Vegetable	Beets
	Green celery strips
Bread with butter	Bread with 1 teaspoon butter
Dessert	Apple snow
Milk	Milk—1 glass
BEDTIME	
Milk—1 glass	Milk—1 glass

OSTEOPOROSIS

Osteoporosis is a bone disease of frequent occurrence in middle age, yet its etiology and its treatment are poorly understood. Various surveys of populations in homes for the aged and of other patients receiving ambulatory care have shown 15 to 50 per cent of the population over age 65 to be affected.[12] A minimum of four million noninstitutionalized persons are believed to have severe osteoporosis. The disease occurs four times as frequently in women as in men.

Etiology. Osteoporosis is a deficiency disease, but it would be erroneous to assume that a deficit in dietary intake is primarily responsible. Rather, the aspects of deficiency are the result of many factors, among which are the following: endocrine disorders such as hyperthyroidism, hyperparathyroidism, hyperadrenocorticism, and acromegaly; immobilization; rheumatoid arthritis;

sickle cell anemia; nutritional deficiencies such as of calcium, protein, ascorbic acid, and others.[12]

Some authorities consider osteoporosis to be a disease of the protein matrix and have associated this with the frequent occurrence of a low-protein intake. Others have shown a close correlation between the degree of mineralization of the bone and the intake of calcium. Osteoporosis occurs far more frequently in women who have had a lifetime history of low calcium intake than it does in women who have always had a liberal calcium intake.

Metabolic changes and their effects. The principal symptoms of osteoporosis are low back pain, sometimes severe, and often a history of vertebral fractures. Over a period of years the individual may have lost height—sometimes several inches. Roentgenographic changes are not diagnosed until as much as 30 per cent of the bone mass has been lost.

Osteoporosis is characterized by a reduction in the total bone mass, but with no known change in the structure or chemical composition of the bone. Because of the reduction in the number of cells, there is a decrease in the thickness of the cortex, a thinning of the trabeculae, and an increased porosity of the bone. As a result, fractures occur with greater frequency.

Blood levels of calcium, phosphorus, and alkaline phosphatase are normal, as are also the serum protein and lipoprotein levels. Calcium, phosphorus, and nitrogen balances are frequently negative. Inadequate dietary intake, defective absorption from the gastrointestinal tract, or excessive bone resorption could explain such negative balances. It is well to keep in mind that older individuals may require more calcium to achieve balance than those who are younger.

Modification of the diet. The factors which may have initiated the osteoporosis must be determined before effective therapy can be instituted. Estrogens and androgens have been used advantageously in many patients, since the hormones exert an anabolic effect on proteins and also play a role in better retention of minerals in bone. Physiotherapy is required to relieve pain and to prevent immobilization.

A diet liberal in calcium is generally recommended. The inclusion of at least 1 quart of milk, some hard cheese, and a normal allowance of other foods would bring the daily intake of calcium to about 1.5 gm. A calcium supplement may also be used in the form of calcium gluconate or calcium lactate. In some instances a supplement of vitamin D has appeared to improve the absorption of calcium and the mineralization of bone.

PROBLEMS AND REVIEW

1. Differentiate between the hypoglycemia in functional hyperinsulinism, Addison's disease, and liver diseases. What modification of carbohydrate level of the diet is required for each?
2. What is the advantage of a high-protein and high-fat intake in hyperinsulinism?
3. *Problem.* Calculate a diet for a patient with functional hyperinsulinism who requires

2400 calories, 130 gm protein, and 75 gm carbohydrate. Use the exchange lists for the calculation. Divide the day's allowance into three equal meals.

4. What modifications of mineral and water metabolism are present in Addison's disease? In what way is this corrected by hormone therapy?

5. Why is a sodium-restricted diet occasionally ordered for a patient receiving hormone therapy in Addison's disease? Under what circumstances would an increase in sodium intake be used?

6. On the basis of your understanding of the metabolism in Addison's disease, what are some of the functions of the adrenal gland in the normal individual? What is the effect of the activity of the pituitary?

7. What are the characteristic symptoms of hyperthyroidism?

8. Compare the diet which might be used in a hyperthyroid patient who is well controlled with antithyroid drugs, and one who has an elevated metabolic rate.

9. Suggest five ways in which the calories of a diet for a patient with hyperthyroidism might be increased.

10. Why does a surgeon so frequently insist that a patient gain weight before an operation on the thyroid?

11. What is myxedema? What is its chief cause? How can you explain the frequent occurrence of overweight?

12. Diet is neither causative nor curative in arthritis. On this basis, outline briefly the principles of dietary consideration in arthritis.

13. What are the dietary implications of long-term use of cortisone in arthritis or other diseases?

14. What are the sources of uric acid to the body? In what ways is uric acid metabolism disturbed in gout?

15. How can you explain the fact that a person who has gout may have an acute attack following surgery or during an acute infection?

16. What is the basis for restricting the protein intake to 1 gm per kilogram in the dietary planning for a patient with gout?

17. What problems are entailed when a purine-free diet is ordered for a patient, insofar as nutritional adequacy is concerned?

18. *Problem.* Plan a menu for 1 day for a low-purine diet.

19. What is the role of each of these hormones on protein and mineral metabolism: thyroxine; parathormone; androgen; cortisone?

20. On the basis of current research related to osteoporosis, what dietary measures may be instrumental in preventing the disease?

21. What modifications of the normal diet may be helpful in the treatment of osteoporosis?

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Chapter 40

NUTRITION IN NERVOUS DISTURBANCES

Ketogenic Diet

The central and peripheral nervous systems require appropriate nutrients for tissue synthesis and for the elaboration of enzymes. Glucose is the source of energy for the brain, and any interference with its supply leads to rapid and irreversible changes in the tissues. When the body is at rest, as much as 25 per cent of the total oxygen consumption is accounted for by the brain alone.[1] Obviously, this entails a massive blood supply. Nutritional deficiencies, imbalances, or the toxic effects of intermediary metabolites profoundly influence the development and functioning of the nervous system.

The effects of undernutrition in preschool children, chronic malnutrition at any age, and alcoholism as a specific example of undernutrition will be discussed as they apply to the nervous system in this chapter. The inborn errors of metabolism represent the extreme range of mental retardation, and are the result of defects in the production of enzymes for the normal metabolism of nutrients. These congenital diseases will be discussed in Chapter 47.

Undernutrition in preschool children. As world nutrition studies on children have progressed, there has been a growing recognition of the effects of undernutrition on the central nervous system. This is most apparent in children under four who have had a deficient nutrient intake associated with parasite infestation, and disease.[2]

In the developing countries infants at birth have been found to compare favorably with those in a more advantageous environment insofar as neuromuscular development is concerned. Apparently, if the woman's nutritional status is sufficient to allow for fertilization and gestation, she will furnish the necessary nutrients for the normal fetus.[2]

The nutritional environment during the first few years is especially significant. About 90 per cent of the adult brain size has been achieved by the age of four. Moreover, increasing differentiation of cellular function occurs during these early years. Because most of the growth and development of the central nervous system has taken place at an early age, a deficient diet could lead to changes in structure and function which could not be reversed at a later time

Studies on kwashiorkor have shown that the physical impairment during the

early years may be corrected in large part by giving an improved diet. On the other hand, psychological, neuromuscular, and intellectual capacities may be 10 to 25 per cent below normal, and remain so even after dietary treatment. Even though such reduction in functioning of the brain is not classed as severe, it reduces the potential of the individual to contribute to his own well-being and that of society. As many as 70 per cent of preschool children in developing countries are undernourished, and the implications for the world are indeed sobering.[2]

Protein-calorie deficiencies affect the developing central nervous system in several ways. The synthesis of cellular structures and of specific enzymes is reduced because essential amino acids are lacking or because protein is being used as a source of energy. Abnormal metabolites may accumulate and interfere with the transport of nutrients across the cell membrane. Interference with DNA and RNA formation may also occur.[2]

Vitamins and the functioning of the nervous system. Some of the earliest observations on vitamins were related to changes in the behavior of individuals.

The polyneuritis of beriberi or associated with chronic alcoholism and the therapeutic effects of thiamine supplementation are well known. Brozek[3] studied the effect of thiamine deprivation of 10 healthy young men who had diets restricted in thiamine for 168 days, and who then received no thiamine whatsoever for an additional 15 to 27 days. The period of acute deprivation led to severe nausea, general weakness, elevated blood pyruvic acid levels, incoordination of the legs, paresthesias, and muscle tenderness. The subjects complained increasingly of such symptoms as inability to concentrate, loss of appetite, muscle and joint pains, irritability, lack of a sense of well-being, and many others. The steadiness of the hand, the coordination of eye-hand movements, and the speed of motion were adversely affected. The psychoneurotic scales—hypochondriasis, depression, and hysteria—indicated deterioration of personality. Thiamine supplementation provided consistent improvement.

The studies of Jolliffe[4] and Williams[5] showed the regular occurrence of symptoms when thiamine-depleted diets were fed to human beings. Such depleted individuals failed to perform their usual tasks, were suspicious, and fearful. They had numerous complaints concerning gastrointestinal disturbances, increased sensitivity to pain, shortness of breath, palpitation, and burning of the feet. When thiamine was administered without the subject's knowledge of any change in routine, the symptoms quickly and dramatically disappeared. It would be quite incorrect to try to explain all neurasthenic complaints of patients on a nutritional basis, but, unquestionably, deficient food intake or utilization does play a role.

The use of niacin in the treatment of the psychotic pellagrin represents an outstanding advance in neuropsychiatry as well as in nutrition. Some years ago convulsions were observed in infants whose formulas were deprived of vitamin B_6.[6] Tuberculous patients treated with isoniazid, which is antagonistic to the action of vitamin B_6, experience a polyneuritis which can be prevented by including vitamin B_6 supplements. Although no pantothenic acid

deficiency has been observed in man with customary food intakes, the experimental production of deficiency of this vitamin in man resulted in apathy, numbness and tingling of the extremities, dizziness, irritability, and sullenness. The neurologic manifestations resulting from lack of vitamin B^{12} as in pernicious anemia (Chapter 44) are well known.

ALCOHOLISM

Nutritional deficiencies in alcoholism. Alcoholics account for about 10 per cent of first admissions to the psychiatric wards of hospitals. One of the aspects of alcoholism is the nutritional deficiency imposed upon the individual. The individual does not superimpose his intake of alcohol on an adequate diet, but substitutes alcohol for much of the normal food intake. As a consequence, a large proportion of the energy requirement is met by a highly purified diet, and the intake of proteins, minerals, and vitamins may be grossly deficient.

The disturbances to the nervous system appear to be those of nutritional deficiency rather than to toxicity of alcohol *per se*. Polyneuropathy—weakness, numbness, and paresthesia—is a frequent finding and is characteristic of a lack of thiamine; when the vitamin is supplied the symptoms disappear.[7] Symptoms characteristic of pellagra sometimes seen in alcoholics are reversed when niacin is provided. Lack of vitamin B_6 and of pantothenic acid may also be responsible for neurologic changes.

Other physiologic disturbances also occur in alcoholism. The fatty liver, eventually resulting in cirrhosis, is reversible when adequate protein and the accompanying lipotropic factors are supplied. A reduction in serum magnesium levels is occasionally seen in delirium tremens, and severe—even fatal—hypoglycemia is a further complication.[8]

Wernicke's-Korsakoff syndrome. Wernicke's syndrome and Korsakoff's psychoses are highly associated with alcoholism and appear to be different phases of the same disease. Wernicke's syndrome has an abrupt onset characterized by ophthalmoplegia (paralysis of the eye muscles), nystagmus (rapid movement of the eyeballs), and ataxia (uncoordinated gait).[9] The patient is often unable to stand or walk without support. The eye changes and the gait are dramatically corrected, often within hours, by the administration of thiamine.

Korsakoff's syndrome may not be apparent until several weeks after the changes in the eye and gait have become evident. The chief defect is the disturbance in memory and the inability to learn new things so that only the most routine tasks can be performed. Moreover, there is failure to associate past events in their proper sequence. Patients may be confused, anxious, fearful, and even delirious. Vitamin therapy has produced marked effects in restoring the patient to being responsive, alert, and attentive. However, when memory defects are present, they appear to persist despite therapy, suggesting that structural changes in the brain may be irreversible.

WINCAM HOME SCIE.

NUTRITION FOR THE MENTALLY ILL

About half of all hospital beds are occupied by patients who are mentally ill. Probably less than 5 per cent of these are accounted for by the mentally retarded as a result of the inborn errors of metabolism. The biochemical changes which may affect function or structure of the nervous system are poorly understood. Alterations in the metabolism of amino acids, especially tryptophan and phenylalanine, have been described in schizophrenia, but it is too early to make applications of this research.

Diet for the mentally ill. Diet is an important part of the total program of rehabilitation for the psychiatric patient. Aside from its nutritional necessity, food provides basic security and pleasurable satisfaction. The patient needs to feel that someone is genuinely concerned about his welfare and cares for him. The dietitian and nurse—through the care shown in meal planning, preparation, and service and through their expressions of interest to the individual—are participants in the therapy.

To plan a nutritionally adequate diet is obviously not enough. The service of food which is attractive to the eye, tempting of odor, and satisfying to the palate is just as important in the psychiatric hospital as in any other feeding situation. The mentally ill may express marked irritability when given foods they dislike. Food service in a cafeteria permits the patient to exercise some choice in his food selection, and thus helps to eliminate some of the irritations.

Patients react favorably and are less destructive when an attractive dining environment is provided. A well-planned dining room with a cheerful color scheme, curtains or draperies at the windows, small attractive tables, and suitable background music is conducive to food acceptance and contributes to the therapy of the patient. Attention to birthdays, holidays, and other special events provides additional evidence that the patient is cared for.

Psychiatric patients frequently eat inadequate or excessive amounts of food. A regular schedule of weighing of patients—about once a month—will help to detect such changes, and correction can be started before marked weight change has occurred. Marked weight gain is not uncommon. It would seem easy to control this in a hospital by providing a diet designed for weight maintenance. However, the privileges of food purchases from a canteen and food gifts from relatives and friends must be taken into consideration. Patients are often known to eat food left by other patients.

Refusal to eat is a problem presented by other psychiatric patients. Hussar[10] recommends that the nurse or attendant should note any patient who refuses more than half of a meal. A 4- or 5-day simple check list helps to identify whether the refusal follows a pattern with respect to a particular food or meal. Refusal of food sometimes denotes an underlying physical illness about which the patient who is withdrawn or mute does not complain. Those who need to gain weight may require close supervision in taking small, frequent feedings;

some may be helped if butter is spread on the bread, milk and sugar are put on the cereal, the milk container is opened, the meat is cut, and so on; sincere words of encouragement should be offered when progress is made. Tube feeding (see Chapter 34) may be resorted to when all attempts to achieve satisfactory intake of food fail.

Feeding the mentally retarded presents many problems which may be especially acute in the child. The management of the diet for these patients is discussed in Chapter 46.

EPILEPSY

The nature of epilepsy. Epilepsy is a disease of the central nervous system characterized by loss of consciousness which may last for only a few seconds, as in petit mal attacks, or which may be accompanied by convulsions, as in grand mal attacks. It occurs more frequently in children than in adults. The disease in no way affects the individual's mental ability, but unthinking relatives and friends sometimes attach an entirely unwarranted stigma to the disease, and thus may increase the tension states in the individual.

Treatment. Various drugs such as phenobarbital or diphenylhydantoin sodium or others have been employed with considerable success in the treatment of epilepsy, and have largely replaced the ketogenic diet once so widely used.[11,12] As a rule, a normal diet for the individual's age and activity is prescribed when drug therapy is used. Some fluid restriction is considered to be effective by several clinicians.[12,13]

Mike[14] has described the use of the ketogenic diet for selected children, especially of preschool age, who have petit mal epilepsy. The purpose of the diet is to produce an acidosis by curtailing very severely the amount of available glucose and increasing markedly the intake of fat so that complete combustion of fats cannot take place. The accumulation of acetone bodies (acetone, acetoacetic acid, and beta-hydroxybutyric acid) has a favorable effect on the irritability and restlessness of the child, and does not dull the mental function as some drugs do. In fact, children thought to be mentally retarded were found to be alert and bright when their seizures were controlled by diet.[14] The maintenance of a continuous state of acidosis is essential, for even small amounts of carbohydrate lead to seizures.

Mike has emphasized the difficulties of dietary management inasmuch as the diet is severely restricted in carbohydrate, is unpalatable, lacks bulk, and deviates sharply from customary food patterns. The diet requires greater care in its planning and preparation than other metabolic diets. A careful evaluation of the probable success of the diet for each patient and the ability of the parents to understand and adhere to the regulations is essential.

Modification of the diet. Sufficient calories for normal weight and for the maintenance of normal growth are necessary. The allowances recommended

by Mike[14] are

AGE (YEARS)	CALORIES PER KG
2–3	100 to 80
3–5	80 to 60
5–10	79 to 55

PROTEIN. An allowance of 1 gm protein per kilogram of body weight is sufficient, but may be increased to 1.5 gm per kilogram for the older child.

CARBOHYDRATE AND FAT. The nonprotein calories are so divided that a ketogenic to antiketogenic ratio of approximately 3 to 1 or 4 to 1 is maintained. Ketogenic factors (fatty acids) in the diet include 90 per cent of the fat, and about 50 per cent of the protein. The antiketogenic factors in the diet (available glucose) are derived from 100 per cent of the carbohydrate, plus approximately 50 per cent of the protein and 10 per cent of the fat. Obviously, to achieve a 3-to-1 or 4-to-1 ratio, the carbohydrate must be sharply restricted and the fat intake greatly increased. The level of carbohydrate usually needs to be less than 30 gm if ketosis is to be produced, but should never be less than 10 gm daily.

The diet for a 5-year-old child weighing 25 kg illustrates the calculation of a diet prescription.

1. Calories: $25 \times 70 = 1750$
2. Protein: $25 \times 1 = 25$ gm
3. Calories from protein $= 25 \times 4 = 100$
4. Calories from carbohydrate and fat: $1750 - 100 = 1650$

If we allow 25 gm carbohydrate, the fat intake would need to be 172 gm as noted in the following calculations:

5. Calories from carbohydrate: $25 \times 4 = 100$
6. Calories from fat: $1650 - 100 = 1550$
7. Grams of fat: $1550 \div 9 = 172$

The fatty acid to glucose ratio of this diet is as follows:

$$\frac{\text{Fatty acids}}{\text{Available glucose}} = \frac{0.50\,(25) + 0.9\,(172)}{0.50\,(25) + 0.1\,(172) + 1.0\,(25)} = \frac{167}{55} = \frac{3}{1}$$

The maintenance of a constant acidosis requires that the protein, fat, and carbohydrate for the day be divided in three equal meals. The urine shows a positive test for acetoacetic acid when acidosis is being maintained.

MINERALS AND VITAMINS. Calcium gluconate or lactate is prescribed to furnish about 0.5 gm calcium daily. An iron supplement providing 7 to 10 mg elemental iron is also given. The vitamin needs are met by giving about 0.6 ml of an aqueous multivitamin preparation.

Management of the diet. For the first 24 to 72 hours the child is given nothing but water, usually restricted to 500 to 1000 ml. Hunger disappears as ketosis increases. When ketosis is marked the diet is initiated, but is not forced until the transition has been accomplished. During this period nausea and vomiting may occur.

The diet may be calculated by using the values for individual foods as in Table A–1, or by using food groupings such as those developed by Mike. The meal exchange lists are not satisfactory for the calculation.[14] The predominant foods in the diet are carefully restricted amounts of meat, cheese, and eggs; cream, butter, bacon, mayonnaise; restricted amounts of low-carbohydrate vegetables and fruits. Other foods are avoided: sugar-containing beverages; breads and cereals; desserts such as cake, cookies, ice cream, pastries, pie, puddings; milk; all sweets including sugar, jellies, candy, preserves; vegetables and fruits high in carbohydrate.

The diet must be weighed on a gram scale and all food must be consumed at each meal. Foods may not be saved for later consumption. If no improvement occurs within 6 weeks, there is nothing to be gained by further continuance of the diet. If improvement does occur, the diet must be continued for a year or longer. Gradually the diet is liberalized with very small increases in the carbohydrate and corresponding caloric decreases in the fat. Table 40–1 illustrates a sample calculation for the ketogenic diet.

Table 40–1. Sample Calculation for Ketogenic Diet

Food	Household Measure	Weight gm	Protein gm	Fat gm	Carbohydrate gm
Breakfast					
Egg, whole	1	50	6	6	—
Butter	2 teaspoons	10	—	8	—
Cream, whipping	½ cup	120	3	45	4
Fruit (Orange)	⅓	60	1	—	5
			10	59	9
Luncheon or supper					
Beef, lean	⅔ ounce	20	6	2	—
Tomato, canned	½ cup	120	1	—	5
Cream, whipping	½ cup	120	3	45	4
Butter	2 teaspoons	10	—	8	—
Cellu wafers					
			10	55	9
Dinner					
Cheddar cheese	⅔ ounce	20	4	6	—
Cream, whipping	½ cup	120	3	45	4
Grapes, seedless	¼ cup	40	1	—	6
Butter	2 teaspoons	10	—	8	—
Cellu wafers					
			8	59	10
Total for the Day			28	173	28

$$\frac{\text{Ketogenic factors}}{\text{Antiketogenic factors}} = \frac{170}{59} = 2.9$$

PROBLEMS AND REVIEW

1. Describe the development of the nervous system in relation to other factors in growth and development of the young child.
2. What is the principal source of energy for the brain? What proportion of oxygen consumption is required by the brain?
3. Why would you expect vitamin deficiencies to have an adverse effect on the functioning of the nervous system? Describe the changes that take place in deficiency of thiamine; of vitamin B_6.
4. What is the effect of alcoholism on the nutritional state of the individual? How can you explain some of the symptoms characteristic of Wernicke's syndrome?
5. What are some of the meanings of food that may have special relevance to the mentally ill? What recommendations could you make for the feeding of the mentally ill?
6. What is epilepsy? What is the rationale for a ketogenic diet for the treatment of epilepsy? Why is the diet seldom used?
7. *Problem.* Modify the diet calculated in Table 40–1 so that it provides a ketogenic-antiketogenic ratio of 3.5 to 1.
8. *Problem.* List some ways in which the whipping cream and butter may be used in the ketogenic diet. What purpose is served by the Cellu wafers?

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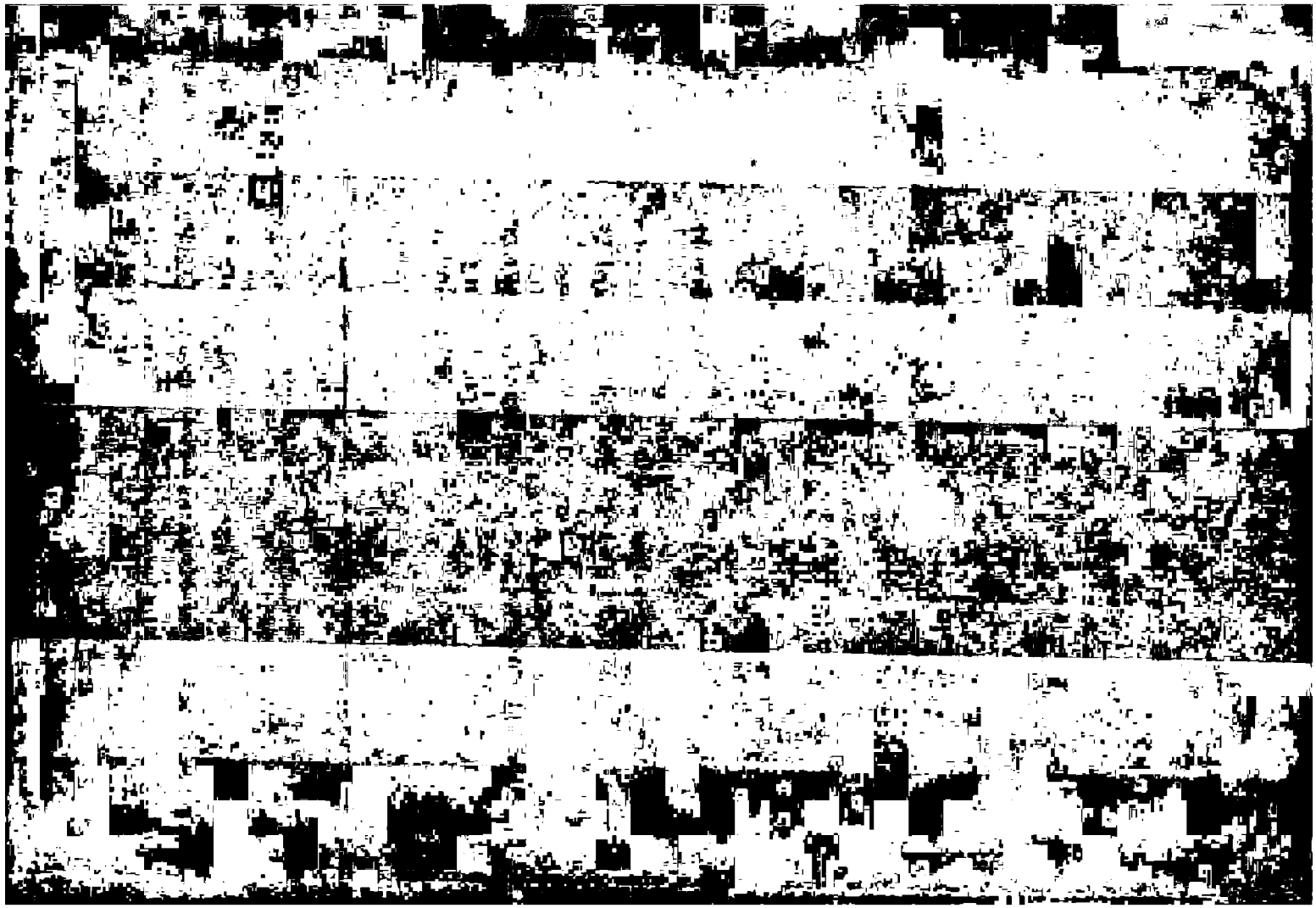
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UNIT XII
Diet in Cardiovascular and Renal Disorders

Chapter

41 ATHEROSCLEROSIS
Fat-Controlled Diets

42 DIETARY MANAGEMENT OF ACUTE AND CHRONIC DISEASES OF THE HEART
Sodium-Restricted Diet

43 DIET IN DISEASES OF THE KIDNEY
Low-Protein Diets; Potassium-Restricted Diet; Calcium- and Phosphorus-Restricted Diet

44 ANEMIAS

Chapter 41

ATHEROSCLEROSIS
Fat-Controlled Diets

Cardiovascular disease in the United States. Almost one million deaths annually are caused by cardiovascular diseases, representing 54.5 per cent of all mortality.[1] No country in the world has a higher death rate from these diseases. The mortality from coronary diseases in white and nonwhite males at ages 45 to 54 is more than five times that of white women and more than twice that of nonwhite women. The incidence of new heart attacks in men is 3 per 1000 at age forty, 10 per 1000 at age fifty, and 20 per thousand at age sixty. Clearly, cardiovascular disease is the major public health problem demanding concerted effort in its prevention as well as in its treatment.

This chapter is concerned with (1) the role of diet in the etiology of atherosclerosis, and (2) the dietary modification which may be effective in reducing the incidence of atherosclerosis. The management of coronary disease is discussed in the following chapter.

Multiple risk factors in coronary disease. Certain findings in persons free of clinical manifestations of heart disease increase the likelihood that disease will develop in later years. In a recent review Stamler[2] has discussed the following as major risk factors: (1) hypercholesteremia, (2) hypertension, (3) diabetes mellitus, (4) obesity, (5) diet, (6) sedentary living, and (7) cigarette smoking. He has also listed the following as other factors adding to risk: psychological stresses, tension, personality, behavior patterns, and the pace of modern life; organic disorders such as gout, thyroid, and renal diseases; abnormal electrocardiographic findings at rest, and during or following exercises; and family predisposition. One cannot implicate diet alone, but undoubtedly dietary factors do play a major etiologic role.

Nature of atherosclerosis. This is a disease primarily concerned with the intimal layer of the artery and is characterized by thickening and loss of elasticity of the arterial wall. The atheromatous lesions (plaques) contain free cholesterol and cholesterol esters, triglycerides, a highly insoluble lipid material not found in the circulating plasma known as *ceroid*, deposits of calcium and iron, red blood cells, and fibrous tissue. The lesions begin to form early in

life. As they thicken, less space remains through which the blood can flow. (See Figure 41–1.) The lesions may ulcerate with the result that the clot which forms partially or completely occludes the lumen of the artery; when the coronary artery is affected, the outcome may be near fatal or fatal. Coronary occlusion is by no means attributed only to ulcerations, however.

Diet and atherosclerosis. The relation of diet to atherosclerosis and coronary disease may be stated thus:

$$\text{Diet} \xrightarrow{A} \text{Abnormal blood lipids} \xrightarrow{B} \text{Atherosclerosis} \xrightarrow{C} \text{Coronary disease}$$

At the outset it should be stated that the mechanisms for the development of atheroma and the factors that initiate coronary disease are not clearly understood. Abnormal blood lipids are not *diagnostic* of coronary diseases. Many people with abnormal blood lipids do not have coronary disease, whereas some who have relatively normal lipid levels are affected.

Particular attention has been given to the levels of cholesterol, triglycerides, and certain classes of β-lipoproteins in the blood. The lipid composition of the atheroma correlates well with that of the blood, and thus it would appear that the nature and level of the blood lipids could influence the deposition of the atheromatous plaques. Cholesterol is an important constituent of atheroma, and it is hypothesized that the blood cholesterol level and its variations are predictive of the degree of atherosclerosis and hence of coronary disease. Some investigators[3,4] believe that an elevated serum triglyceride level correlates more closely with coronary disease.

Many dietary factors have an influence on the level of the blood lipids, of which the following appear to be most important. (See Figure 41–2.)

FAT. Americans consume diets which provide more than 40 per cent of the calories as fat. The saturated fat in these diets is about four times as high as polyunsaturated fats. Epidemiologic studies have shown that populations who consume low-fat diets generally have lower blood serum cholesterol levels than those who consume high-fat diets. In turn, a strong correlation exists between high-fat consumption and coronary heart disease.

The kind of fat appears to be even more important than the total amount of fat. Diets that have a liberal proportion of polyunsaturated fatty acids and that are low in saturated fatty acids will lower the blood cholesterol level. Conversely, diets high in saturated fatty acids will lead to an increase in the blood cholesterol.

Christakis and his associates[5] have recently reported on a seven-year experience with a "prudent" diet. This is a regimen in which saturated, monounsaturated, and polyunsaturated fatty acids are in equal proportions. Those men who used the diet up to seven years had significantly lower plasma cholesterol levels and lesser incidence of coronary disease than did men consuming their usual diets.



A. Normal artery.

B. Deposits formed in inner lining of artery.

C. Deposits harden.

D. Normal channel is blocked by a blood clot.

FIG. 41–1. Gradual development of atherosclerosis in a coronary artery, leading to a

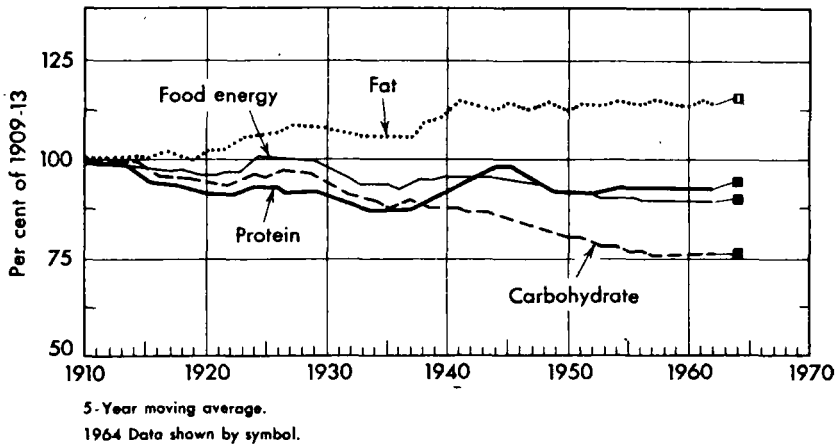


FIG. 41–2. Per capita civilian consumption of food energy, protein, fat, and carbohydrate, 1910 to 1965. Note that the fat intake has increased about 13 per cent and the carbohydrate intake has decreased approximately 25 per cent. (*Courtesy, Agricultural Research Service, U.S. Department of Agriculture.*)

CHOLESTEROL. In a recent report by Brown and Page[6] the favorable effects of a diet high in polyunsaturated fat were nullified if as few as two eggs were included daily. Eggs laid by hens which had received a diet high in polyunsaturated fat were found to have a greatly increased amount of polyunsaturates. However, their use in a diet rich in vegetable oils led to a prompt increase in the blood cholesterol level, just as did the inclusion of regular eggs. The cholesterol content of 2 regular eggs or 2 eggs high in polyunsaturated fatty acid increased the total dietary cholesterol fourfold. This increase in cholesterol intake was held responsible for the failure to lower blood cholesterol on a diet otherwise rich in polyunsaturated fatty acids. Increasing the dietary cholesterol from 0 to 0.8 gm daily without other dietary change results in a progressive increase in the plasma cholesterol.[4]

CARBOHYDRATES. During the last half century the source of carbohydrates as well as the total amount of carbohydrates in the American diet have undergone greater changes than those for any other nutrients. In the United States a marked decline has taken place in the total carbohydrate but this has been at the expense principally of the complex carbohydrates, while the intake of mono- and disaccharides has increased. When sugar in the diet is replaced by complex carbohydrates (starches) without altering other dietary factors, the plasma concentrations of cholesterol and of triglyceride are reduced. Conversely, the substitution of sugar for complex carbohydrate has been found to increase these blood lipids.[7,8]

CALORIE BALANCE. Overweight has been generally stated to be a predisposing factor to coronary disease. In a study conducted in Framingham, Massachusetts, overweight alone was found to constitute only a slight risk except when it was associated with elevated blood lipids.[4] When overweight is associated with diabetes, the plasma cholesterol and triglyceride levels are custom-

arily high. A reduction in calories and carbohydrate and a relatively high proportion of polyunsaturated fats effectively lower these levels. Physical exercise and the maintenance of calorie equilibrium are undoubtedly beneficial in reducing the blood lipid levels.

MEAL PATTERN. Many people eat a small breakfast and lunch, and a large dinner, which may contain half of the day's energy intake. When meals are of relatively equal size, blood lipid levels are lower than they are if one meal is large.[8] It is speculated that large meals may overload the usual mechanisms for carbohydrate metabolism, so that alternate metabolic pathways are used. These alternate pathways, however, favor the synthesis of cholesterol.

Uses of modified diets. The Food and Nutrition Board has reached the following conclusion concerning the diet to be followed by the American public.

> Until we learn more about which fats are desirable nutritionally, the Board recommends that the American consumer should partake of the foods that make up a varied, adequate, and not overly rich diet and maintain a normal body weight by judicious control of caloric intake and by daily exercise.*

The Board has also pointed out that the food industry, regulatory agencies, and communications media can play an important role by emphasizing the importance of weight control and exercise, by avoiding exaggerated claims for foods, and by providing labeling concerning the composition of food.

The fat-controlled diets described below are intended for use by those individuals who constitute a high-risk group, and who are under the care of a physician.

Modification of the diet. Fat-controlled diets have been developed by a committee of dietitians and physicians, and published by the American Heart Association. The important characteristics of the diets are discussed in the following paragraphs.

FAT. About 35 to 40 per cent of calories are derived from fat, but the choice emphasizes oils high in polyunsaturated fats and sharply restricts those high in saturated fats. (See Figure 41–3.) Thus, lean cuts of beef, lamb, and pork may be used only three times a week while chicken, turkey, fish, and meat substitutes are emphasized. Only skim milk is permitted.

The ratio of polyunsaturated to saturated fatty acids is about 1.1: 1 at 1200 calories, 1.3:1 at 1800 calories, and 1.5:1 at 2300 calories.

CHOLESTEROL. Eggs are restricted to three per week, and organ meats are omitted.

ENERGY. The calorie level selected should be that which maintains normal weight. For sedentary men and women this may be 1800 or slightly more. A low-calorie level is chosen for the obese.

* Food and Nutrition Board: *Dietary Fat and Human Health.* Pub. 1147, National Academy of Sciences, National Research Council, Washington, D.C., 1966, p. 43.

NUTRITIVE ADEQUACY. Fat-controlled diets are designed to provide the essential nutrients. Vitamin A will not be fully supplied unless dark-green leafy or deep-yellow vegetables are eaten daily, since the diet excludes other important sources of the vitamin.

The food lists, daily food allowances, and sample meal pattern are shown in Tables 41–1, 41–2, and 41–3.

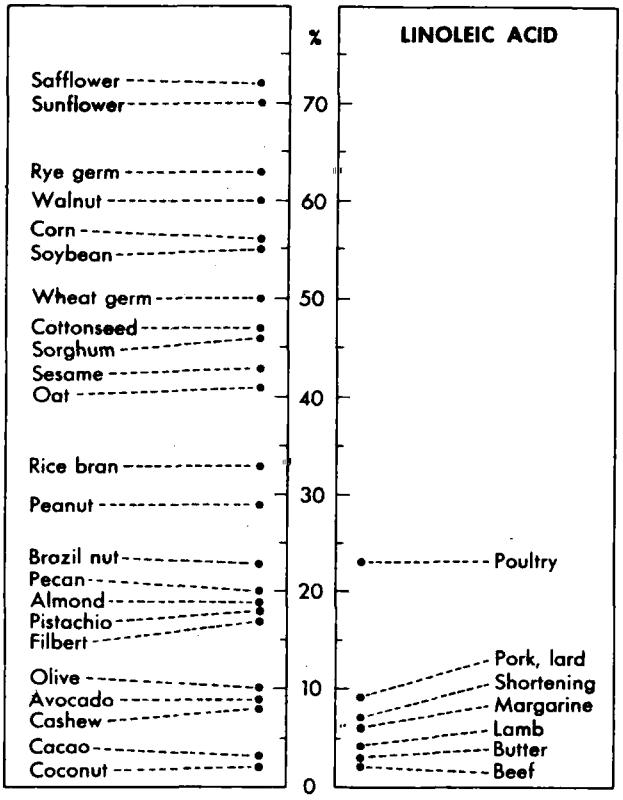


FIG. 41–3. Percentage of linoleic acid in fats and oils of plant and animal origin. (*Courtesy, Dr. Callie M. Coons and the* Journal of the American Dietetic Association.)

Food preparation. The success of this diet is dependent upon rigid restriction of saturated fats and emphasis upon polyunsaturated fats.

1. Select only lean cuts of meat. Cut off any visible fat. Use only skim milk. (See Figure 41–4.)
2. Meat, fish and poultry may be cooked in any way. If calories are restricted, deep fat frying should not be used. Part of the daily oil allowances may be used in meat preparation.
3. If stews or soups are prepared the fat should be skimmed off. This is facilitated by cooking a day before use and chilling in the refrigerator so that the fat is hardened.

Table 41–1. Food Lists for Fat-Controlled Diets*

Foods to Use	Foods to Avoid
Milk List	
Skim milk	Whole-milk, homogenized milk, canned milk
Nonfat dry milk	Sweet cream, powdered cream
Buttermilk	Ice cream unless homemade with nonfat dry milk
	Sour cream
	Whole-milk buttermilk and yogurt
	Cheese made from whole milk
Vegetables	
As desired	
See List 2, Table A–4	
Fruits	
As desired	
See List 3, Table A–4	
Breads, Cereals List (includes some higher calorie vegetables)	
1 slice bread	Commercial biscuits, muffins, cornbreads, griddle cakes, cookies, crackers
1 roll (2–3 inches across)	Mixes for biscuits, muffins, and cakes
1 home-made biscuit or muffin (2–3 inches across)	Coffee cakes, cakes (except angel food), pies, sweet rolls, doughnuts, and pastries
1 square home-made cornbread (1½ inches square)	
1 griddlecake (4 inches across) made with skim milk or fruit juice and day's allowed fat	
4 pieces melba toast (3½ by 1½ by ⅛ inches)	
1 piece matso (5 inches square)	
¾ ounce bread sticks, rye wafers, or pretzels	
1½ cups popcorn (popped at home with fat or oil from day's allowance)	
½ cup cooked cereal	
¾ cup dry cereal	
½ cup cooked rice, grits, hominy, barley, or buckwheat groats	
½ cup cooked spaghetti, noodles, or macaroni	
¼ cup dry bread crumbs	
3 tablespoons flour	
2½ tablespoons corn meal	
½ cup cooked dried beans, peas, lentils, or chickpeas	
⅓ cup corn, kernels or cream style	
1 ear corn on the cob (4 inches long)	
1 small white potato	
¼ cup sweet potato, cooked	

* Adapted from *Planning Fat-Controlled Meals for 1200 and 1800 Calories.* Revised, American Heart Association, New York, 1966.

Table 41–1. Food Lists for Fat-Controlled Diets (Continued)

Foods to Use	*Foods to Avoid*
Meat, Fish, and Poultry List	
Selections from this group for 11 of the 14 main meals	
Poultry without skin: chicken, turkey, cornish hen, squab	Skin of chicken or turkey Duck or goose
Fish: any kind except shellfish	Fish roe; caviar
Veal: any lean cut	Fish canned in olive oil
Meat substitute: cottage cheese (preferably uncreamed), yogurt from partially skimmed milk, dried peas or beans, peanut butter, nuts (especially walnuts)	Shellfish (shrimp, crab, lobster, clams) Note: 2 ounces may be used *in place of* 1 egg
Selections from this group for 3 of the 14 main meals	
Beef:	
Hamburger—ground round or chuck	Beef high in fat or marbled
Roasts, pot roasts, stew meats—sirloin tip, round, rump, chuck, arm	Lamb high in fat
Steaks—flank, sirloin, T-bone, porterhouse, tenderloin, round, cube	Pork high in fat Bacon, salt pork, spareribs
Soup meats— shank or shin	Frankfurters, sausage, cold cuts
Other—dried chipped beef	Canned meats
Lamb:	Organ meats such as kidney, brain, sweetbread, liver Note: 2 ounces liver, sweetbreads, or heart may be substituted for one egg
Roast or steak—leg	
Chops, loin, rib, shoulder	
Pork:	Any visible fat on meat
Roast—loin, center cut ham	
Chops—loin	
Tenderloin	
Ham:	
Baked, center cut steaks, picnic, butt, Canadian bacon	
Fat List	
Corn oil	Butter
Cottonseed oil	Ordinary margarines
Safflower oil	Ordinary solid shortenings
Sesame seed oil	Lard
Soybean oil	Salt pork
Sunflower oil	Chicken fat
Mayonnaise (1 tsp mayonnaise equals 1 tsp oil)	Coconut oil
French dressing made without allowed oil (1½ tsp dressing equals 1 tsp oil)	Olive oil Chocolate
Sugars and Sweets List	
White, brown, or maple sugar	
Corn syrup or maple syrup	
Honey	
Molasses	
Jelly, jam, or marmalade	

Table 41–1. Food Lists for Fat-Controlled Diets (Continued)

Foods to Use	Foods to Avoid
Dessert List	
(Each serving listed equals 1 tbsp sugar. All desserts except the one marked † are fat free.) ¼ cup tapioca or cornstarch pudding made with fruit and fruit juice or with skim milk ¼ cup fruit whip ⅓ cup gelatin dessert ¼ cup sherbet (preferably water ice) ⅓ cup sweetened canned or frozen fruit 1 small slice angel food cake 2 sugar cookies† 3 nut meringues ¾ cup sweetened carbonated beverages ⅔ cup cocoa (not chocolate) made with skim milk from milk allowance Candies: 3 medium or 14 small gum drops; 3 marshmallows; 4 hard fruit drops; or 2 mint patties (no chocolate)	Puddings, custards, and ice creams unless made with skim milk or nonfat dry milk powder Whipped cream desserts Cookies unless made with allowed fat or oil
Miscellaneous	
	Sauces and gravies unless made with allowed fat or oil or made from skimmed stock Commercially fried foods (e.g., potato chips, French fried potatoes, fried fish) Cream soups; creamed dishes Frozen or packaged dinners Olives Macadamia nuts Avocado Chocolate Candies made with chocolate, butter, cream, or coconut Coconut Foods made with egg yolk unless counted as part of allowance Fudge, chocolate Commercial popcorn Substitutes for coffee cream

4. The oil allowance may be used in these ways:
   (a) Substitute oil for an equivalent amount of solid fat in recipes for: muffins, griddle cakes, waffles, yeast breads. Special recipes are also available for pie crust, cake, and biscuits made with oil.
   (b) Meat and fish may be brushed with oil before broiling or roasting.

Table 41–2. Diet Plans for Fat-Controlled Diets

	1200 Calories*	1800 Calories*	2000–2600 Calories Men (Sedentary) Women (Moderately Active)
Milk, skim	1 pint	1 pint	1 pint
Vegetables	3 or more servings	3 or more servings	As desired; at least 1 yellow or leafy green
Fruits	3 servings	3 servings	As desired; at least 1 citrus
Breads and cereals	4 servings	7 servings	As desired
Meat, fish, or poultry cooked	5 ounces	6 ounces	6 ounces
Eggs	3 yolks (*each week*)	3 yolks (*each week*)	3 yolks (*each week*) †
Fat, total allowance	2 tablespoons	4 tablespoons	4–5 tablespoons
special margarine	(up to 1 teaspoon)	(up to 1 tablespoon)	(up to 2 tablespoons)
Sugars and sweets	1 serving if substituted for 1 serving breads and cereals	2 servings	As desired

* Adapted from *Planning Fat-Controlled Meals for 1200 and 1800 Calories*, Revised. American Heart Association, New York, 1966.

† Egg whites may be used as desired.

(c) Meats, fish, poultry, egg may be pan fried.

(d) Cream sauces may be made using skim milk, and oil instead of solid fat.

(e) Meat, poultry, and fish may be marinated in oil and lemon juice or vinegar with herb seasonings.

(f) Vegetables may be cooked in a tightly covered pan, using a minimum amount of water, and adding oil and seasonings for flavor.

(g) Oil may be blended with skim milk in a blender and flavored for a beverage. It should be consumed immediately after blending.

5. Special margarines high in polyunsaturated fat may be substituted for part of the oil allowance, as stated in Table 41–2.

6. Part of the sugar allowance may be used as jelly, jam, marmalade, or honey on bread since the amount of special margarine which may be used is restricted.

Eating away from home. Whenever one has a choice of menu in a restaurant or cafeteria, it is possible to adhere rather closely to the diet. A first course may consist of fruit or vegetable juice, fruit, or a clear soup. Roast or broiled meat may be trimmed of visible fat, choosing those cuts likely to be lean. Chicken or fish represent good choices. Salads with mayonnaise or French dressing are appropriate. Dessert selection could be fresh or canned fruit, sherbet, or angel cake.

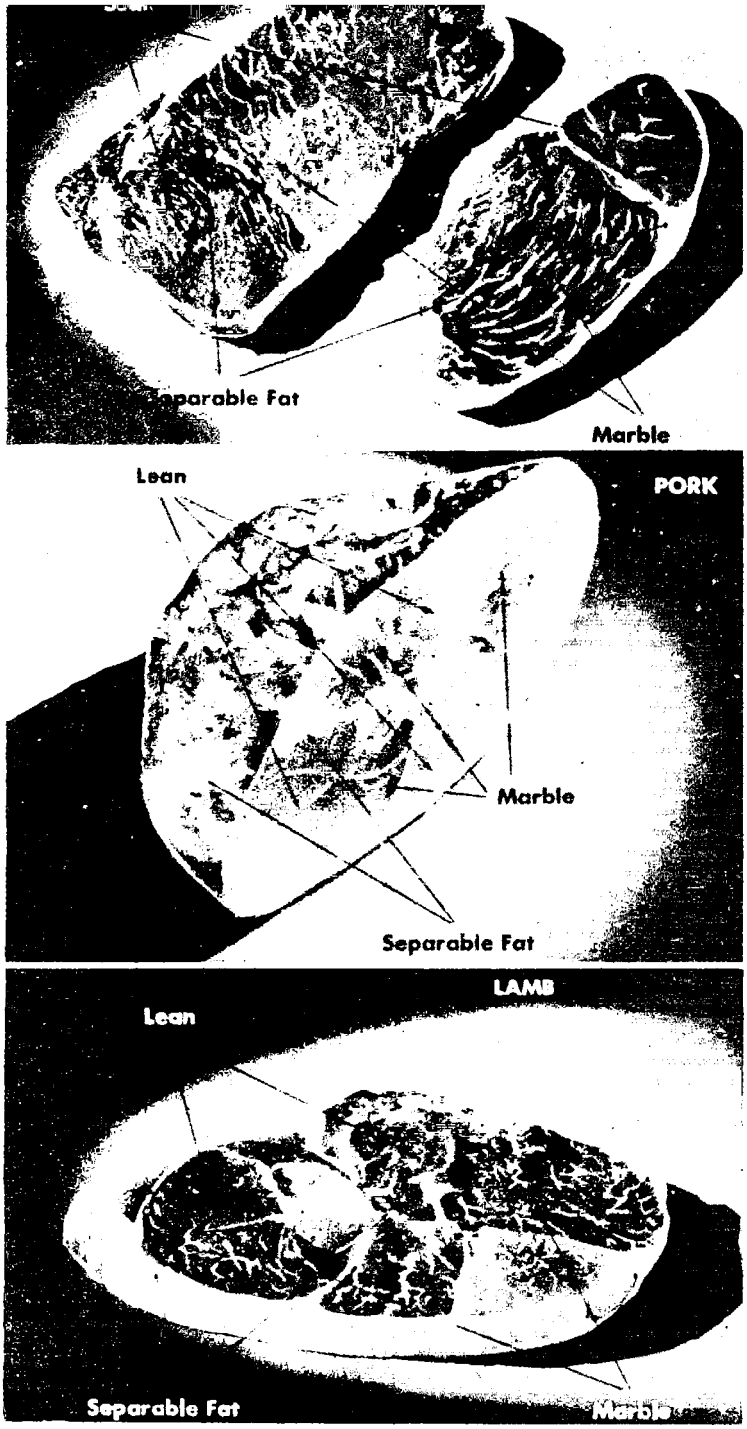


FIG. 41–4. These cuts of meat show extremely lean portions, and those that are lean with some marbling of fat. Some fat is easily separable from the meat. The individual who requires a fat-controlled diet would use the extremely lean portion of the cut. (*Courtesy, National Live Stock and Meat Board.*)

Table 41–3. Meal Pattern and Sample Menu for 1800-Calorie Fat-Controlled Diet

Breakfast	
Citrus fruit or other good source of ascorbic acid	Orange and grapefruit slices
Cereal—1 serving	Whole-wheat cooked cereal with brown sugar, skim milk
Milk, skim—½ cup	
Egg—1 (but only 3 per week)	Egg, fried in oil (1 teaspoon)
Bread—2 slices	Homemade muffins made with oil—2
Fat—1 tablespoon	Special margarine—2 teaspoons
Sugar—1 tablespoon	
Coffee or tea	Coffee with sugar
Luncheon or supper	
Lean meat, fish, poultry or cottage cheese—3 ounces	Broiled chicken—3 ounces, brushed with oil
	Ripe tomato slices fried in oil
Dark-green or yellow vegetable—1 serving	Tossed green salad with French dressing—1 tablespoon
Bread—1 slice	Rye bread
Milk, skim—1 cup	Milk, skim—1 cup
Fruit—1 serving	Baked apple
Sugar or sweets—3 teaspoons	
Fat—1 tablespoon	
Dinner	
Lean meat, fish, poultry—3 ounces	Shrimp creole (oil in sauce)
Potato—or substitute—1	Rice
Vegetable—1 serving	Asparagus, with pimento, oil
Bread—1 slice	Hard roll with special margarine (1 teaspoon)
Milk, skim—½ cup	Milk, skim—½ cup
Fruit—1 serving	Sliced peaches
Sugar or sweets—3 teaspoons	Angel cake, small slice
Fat—1 tablespoon	

If there is no opportunity to choose, one can still make reasonable adjustments by trimming fat from meat, by removing skin from poultry, and by not eating foods likely to be high in saturated fat. Foods to be especially avoided when eating out are butter or margarine, fried foods, creamed dishes, gravy, pastries, ice cream, cakes, and cookies.

PROBLEM AND REVIEW

1. Explain each of these terms: atherosclerosis; β-lipoproteins; polyunsaturated fatty acid; hydrogenated fat; saturated fat.
2. List at least eight factors which have a bearing on the blood cholesterol level.
3. What relationship exists between the amount and nature of the dietary fat and the blood cholesterol level?
4. Why is it inadvisable at the present time to recommend that all Americans modify the kind and amount of fat they ingest?

5. In what circumstances is a controlled-fat diet recommended?

6. *Problem.* Plan a normal diet for 1 day. Calculate the total fat, the saturated fat, and the linoleic acid content. Revise the diet so that the linoleic acid level is two times as high as the saturated fat. What measures can you suggest for making such a change acceptable to the patient?

7. Examine advertising and labeling for food fats. Evaluate the statements made according to your understanding of the relationship of fat to the change in blood cholesterol level.

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Chapter 42

DIETARY MANAGEMENT OF ACUTE AND CHRONIC DISEASES OF THE HEART

Sodium-Restricted Diet

Role of nutrition in cardiac efficiency. The heart muscle, like any other body tissue, is dependent upon an adequate supply of all the essential nutrients. The markedly malnourished peoples of the world frequently manifest cardiac impairment such as dyspnea and palpitation on exertion, enlargement of the heart, and systolic murmurs. Inadequate thiamine has been shown to be especially responsible for these conditions which are common manifestations of beriberi.

Semistarvation diets given to 36 young men in controlled studies at the University of Minnesota[1] resulted in loss of weight, lower metabolic rate, decrease in blood pressure, pulse rate, and heart size. There was a general depression of circulatory function in these previously normal individuals which must not be confused with circulatory failure. When these men were again given normal diets, the blood pressure returned to normal. The increase in body weight and the total daily metabolism placed a temporary strain on the cardiovascular system which resulted in the frequent occurrence of moderate tachycardia and dyspnea.

Similar observations were made in a survey of the population in Leningrad during and following the siege of World War II. During the period of semistarvation the incidence of hypertension and of associated cardiac disease decreased very markedly, but the rate and severity of hypertensive disease increased so alarmingly during recovery as to constitute a major medical problem.

Clinical findings related to dietary management. Diseases of the heart may affect (1) the pericardium or outer covering of the organ, (2) the endocardium or membranes lining the heart, or (3) the myocardium or the heart muscle. In addition, the blood vessels within the heart or those leaving the heart, or the heart valves may be diseased. Heart disease may be acute with no prior warning, as in a coronary occlusion, or chronic with progressively decreasing ability to maintain the circulation.

	ory
Pimento	Sesame seeds
Poppy seed	Sorrel
Poultry seasoning	Sugar
Purslane	Tarragon
Rosemary	Thyme
Saccharin	Turmeric
Sucaryl (calcium salt only)	Vanilla extract
	Vinegar
Saffron	Wine, if allowed by physician
Sage	
Salt substitutes (with physician's approval)	Walnut extract

Meal planning with unit lists. The 500-mg sodium diet at thr levels is shown in Table 42–2.

Table 42–2. Food Allowances for 500-Milligram Sodium Diet

Food List	1200 Calories	1800 Calories	Unrestricte Calories
	units	*units*	*units*
Milk	2 (skim)	2 (whole)	2 (whole)
Vegetables, A	1	1	1 or more
B	1	1	1 or more
C	1	1	1 or more
Fruit	4	4	2 or more
Bread	5	7	4 or mo
Meat	5	5	5 only
Fat	0	4	sir
Free choice	1	2	

The 500-mg sodium diet may be adjusted for lower or hig as follows:

250 mg sodium: substitute low-sodium milk for regular n

1000 mg sodium: substitute 2 slices ordinary salted br sodium) and 2 teaspoons salted butter (contains 100 r unsalted bread and 2 teaspoons unsalted butter; *or* use ½ at the table to salt the food.

Mild sodium restriction: use foods lightly salted anc and butter, regular milk. Omit the salting of food at t potato chips, salted popcorn and nuts, olives, pickles and salted meats.

MEAL PATTERN SAMP

(500 mg sodium, 1800 calories)

	Low-sodium t[illegible] egg [illegible]ce
unit	Butter, unsalted—[illegible] poon
[illegible] (Cont.)	Milk—½ cup
y	offee with sugar (Note: 2 teaspoons
[illegible]	sed in apple
	SAMPLE
EON OR SUPPER	
or poultry—2 ounces	Broiled fresh flounder
A group	Stewed tomatoes
nits	Baked potato—1 small
	Low-sodium muffins—2 medium
alted—1 unit	Butter, unsalted—1 teaspoon
aspoons	Grape jelly—2 teaspoons
p	Milk, whole—1 cup
nit	Bing cherries
R	
or poultry—2 ounces	Broiled breast of chicken
B group—½ cup	Fresh green peas
C group—½ cup	Steamed rice (from bread list)
alted—2 units	Low-sodium rolls—2
alted—2 units	Butter, unsalted—2 teaspoons
aspoons	Currant jelly—2 teaspoons
nits	Sliced banana
cup	Milk—½ cup
	Tea with lemon

tion of food. Ingenuity is required in the preparation of foods for st[illegible] l diets so that they may be accepted by the patient. A number s[illegible] s are available, but they should be used only upon the recom- physician since some of them contain potassium which may en there is renal damage.

g aids are available (see p. 759 for list) to provide taste ices are especially useful, but they should be used with a suitable combinations are provided on page 759.

muffins, waffles, and doughnuts may be prepared l egg allowance of the diet. Low-sodium baking l for regular baking powder. Low-sodium milk is through an ion exchange resin in the cold. The quivalent amount of potassium, and the resultant hole milk. The calcium value of low-sodium milk f whole milk, the thiamine content is about half vel is almost twice as high. In other nutrients vorably with whole milk.[4] When diets are re- cipes requiring milk may be prepared success-

Dangers of sodium restriction. Diets that are very low in sodium must be used with caution since there is occasional danger of depletion of body sodium. Hot weather may bring about great losses of sodium through the skin, while vomiting, diarrhea, surgery, renal damage, or the use of mercurial diuretics also increases the amounts of sodium lost from the body. Sodium depletion is characterized by weakness, abdominal cramps, lethargy, oliguria, azotemia, and disturbances in the acid-base balance. Patients must be instructed to recognize the symptoms of danger and to consult a physician immediately when they occur.

Counseling the patient. Perhaps no diet provides greater obstacles with respect to acceptance for taste appeal, and understanding of the permissible food choices than does the sodium-restricted diet. Skilled counseling of the patient by dietitian, nurse, and physician is essential from the time the diet is first prescribed. Far too many patients have assumed that the omission of salt merely represented poor cookery, and have eaten forbidden foods brought in by well-meaning but uninformed relatives and friends.

When a sodium-restricted diet is to be continued in the home, the patient should be given some understanding of the purposes of the diet, and some indication regarding the length of time he may need to use the diet. He needs information on the foods that are permitted on the diet, what foods are contraindicated, where foods may be purchased, and how to prepare palatable foods with flavoring aids.

The American Heart Association has published detailed booklets concerning three levels of sodium restriction, and also a leaflet for those patients who may find that much detail can be confusing. Neither of these teaching aids should take the place of individualized instruction and guidance, nor should the patient be expected to comprehend all of the information provided in a short space of time. Cultural food patterns must be considered, for favorite dishes are often high in sodium. Usually these dishes may be adapted to the sodium-restricted regimen, rather than omitting them entirely.

HYPERTENSION

Hypertension, or elevation of the blood pressure above normal, is a symptom which accompanies many cardiovascular and renal diseases. It may occur at any age but is found most frequently in people over 40 years of age. Hypertension may be caused temporarily by emotional disturbances or by excessive smoking. Certain kidney disturbances or tumor of the adrenal are responsible for a small proportion of cases. However, about 85 to 90 per cent of patients belong to the group known as essential hypertension, for which the cause is unknown. Dahl[5] and others have suggested that a high-salt intake over long periods of time is accompanied with an increased probability of high blood pressure.

Dietary indications. Hypertension is often reduced if weight loss is brought about in the obese patient. The discovery of antihypertensive drugs has decreased the interest in low-sodium regimens. When a low-sodium diet is ordered, it must be strictly observed for at least 4 to 6 weeks before noticeable improvement may be seen. The drastic restriction of 200 to 250 mg sodium daily is difficult in terms of control of sodium level and in acceptability. The regimen described some years ago by Kempner[6] consisted of 200 to 300 gm rice (dry weight), fruits, fruit juices, and sugars to provide 2000 calories, 15 to 20 gm protein, 5 gm fat, and 100 to 150 mg sodium. It is seldom used because of the great difficulty experienced by most patients in adhering to the monotonous regimen.

PROBLEM AND REVIEW

1. For a patient with congestive heart failure, what are the modifications of diet required for (a) calorie level; (b) protein; (c) fluid intake; (d) number of meals; (e) choice of food?
2. When is a 250-mg sodium diet likely to be ordered? A 500-mg sodium diet? A 1000-mg sodium diet? A mild restriction?
3. *Problem.* Plan the menu for one day for a 500-mg sodium diet with calories restricted to 1800. What are some of the problems you might encounter in getting the patient to follow this diet? How would you meet them?
4. Examine the label on several dietetic foods and evaluate each product for its usefulness in terms of a 500-mg sodium diet.
5. What changes would you make in a recipe for baking powder biscuits and for muffins so that they might be used on a 1000-mg sodium diet?
6. How does low-sodium milk compare with regular milk in its nutritive value? When should it be used?
7. What foods may present problems in salt restriction for the Jewish patient; the Chinese patient; the Puerto Rican; the Italian?

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Chapter 43

DIET IN DISEASES OF THE KIDNEY

Low-Protein Diets; Potassium-Restricted Diet; Calcium- and Phosphorus-Restricted Diet

Functions of the kidney. The chief function of the kidneys is the maintenance of a constant composition and volume of the blood. This includes the regulation of the osmotic pressure, the electrolyte and water balance, and the acid-base balance. By regulation of the composition of the blood the maintenance of homeostasis in the interstitial and intracellular fluid compartments of the body is achieved. The urine includes all those waste materials that must be excreted in order to achieve this state of equilibrium.

The *nephron*, of which there are more than one million in each kidney, is the functioning unit. Each nephron consists of a *glomerulus*, or tuft of capillaries, surrounded by a capsule, and attached to a long winding tubule (see Figure 43–1). The glomeruli behave as filters; that is, the glomerular filtrate is of essentially the same composition as the blood except that it contains no protein and other large colloidal particles. The glomerular filtration rate of normal kidneys in the adult is about 125 ml fluid per minute, or about 180 liters in 24 hours.

The tubule consists of the *proximal* convoluted tubule, *Henle's* loop, and the *distal* convoluted tubule which leads into the system of collecting tubules emptying into the pelvis of the kidney. The fluid waste then enters the bladder by means of the ureters and is finally eliminated from the body as urine.

As the glomerular filtrate moves through the proximal tubule practically all of the glucose, amino acids, and ascorbic acid are reabsorbed into the circulation; about 80 to 85 per cent of the water and electrolytes (Na^+, K^+, Cl^-, HCO_3^-, HPO_4^{--}, and SO_4^{--}) are reabsorbed into the circulation. By the time the glomerular filtrate has reached Henle's loop, it has already undergone marked changes in composition. Reabsorption of the remaining water and adjustment of the sodium, potassium, and chloride concentrations are accomplished in the distal and collecting tubules. By the time urine has been formed, more than 99 per cent of the water, sodium, chloride, and bicarbonate has been reabsorbed into the circulation.

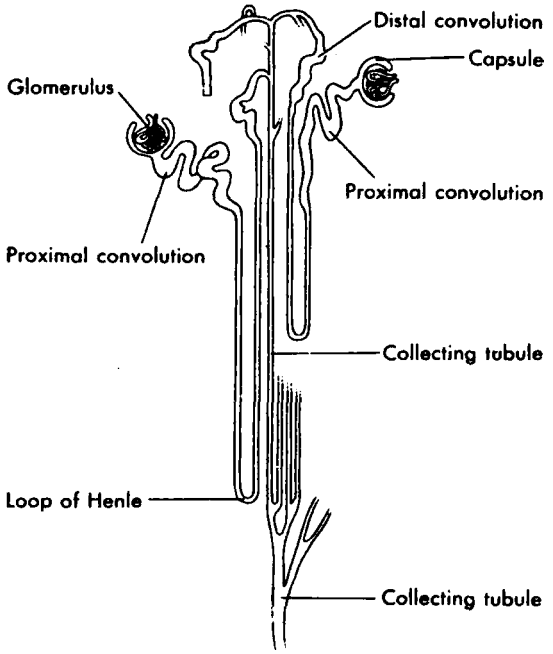


FIG. 43–1. Diagram of the course of two renal tubules. (*From Kimber, D. C., Gray, C. E., Stackpole, C. E., Leavell, L. C., and Miller, M. A.:* Anatomy and Physiology, *15th ed. The Macmillan Company, New York, 1966.*)

The reabsorption of water from the distal tubules is controlled primarily by the antidiuretic hormone (ADH), also known as vasopressin, produced by the pituitary gland. *Osmoreceptors* in the hypothalamus are sensitive to an increase in the osmotic pressure of the blood and cause the secretion of antidiuretic hormone which increases the reabsorption of water. When the osmotic pressure is low, the hormone is not produced and diuresis takes place.

The reabsorption of sodium from the distal tubule is regulated by mineralocorticoids, chiefly aldosterone and deoxycorticosterone, which are secreted by the adrenal cortex. In order to increase sodium reabsorption, potassium is secreted into the tubular fluid. Thus, the mineralocorticoids serve to retain sodium and to remove potassium. (See also Chapter 39 for discussion of adrenocortical insufficiency.)

Urine consists of about 95 per cent water and 5 per cent solids. In a 24-hour period the adult excretes about 50 to 70 gm solids with about three fifths of this being nitrogenous waste, and two fifths inorganic salts. Urea is the predominating nitrogenous substance in the urine, along with much smaller amounts of uric acid, ammonia, and creatinine. Sodium chloride is the principal inorganic salt excreted, but the amount varies widely with intake. In addition, chloride, phosphate, and sulfate salts of calcium, sodium, potassium, and magnesium are excreted.

The normal kidney produces a urine which may vary in specific gravity from about 1.008 to 1.035, depending upon the proportions of water and solids to be excreted. For an average load of solids, about 600 ml fluid must be excreted; this is sometimes referred to as the *obligatory* fluid requirement. With an increase in the production of solid wastes, a corresponding increase in fluid for their excretion would be required. Among the situations in which increased solid wastes are produced are the following: (1) a protein intake in excess of body needs for synthesis will be used as a source of energy, with the urea resulting from the deamination of amino acids adding to the excretory load; (2) increased catabolism of body tissues following any stress such as surgery, injury, or fever would increase the urea production; and (3) increased intake of salts would increase the amounts to be excreted. The fluid requirement is greatly increased when the kidney is unable to produce a concentrated urine.

The kidneys play an important role in helping to maintain the normal pH of body fluids by excreting an acid urine and by synthesizing ammonia whenever necessary. Foreign substances which cannot be utilized by the body are eliminated in part by the kidney. One example of such a foreign substance is hippuric acid, which is synthesized by the liver from the benzoic acid occurring in certain foods.

Disturbances of kidney function. Nephritis, or Bright's disease, is an inflammation of the kidney, involving the parenchyma and interstitial tissues. If there is serious interference with the functioning of the kidney, waste products accumulate in the blood so that eventual acidosis and uremia occur. Edema may be initiated if the proteins in the circulation and in the tissues have been depleted because of inadequate protein intake or excessive loss in the urine. An accumulation of sodium in the body may likewise result in edema. It may be expected, then, that the diet will be modified with respect to its protein level and its mineral content. The dietary regimens for acute and chronic glomerulonephritis, nephrosis, nephrosclerosis, acute anuria and uremia, and urinary calculi will be discussed in this chapter.

ACUTE GLOMERULONEPHRITIS

Symptoms and clinical findings. Acute glomerulonephritis, also known as hemorrhagic nephritis, is primarily confined to the glomeruli. It occurs mostly in children and young adults as a frequent sequel to streptococcic infections such as scarlet fever, tonsillitis, pneumonia, and respiratory infections. It is usually characterized by a diminished urinary volume (oliguria), hematuria, some albuminuria, slight generalized edema, varying degrees of hypertension, and some nitrogen retention (azotemia). Nausea and vomiting may be especially annoying symptoms.

The acute phase of the illness lasts from several days to a week, but renal function returns to normal much more slowly. Full recovery is the rule, providing treatment is prompt and appropriate. The length of time for recovery may vary from 2 or 3 weeks to several months, as determined by function tests rather than subjective impressions.

Modification of the diet. Diet assumes secondary importance during the acute phase of the illness since nausea and vomiting make it unrealistic to provide an adequate intake. During this period an effort should be made to provide sufficient fluid to maintain water balance and to provide nonprotein calories to avoid excessive tissue catabolism. Initially, carbohydrate may be provided as fruit juices sweetened with glucose if the patient is able to take them; or it may occasionally be necessary to give glucose intravenously or by tube feeding. As the patient improves, the following dietary modifications are appropriate.

ENERGY. An adequate intake of carbohydrate and fat reduces the nitrogen metabolism to a minimum and thus reduces the work required of the kidney. Moreover, a reduction in tissue breakdown slows down the release of potassium from the cells into the extracellular fluid.

PROTEIN. Marked restriction of protein—about 0.2 gm per kilogram—is recommended by some clinicians[1] for all patients during the acute phase, while others prescribe such restriction only when the blood nitrogen levels are elevated. During recovery the protein may be increased to 0.5 gm per kilogram for adults and 0.75 gm per kilogram for the child. However, if there is marked albuminuria, the protein intake should be increased by the amount of protein lost in the urine.

Three levels of protein are outlined on page 646. The 20-gm protein diet should be used for only a few days. If the patient does not consume sufficient food to meet his energy needs, the work of the kidney will not be appreciably diminished since excessive tissue breakdown will also result in nitrogenous wastes to be excreted.

The 40-gm and 60-gm levels of protein will maintain nitrogen equilibrium in the adult and may be used for longer periods of time providing that (1) the patient has not been previously malnourished, (2) the caloric intake satisfies energy needs, (3) some complete protein is included at each meal, and (4) there are no protein losses in the urine. (See Table 43–1.)

SODIUM. When edema and hypertension are present, sodium restriction of 500 to 1000 mg is generally indicated. Danowski[2] recommends some sodium restriction in all patients because of the danger of hypertension, congestive failure, and pulmonary edema. Rigid restriction of sodium may seriously interfere with an already poor appetite.

FLUID. During the oliguric stage, fluids are usually limited to 500 to 700 ml daily; this approximately replaces the fluid losses by insensible perspiration. Larger amounts of fluid are given when there has been vomiting or other gastrointestinal losses, or excessive perspiration.

Table 43–1. Food Allowances for Three Levels of Protein

Food	Prescribed Protein Level		
	20 gm	40 gm	60 gm
Milk, cups	0	½	2
Cream, cups	½	½	0
Lean meat, poultry, or fish, ounces	0	1	2½
Eggs	0	1	1
Vegetables, including one raw:			
Potato or substitute, servings	2	2	2
Green leafy or deep yellow, servings	1	1	1
Other vegetable, servings	1–2	1–2	1–2
Fruits, including one citrus:			
Fresh, canned, or frozer, with sugar, servings	3	3	3
Fruit juice, cups	2	1	0
Cereal, enriched or whole-grain, servings	1	1	1
Bread, enriched or whole-grain, slices	3	4	4
Butter or margarine, tablespoons	3	3	3
Sugar, jelly, jam, tablespoons	7	4	4
Nutritive values			
Calories	1990	2025	2020
Protein, gm	20	40	60
Fat, gm	70	85	80
Carbohydrate, gm	320	275	265
Sodium—using regular milk; all foods processed and prepared without added sodium, mg	150	300	500

VERY LOW TO MODERATELY LOW PROTEIN DIETS*

Characteristics and general rules:

Milk, eggs, meat, poultry, and fish are restricted (or omitted) depending upon the desired protein level. When they are allowed, some of these complete protein foods should be included at each meal to provide the most effective mixture of amino acids.

Calcium, riboflavin, and iron levels are below the Recommended Dietary Allowances for the 20-gm and 40-gm protein diets. If the diets are used for more than a few days, supplements should be prescribed.

For a soft diet in the initial stages, select breads, cereals, fruits, and vegetables from the list of foods allowed on page 444.

When sodium restriction is ordered, the food selection should be based on the unit lists in Chapter 42.

The allowance of sugars and sweets may be used in fruit juices, as carbonated beverages, hard candy, fruit ices, syrups, or jellies.

When fluids are restricted, fruit juices may be used instead of water. However, the meal pattern below may also require some restriction in beverages and other fluids.

* Adapted from regimen described by Agnes Wallsten, unpublished research report, Drexel Institute of Technology, 1959.

MEAL PATTERN	SAMPLE MENU
(20 gm protein)	
BREAKFAST	
Fruit	Stewed figs
Cereal with cream, sugar	Cooked Ralston with cream and sugar
Enriched or whole-grain toast—1 slice	Enriched toast
Butter—2 teaspoons	Butter
Jelly—1 tablespoon	Grape jelly
Sugar—1 tablespoon	
Beverage	Coffee with cream and sugar
MIDMORNING	
Fruit juice with glucose	Grapefruit juice with glucose
LUNCHEON OR SUPPER	
Potato or substitute	Baked macaroni with tomato
Cooked vegetable	Buttered broccoli
Salad with dressing	Tossed green salad; French dressing
Bread with butter	Rye bread with butter
Fruit	Canned apricots
Beverage with sugar	Tea with sugar
MIDAFTERNOON	
Fruit juice	Grape juice and ginger ale
DINNER	
Potato or substitute with butter	Baked potato with butter
Vegetable with butter	Pimento wax beans
Salad with dressing	Grapefruit, apple, and avocado salad Fruit salad dressing
Bread with butter—1 slice	Dinner roll with butter
Dessert	Lime ice
Beverage with sugar	Tea or coffee, if desired
EVENING NOURISHMENT	
Fruit juice with glucose	Orange juice with glucose

MEAL PATTERN FOR 40 gm PROTEIN

Follow pattern for 20-gm protein level, with these additions:

BREAKFAST
Milk—½ cup

LUNCHEON
Egg—1
Bread—1 slice

DINNER
Meat—1 ounce

MEAL PATTERN FOR 60 gm PROTEIN

Follow pattern for 20-gm protein level, with these additions:

BREAKFAST
Milk—1 cup; omit cream

LUNCHEON
Egg—1
Milk—1 cup
Bread—1 slice

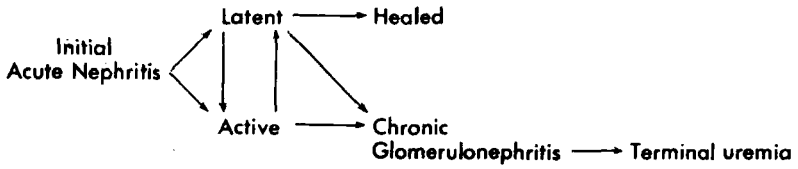
DINNER
Lean meat, poultry, fish—2½ ounces

Management of the diet. When nausea and vomiting have subsided, the patient is given easily digested foods with emphasis on a liberal carbohydrate intake. Between-meal feedings are desirable to provide a continuous source of calories, thus minimizing tissue catabolism.

Sugars, syrups, jelly, and hard candy contribute effectively to the carbohydrate intake without increasing the protein intake, but excessive amounts may be irritating and nauseating to some patients so that the appetite is impaired. Sweetened fruits and fruit juices may be used between meals to provide carbohydrate; fruit ices are especially refreshing. Breads, cereals, rice, macaroni, spaghetti, noodles, and potato provide liberal levels of carbohydrate; each serving of these foods also contains 2 to 3 gm protein. Cream and butter usually may be included to advantage.

CHRONIC GLOMERULONEPHRITIS

Nephritis may be of short duration, subacute or latent, or chronic as illustrated in the following diagram.*



During latent periods, the patient appears to be in good health and is asymptomatic. The nephritis may be detected only by laboratory tests. As the disease progresses, there is gradually increasing involvement: proteinuria, hematuria, hypertension, and vascular changes in the retina. The kidneys are unable to concentrate urine, and there are both frequent urination and nocturia. The nephrotic syndrome characterized by massive edema and severe proteinuria may develop (see p. 696). Malnutrition characterized by a persistent anemia

* Duncan, G. G.: *Diseases of Metabolism*, 2nd ed. W. B. Saunders Company, Philadelphia, 1947, p. 954.

and depletion of plasma proteins is often marked. Eventually the symptoms of renal failure occur (see Uremia, p. 651).

Modification of the diet. Good nutritional management can prolong life and enhance the sense of well-being. The objectives of dietary management are (1) to maintain the patient in a state of good nutrition to afford better resistance to infection; (2) to control and correct protein deficiency; (3) to prevent edema; (4) to avoid unnecessary harm to the kidneys; and (5) to provide attractive, easily digested meals adjusted to the individual patient's requirements. A rigid dietary program may be so poorly accepted by the patient that the principles upon which the regimen is based cannot be put into practice.

PROTEIN. Many clinicians recommend moderate to severe restriction of protein in chronic nephritis, while others believe that no good purpose is served by limiting protein below normal levels of intake. A number of factors must be considered in determining the protein level for a given patient.

Some breakdown of body tissues continues as long as life exists, but this can be minimized when the carbohydrate and fat intakes are fully adequate. Superimposed upon the wear-and-tear quota of protein, there may be a variable loss of protein in the urine. The end result of too much restriction of dietary protein is an accompanying reduction of tissue and plasma proteins followed by edema and progressive weakness. On the other hand, excessive dietary intake of protein leads to an additional load of nitrogenous constituents to be excreted by the kidney.

During the latent stage, the normal daily allowance of protein—60 to 70 gm for the adult—plus the amount of protein lost in the urine suffices. When nitrogen retention becomes more marked, further restriction of protein to 40 to 50 gm daily is recommended. Patients who are malnourished, edematous, and who lose much protein in the urine may require as much as 80 to 100 gm protein daily to replenish the tissues and correct for urinary losses.

ENERGY. Sufficient carbohydrate and fat should be provided so that the body's energy needs may be met without the breakdown of body protein. A carbohydrate intake of 300 gm and fat intake of 80 gm would provide 1900 nonprotein calories; this level is sufficient for the sedentary patient.

SODIUM. Levels of sodium ranging between 500 and 1000 mg daily are often used during edema, while the reformation of edema fluid may be prevented with less rigid sodium restriction.

It will be noted that the sodium restriction is usually less severe than that recommended for cardiovascular diseases. The diseased kidney has less ability to reabsorb sodium so that varying amounts of sodium are excreted regardless of the dietary restriction. Thus, too marked a restriction may actually lead to body depletion of sodium with its attendant weakness, nausea, and symptoms of shock. Some patients are "salt wasters," that is, they excrete large amounts of sodium.

POTASSIUM. As kidney damage becomes more severe, the ability to excrete potassium is diminished. Most foods contain considerable amounts of potas-

sium (see Table A-6). Salt substitutes should be used with caution if they contain potassium.

FLUID. The inability of the kidney to concentrate urine makes it undesirable to restrict fluids. Usually 1 to 2 liters of liquids will suffice to satisfy thirst. This amount permits the excretion of solid wastes with a minimum of work by the kidney. Additional fluid may be necessary in the presence of a fever, vomiting, or nitrogen retention.

Management of the daily diet. The normal diet, Chapter 29, may serve as the basis during the latent stages of nephritis. If mild sodium restriction is desired, the patient should be instructed concerning the foods that are high in salt content and should avoid the use of salt at the table. Cooked foods should be lightly salted.

Diets restricted in protein to 40 gm and 60 gm daily are described on pages 646–48. Frequent small feedings of high-carbohydrate foods should be encouraged so that tissue catabolism may be minimized.

DEGENERATIVE BRIGHT'S DISEASE (NEPHROSIS)

Degenerative Bright's disease is distinguished clinically from glomerulonephritis by the consistent absence of hypertension and hematuria and the usual absence of anemia and nitrogen retention. Like glomerulonephritis, it is characterized by proteinuria, but to an even more marked degree. The serum proteins are more seriously depleted than in glomerulonephritis, and this characteristic, which often results in massive edema, presents a primary problem in treatment. There is usually no associated cardiovascular disease.

The primary dietary factor requiring consideration is the replacement of protein, since urinary losses may be very large. A high-protein diet with sodium restriction is suitable.

NEPHROSCLEROSIS (ARTERIOSCLEROTIC BRIGHT'S DISEASE)

Nephrosclerosis, or hardening of the renal arteries, occurs in adults after 35 years of age, as a rule, and is associated with arteriosclerosis. The disease may run a benign course for many years. During late stages some albuminuria, nitrogen retention, and retinal changes develop. Death usually results from circulatory failure. In a small number of younger persons nephrosclerosis runs a stormy, rapid course leading to uremia and death. This is called malignant hypertension.

Modification of the diet. Weight reduction of the obese is desirable. A 200-mg sodium diet has been used successfully in some instances. The protein intake may be kept at a normal level until marked nitrogen retention indicates that the kidney is no longer able to eliminate wastes satisfactorily. The diet on

page 646 may be used, with or without sodium restriction, when a lower level of protein becomes necessary.

ACUTE ANURIA

Anuria refers to the suppression of renal secretion. It may occur as the result of obstruction of the urinary pathways, following a disturbance of the general circulation with a depression of renal flow, or in terminal nephritis. Acute renal failure may occur in acute glomerulonephritis (see p. 644), following the ingestion or inhalation of poisons (carbon tetrachloride, mercury) or subsequent to extensive burns or severe injuries, The chief metabolic derangements include (1) elevation of the nitrogenous constituents of the blood (uremia); (2) water and sodium imbalance; and (3) an elevated potassium level (hyperkalemia) unless there are concomitant losses due to vomiting and diarrhea.

Uremia. The symptoms of uremia appear when kidney function has decreased to such an extent that waste products are no longer excreted from the body. The patient may complain of headache, visual disturbances, weakness, nausea, and vomiting. Drowsiness, lethargy, and finally coma take place. Edema, hypertension, and cardiac failure may be present. In addition to the marked retention of nitrogenous constituents, there are usually an accompanying acidosis and water imbalance.

Rationale for treatment. The dietary management is directed toward avoiding the accumulation in the blood of nitrogenous wastes, potassium, sodium, and water. It is further designed to reduce the incidence of acidosis. The provision of adequate calories at low protein, sodium, and potassium levels is difficult because the selection of foods is so limited, thereby providing the patient with an unpalatable diet when his appetite is already poor. Anorexia and vomiting are common complications.

In recent years patients with chronic renal failure who would otherwise die in terminal uremia have been maintained for extended periods by dialysis using the artificial kidney or peritoneal dialysis. By either of these procedures the patient's blood is dialyzed so that the accumulated wastes are removed. The use of ion exchange resins is of some help in permitting a slight liberalization of potassium intake and thereby a somewhat more varied choice of foods. Nevertheless, a rigorously controlled diet with respect to protein, sodium, potassium, and fluid content is essential so that wastes will not accumulate too rapidly in the intervals between dialysis.

Electrolyte-free diet. An electrolyte-free diet is of some value on a short-term basis to minimize dangerous accumulations of sodium, potassium, and urea during the oliguric or anuric phase of nephritis. As little as 100 to 200 gm carbohydrate is effective in reducing tissue catabolism and the consequent accumulation of urea, phosphates, sulfates, and potassium in the serum. When

both fat and carbohydrate can be used, the daily calorie requirement can be substantially met, thereby keeping tissue catabolism to a minimum. Commercial sugar-fat emulsions may be given orally to accomplish a satisfactory calorie intake,* or the butter-sugar diet first recommended by Borst may be used.[3] It consists of—

¾ cup sugar	2 tablespoons flour
¾ cup butter	2 cups water

Mix flour and sugar. Add water and butter. Cook to consistency of soup. Flavor with vanilla or other extract. Chill before serving. Serve as six equal feedings.

Another variant of the butter-sugar diet consists of liberal servings of rice with butter and sugar; tea with sugar, and butter balls rolled in sugar and thoroughly chilled

Potassium-restricted diet. The normal diet provides about 3 to 8 gm potassium daily, the intake varying directly with the calorie intake. Potassium is widely distributed in foods, being especially rich in meats, dark-green leafy vegetables, whole-grain breads and cereals, and in fruits. A diet restricted in potassium is of necessity also low in protein and will likewise be low in sodium if no salt is added during food preparation.

Potassium salts are quite soluble in water. Consequently, the foods used in the restricted diet should be canned or boiled in a large amount of water. The juices of canned fruits or of vegetables should not be consumed since appreciable amounts of potassium are dissolved in them.

ENERGY. The more nearly the calorie requirement can be met, the more effective the diet will be in reducing the extra load for elimination by the kidney. The catabolism of tissue protein adds to the excretory load for urea and potassium and is largely avoided when sufficient carbohydrate and fat are available.

PROTEIN. An amount of protein just enough to prevent tissue catabolism is provided, about 0.2 to 0.5 gm per kilogram being satisfactory. As much of this protein as possible should be selected from foods of high biologic value. The allowance should be divided among the three meals and taken with ample carbohydrate so that maximum sparing effect is exerted.

SODIUM. The intake of sodium is usually kept at the lowest possible level by including only foods to which no sodium compound has been added. (See Chapter 42 for the planning of such diets.)

FLUID. The fluid intake and excretion must be carefully balanced. Failure to account for the various sources of intake and of excretion could result in edema or dehydration in those patients who are oliguric or anuric.

About 800 ml fluid are excreted daily in the insensible perspiration and another 50 to 150 ml in the feces. Thus, body losses will approach 1000 ml if there are no losses through the kidney, by perspiration, or by vomiting.

When considering the sources of fluid of the body, the water of metabolism,

* Ediol (Schenley Laboratories, Inc., New York, N.Y.); Lipomul® oral (Upjohn Company, Kalamazoo, Michigan).

which amounts to about 400 ml daily, should not be ignored. Each food contains an appreciable amount of water, with fruits and vegetables being especially high. These amounts must be taken into account and subtracted from the daily excretion in order to arrive at an appropriate intake of liquids. Generally speaking, the fluid intake will range between 500 and 1000 ml.

DIET PLANS. Table 43–2 lists typical food allowances for diets restricted in potassium to 850 and 1500 mg. A list of food selections and two sample menus illustrate the use of these food allowances. When sodium is restricted, some of the foods on these lists would be contraindicated (see Chapter 42).

A plan for diets controlled in potassium, sodium, and protein has been described recently.[4] Foods have been grouped in a manner similar to the meal exchange lists used for the calculation of diabetic diets. Each group includes foods of approximately equal protein and potassium values. By including groupings of fruits and vegetables that are somewhat higher in potassium and permitting their use a few times a week, a wider choice of foods is possible.

DIET IN THE POLYURIC STAGE. With the onset of diuresis, the 20-, 40-, and 60-gm protein diets described on page 646 may be used in sequence. The food must be bland and easily digested. Since sodium and fluid losses may be great at this time, dietary restriction of sodium is not necessary. In fact, sodium, potassium, and fluid depletion must be guarded against.

Table 43-2. Food Allowances at Two Levels of Potassium Restriction*

Food	850 mg	1500 mg
Milk	0	½ cup
Cream, light	½ cup	½ cup
Cheese, cottage or Cheddar	0	1 ounce
Egg	0	1
Meat, poultry, fish	0	3 ounces
Vegetables	2 servings	2 servings
Fruits and fruit juices	2 servings	2 servings
Cereal, refined	3 servings	3 servings
Bread, white	3 slices	5 slices
Fats	2 tablespoons or more	2 tablespoons or more
Sweets	2 tablespoons or more	2 tablespoons or more
Beverages, carbonated	1 cup	1 cup
Tea, weak, if desired	⅔ cup	⅔ cup
Calories	1200	1790
Protein, gm	20	63
Fat, gm	48	78
Carbohydrate, gm	173	209
Sodium (none added during preparation)	100	540†
Potassium, mg	850	1500
mEq	22	38

* Potassium values vary widely within food groups, especially for fruits and vegetables. The manner of preparation also influences these values. Therefore, potassium levels of a calculated diet are only approximate.

† This value for sodium includes the salt contained in 1 ounce of Cheddar cheese.

FOOD SELECTION FOR POTASSIUM-RESTRICTED DIETS*

(See Table 43–2 for amounts to be used)

FOODS TO INCLUDE	FOODS TO AVOID
Beverages—carbonated water, ginger-ale, Koolade, Pepsi Cola, Royal Crown Cola, root beer, Seven-Up; tea, ⅔ cup daily	*Beverages*—coffee
Breads—biscuits; light rye; saltines; soda crackers; white, all kinds	*Breads*—cracked wheat, whole-wheat; Ry Krisp; dark rye; whole-wheat crackers
Cereals—cornflakes, cornmeal, farina, Puffed Rice, rice flakes; hominy, macaroni, noodles, rice, spaghetti	*Cereals*—bran, bran flakes, Maltex, oatmeal, Ralston, shredded wheat, Wheatena, or other whole-grain cereal
Cheese—all kinds except processed cheese foods	*Cheese*—processed cheese foods
Eggs—prepared in any way	
Fats—any: butter, margarine, oil	
Fruits—canned applesauce, blackberries, blueberries, cherries, grapefruit, pears, peaches, pineapple. *Do not use juices.* Fresh blueberries, apple, pear	*Fruits*—all fresh except apple, blueberries, pear. Especially avoid: avocado, apricots, banana, cantaloupe, grapes, orange, plums; all dried fruits
Fruit juices—apple, cranberry, pear, peach, pineapple	*Fruit juices*—grapefruit, orange, prune, tangerine, tomato
Meat—all meats, fish, poultry	*Meat*—sardines, scallops
Milk—whole milk, skim milk, buttermilk; sour cream; cream	*Milk*—low-sodium (ion exchange)
Sweets—plain candy; honey; jam, jelly; sugar	*Sweets*—candy with chocolate or nuts
Vegetables—canned asparagus, beets, green and wax beans, carrots, mushrooms, peas, tomatoes. *Do not use liquid.* Fresh cooked cabbage, onions, summer squash Raw endive, lettuce	*Vegetables*—all raw except endive and lettuce. Cooked: Lima beans, beet greens, broccoli, Brussels sprouts, collards, kale, spinach; sweet or white potatoes; dried beans or peas
Miscellaneous—bouillon cube, cornstarch, flour, tapioca, vinegar	*Miscellaneous*—broth, chocolate, cocoa, molasses

SAMPLE MENUS FOR POTASSIUM-RESTRICTED DIETS

850 MG POTASSIUM		1500 MG POTASSIUM	
BREAKFAST		BREAKFAST	
Grapefruit, canned	½ cup	Peaches, canned	2 halves
Puffed Rice	1 cup	Soft cooked egg	1
Cream, light	½ cup	White toast	2 slices
Sugar		Butter	

* If sodium restriction is also required, see Chapter 42 for lists of foods.

850 MG POTASSIUM

BREAKFAST (Cont.)	
White toast	1 slice
Butter	
Marmalade	
Tea	5 ounces

LUNCHEON OR SUPPER	
Steamed rice	½ cup
Summer squash	½ cup
Dinner roll	1
Butter	
Grape jelly	
Cherries, dark, canned	½ cup

DINNER	
Buttered noodles	½ cup
Peas, canned	½ cup
Dinner roll	1
Butter	
Jelly	
Ginger ale	8 ounces

1500 MG POTASSIUM

BREAKFAST (Cont.)	
Blackberry jelly	
Tea	5 ounces

LUNCHEON OR SUPPER	
Cheese	1 ounce
Macaroni, cooked	¾ cup
Milk	½ cup
Green beans, canned	½ cup
Dinner roll	1
Butter	
Jelly	
Pineapple, canned	2 slices
Kola beverage	8 ounces

DINNER	
Roast lamb	3 ounces
Mint jelly	
Noodles	½ cup
Beets, canned	½ cup
Lettuce and endive	
French dressing	
Dinner roll	1
Butter	
Jelly	
Root beer	

BEDTIME	
Puffed Rice	1 cup
Cream, light	½ cup

URINARY CALCULI

Urinary calculi (kidney stones) may be found in the kidney, ureter, bladder, or urethra. They consist of an organic matrix with interspersed crystals and may vary in size from fine gravel to large stones. They constitute a symptom of other disorders, rather than a distinct disease entity.

About 90 per cent of all stones contain calcium as the chief cation. More than half of these are mixtures of calcium, ammonium, and magnesium phosphates and carbonates, while oxalate constitutes the anion in the remainder.[5] Uric acid and cystine stones represent about 4 per cent and 1 per cent of the total incidence of calculi.

The formation of stones is more probable in the presence of urinary tract infections, during periods of high urinary excretion of calcium, and in disorders of cystine or uric acid metabolism. High urinary excretion of calcium occurs in hyperparathyroidism, following overdosage with vitamin D, in long periods of immobilization, in osteoporosis, or following excessive ingestion of

calcium and of absorbable alkalies as in the Sippy regimen for peptic ulcer. Even though vitamin-A deficiency has been cited as contributing to the formation of calculi, it is not believed to be an important factor in the United States.

Rationale of treatment. When the cause of urinary calculi is known, the physician can effectively direct treatment toward the correction of the disorder. For example, this might entail the treatment of an infection, or modification of the regimen for peptic ulcer, or avoidance of long immobilization. However, in a large percentage of urinary calculi, the cause is not known or the disorder is not easily corrected.

The solubility of salts may be increased and the tendency to stone formation minimized by means of acidifying or alkalinizing agents which increase or decrease the pH of the urine. Such treatment implies that the nature of the stones has been determined by laboratory analyses of the stones themselves or by appropriate urine and blood studies.

A liberal fluid intake is essential—3000 ml or more daily—to prevent the production of a urine at a concentration where the salts precipitate out. The patient should be impressed with the importance of taking fluids throughout the day, so that the urine dilution is maintained.

Binding agents are often used to reduce the absorption of calcium and phosphorus from the gastrointestinal tract.

Modification of the diet. No diet of itself is effective in bringing about solution of stones already formed. However, for the predisposed individual it is thought that diet may be of some value in retarding the growth of stones or preventing their recurrence, although the effectiveness of such prophylaxis has not been fully established.

CALCIUM AND PHOSPHORUS RESTRICTION. The diet on page 657 is planned to provide maintenance levels of calcium and phosphorus. Such a diet serves as the starting point for the prevention of calcium phosphate stones. Aluminum hydroxide gel is sometimes prescribed since it combines with phosphate to form an insoluble aluminum phosphate and thus diminishes the absorption of phosphorus and the subsequent formation of insoluble precipitates in the urinary tract.[6] Sodium acid phosphate or sodium phytate similarly reduces the absorption of calcium.[5]

MODIFICATION OF URINE pH. When stones are composed of calcium and magnesium phosphates and carbonates, therapy is directed toward maintaining an acid urine. On the other hand, if oxalate and uric acid stones are being formed, the urine should be kept alkaline. Acidifying or alkalinizing agents are more effective than dietary modification, although the diet should support the therapy by medications.

When an acid-ash diet is prescribed, acid-producing foods (see Table 43–3) would be emphasized. Only 1 pint of milk, 2 servings of fruit, and 2 servings of vegetables would be permitted.

On the other hand, for an alkaline-ash diet fruits and vegetables are used liberally, and the acid-producing foods are restricted to the amounts necessary for satisfactory nutrition.

Table 43–3. Acid-Producing, Alkali-Producing, and Neutral Foods

Acid-Producing	Alkali-Producing	Neutral
Bread, especially whole-wheat	Milk	Butter
Cereals	Fruits	Candy, not chocolate
Cheese	Vegetables	Coffee
Corn		Cornstarch
Crackers	**Especially these**	Fats, cooking
Cranberries	Almonds	Honey
Eggs	Apricots, dried	Lard
Lentils	Beans, Lima, navy	Salad oils
Macaroni, spaghetti, noodles	Beet greens	Sugar
Meat, fish, poultry	Chard	Tapioca
Pastries	Dandelion greens	Tea
Peanuts	Dates	
Plums	Figs	
Prunes	Molasses	
Rice	Olives	
Walnuts	Peas, dried	
	Parsnips	
	Raisins	
	Spinach	
	Watercress	
	Foods prepared with baking powder or baking soda	

OXALATE RESTRICTION. Some oxalate is produced in the body during the metabolism of foodstuffs. Dietary restriction of oxalates may be tried when calculi contain oxalate, but such restriction has not been shown conclusively to be of value. Oxalate-rich foods include green and wax beans, beets and beet greens, chard, endive, okra, spinach, sweet potatoes; currants, figs, gooseberries, Concord grapes, plums, rhubarb, raspberries; almonds, cashew nuts; chocolate, cocoa, tea.

REDUCTION OF URIC ACID METABOLISM. The formation of uric acid stones may be minimized by using a Low-Purine Diet (see Chapter 39) and restricting the protein intake to 1 gm per kilogram body weight.

CYSTINE STONES. A low-protein diet reduces the intake of sulfur-containing amino acids but has not been shown to be effective in the prevention of cystine stones.

CALCIUM- AND PHOSPHORUS-RESTRICTED DIET*

Characteristics and general rules:

The diet provides maintenance levels of calcium and phosphorus. Milk constitutes the main source of calcium in the diet, and milk, eggs, and meat are the principal sources of phosphorus.

* Modification of regimen described by Mary Alice White, unpublished report, Drexel Institute of Technology, 1958.

When further restrictions of calcium and phosphorus are desired, the milk and egg may be eliminated. The calcium level is then reduced to 170 mg, the phosphorus level to 740 mg, and the protein level to 64 gm.

Table 43–4. Calcium- and Phosphorus-Restricted Diet

Include These Foods Daily*		Protein gm	Fat gm	Carbohydrate gm	Ca mg	P mg
Milk	1½ cups	12	15	18	430	340
Egg	1 whole	7	5	—	25	105
Meat, fish, or poultry	6 ounces	42	30	—	20	375
Vegetables:						
Potato	1 small	2	—	15	15	65
Leafy or yellow	½ cup	2	—	7	25	35
Other	½ cup	2	—	7	25	45
Fruits:						
Citrus	½ cup	—	—	10	30	20
Other	2 servings	—	—	20	25	40
Cereal, refined, without added calcium	2 servings	4	—	30	5	30
Bread, refined, without added calcium	6 slices	12	—	90	20	115
Fats	2 tablespoons	—	30	—	—	—
Sugars, sweets	2 tablespoons	—	—	30	—	—
		83	80	227	620	1170

* Protein, fat, and carbohydrate values on the basis of Meal Exchange Lists, Table A-4. Calcium and phosphorus values have been rounded off to the nearest 5 mg. Values for vegetables, fruits, cereals, and breads are averages of those permitted. Individual selections vary somewhat from these averages.

FOODS ALLOWED

Beverages—milk in allowed amounts; coffee, tea

Breads—French or Italian without added milk; pretzels; saltines, matzoth; water rolls

Cereals—corn flakes, corn grits, farina, rice, rice flakes, Puffed Rice; macaroni, noodles, spaghetti; corn meal, cornstarch, tapioca, white flour

Cheese—½ ounce Cheddar or Swiss cheese may be used instead of ½ cup milk

Desserts—angel cake, white sugar cookies, gelatin, fruit pies, fruit tapioca, fruit whip, pudding with allowed milk and egg, shortbread, water ices

FOODS TO AVOID

Beverages—chocolate; cocoa; fountain beverages; proprietary beverages containing milk powder

Breads—biscuits; breads: brown, corn, cracked wheat, raisin, rye, white with nonfat dry milk, whole-wheat; rye wafers; muffins; pancakes; waffles

Cereals—bran, bran flakes, corn and soy grits, oatmeal, wheat flakes, wheat germ, Puffed Wheat, Shredded Wheat; rye flour, soybean flour, self-rising flour, whole-wheat flour

Desserts—cakes and cake mixes, custard, doughnuts, ice cream, Junket, pies with cream filling or milk and eggs, milk puddings—except when daily allowance is used

FOODS ALLOWED	FOODS TO AVOID
Eggs—1 whole. Whites as desired	
Fats—butter, cooking oils and fats, lard, margarine, French dressing	*Fats*—mayonnaise, sweet and sour cream
Fruits—all, but restricting dried fruits to dates (3), prunes (2), raisins (1 tbsp.)	
Meats—beef, ham, lamb, pork, veal; chicken, duck, turkey; bluefish, cod, haddock, halibut, scallops, shad, swordfish, tuna	*Meats*—clams, crab, herring, lobster, mackerel, oyster, fish roe, salmon, sardines, shrimp; brains, heart, kidney, liver, sweetbreads
Milk—1½ cups daily	
Soups—broth of allowed meats; consommé; vegetable; cream soups using allowed milk	*Soups*—cream in excess of milk allowance; bean, lentil, split pea
Sweets—sugar, syrup, jam, jelly, preserves, hard candy, marshmallows, mints without chocolate	*Sweets*—caramels, fudge, milk chocolate, molasses, dark brown sugar
Vegetables—artichokes, asparagus, beans—green or wax, Brussels sprouts, cabbage, carrots, cauliflower, corn, cucumber, eggplant, escarole, lettuce, onions, peppers, potatoes—white and sweet, pumpkin, radishes, romaine, squash, tomatoes, turnips	*Vegetables*—dry beans—kidney, Lima, navy, pea, soybean; beet greens, broccoli, chard, collards, chickpeas, dandelion greens, kale, okra, parsnips, peas—fresh and dried, rutabagas, soybeans, soybean sprouts, spinach, turnip greens, watercress
Miscellaneous—pickles, mustard, salt, spices	*Miscellaneous*—chocolate, cocoa, nuts, olives, brewers' yeast

MEAL PATTERN	SAMPLE MENU
BREAKFAST	
Fruit, preferably citrus	Fresh raspberries
Cereal, refined	Corn flakes
Milk—½ cup	Milk—½ cup
Egg—1 only	Soft-cooked egg
Bread, Italian or French	Toasted Italian bread
Butter or margarine	Butter or margarine
Jelly	Apple jelly
Beverage with sugar, if desired	Coffee
LUNCHEON OR SUPPER	
Meat, poultry, or fish—3 ounces	Cold sliced turkey
Potato or substitute	Potato salad (potato, diced cucumber, minced green pepper and onion, French dressing) on lettuce; tomato wedges
Vegetable	
Salad	
Bread, Italian or French	Italian bread
Butter or margarine	Butter or margarine
Dessert	Angel cake with fresh strawberries
Milk—1 cup	Milk—1 cup only
Tea or coffee, if desired	

MEAL PATTERN (Cont.)	SAMPLE MENU (Cont.)
DINNER	
Meat, poultry, or fish—3 ounces	Roast pork
Potato or substitute (use potato only once daily)	Buttered noodles
Vegetable	Zucchini squash
Bread or rolls, without added milk	Hard rolls, made without milk
Butter or margarine	Butter or margarine
Fruit or dessert	Fruit gelatin
Coffee or tea	Tea with lemon

PROBLEMS AND REVIEW

1. What are the parts of the nephron? How do these parts function?
2. What are the chief wastes excreted by the kidney?
3. In addition to excreting wastes, what other functions are performed by the kidney?
4. What are the characteristic symptoms of acute glomerulonephritis? In what way do these symptoms affect dietary planning?
5. In what way do the abnormal excretion products in renal diseases affect dietary planning?
6. *Problem.* Outline the principles for a dietary regimen for a patient with acute glomerulonephritis, showing the progression of diet from time to time.
7. *Problem.* On the basis of the principles outlined in Problem 6, write a menu for a patient for 1 day. Assume that the diet order restricts protein to 40 gm and sodium to 1000 mg.
8. What reasons can you give for using a protein-free, high-carbohydrate, high-fat diet in acute renal failure? Why are frequent small feedings preferable to three meals?
9. What is accomplished by dialysis with an artificial kidney? Why is a diet restricted in protein and potassium still necessary?
10. What problems are you likely to encounter in planning a potassium-restricted diet?
11. Prepare a list of foods high in calcium; in phosphorus. Why are such foods avoided in the diet of certain patients with urinary calculi?
12. When is an acid-ash diet used? Name six foods to emphasize on such a diet.
13. When is an alkaline ash diet used? Name six foods to emphasize on such a diet.

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Chapter 44
ANEMIAS

Blood is a constantly changing, highly complex tissue which is concerned with the transport of cell nutrients, the elimination of wastes, and the maintenance of chemical equilibrium. Its intricate functions and composition suggest the need for a considerable variety of nutrients. This chapter is especially concerned with deficiencies arising in the framework of red blood cells and in the hemoglobin within these cells.

Normal blood regeneration. Hemoglobin synthesis is ultimately dependent upon the dietary sources of iron and protein. The well-nourished individual maintains a store of iron in the liver and spleen which serves in time of additional demands such as accidental hemorrhage, the accelerated needs during pregnancy, and so on. The liver stores of iron are higher in men than in women.[1] Synthesis of hemoglobin depends also upon an adequate supply of protein and the presence of copper which apparently acts as a catalyst. (See Chapter 9 for more detailed discussion of iron metabolism.)

The framework of the red blood cells is constructed in the bone marrow. The synthesis of nucleic acid and nucleoproteins which precedes the formation of the blood cells is dependent upon the activity of vitamin B_{12} and folic acid with its active form, folinic acid. Ascorbic acid is essential for the conversion of folic acid to folinic acid. Vitamin B_{12} is adequately provided in diets containing animal protein, but it can be absorbed only in the presence of intrinsic factor[2] which is a mucoprotein produced in the gastric juice.

Studies on experimental animals lend support to the importance of other vitamins, in addition to these heretofore mentioned, for the building of the cells: riboflavin, vitamin B_6, niacin, pantothenic acid, and vitamin E. It has not been demonstrated that these vitamins have been sufficiently deficient in the diet of human beings to affect adversely the formation of red blood cells.

The values for hemoglobin and red cells may be affected by age, sex, and geographic location. As a rough approximation, the following may be given as normal blood values:

Red blood cell count	4.5 to 5.0 million per cu mm
Hemoglobin	13.5 to 15 gm per 100 ml
Packed cell volume (hematocrit)	45 per cent

Researchers, in particular, also measure the changes in serum iron, vitamin B_{12}, and folic acid.

Anemia. Anemia is a condition in which there is a reduction in the total circulating hemoglobin. It may be caused by a reduced number of red blood cells, or of the quantity of hemoglobin in the cells, or both. It results in a decreased ability of the blood to carry oxygen to the tissues, which in turn is responsible for varying degrees of skin pallor, loss of skin tone, weakness, headache, loss of appetite, gastrointestinal disturbances, nervousness, palpitation, and shortness of breath.

Anemias may be caused by blood loss, decreased production of blood, or by increased destruction of blood. Faulty nutrition occasioned either by failure to provide essential nutrients, such as iron and protein, or by poor utilization of dietary constituents (for example, failure to absorb vitamin B_{12}) may lead to anemia, the type being dependent upon the initiating defect. Exposure to x-ray or radium, bone tumors, cirrhosis of the liver, carcinoma, and leukemias are examples of conditions which may interfere with red-cell formation by the bone marrow. Increased destruction of the blood may be the result of the action of intestinal parasites, hemolytic bacteria, chemical agents such as coal-tar products and sulfonamide compounds, or abnormal red cell structure (sickle cells).

Anemias are widely prevalent throughout the world. No reliable data on the incidence in the United States are available, but appreciable numbers of infants, young children, adolescent girls, and pregnant women have varying degrees of iron-deficiency anemia. Macrocytic anemias occur less frequently in this country. Macrocytic and iron-deficiency anemias are health problems of great magnitude in the developing tropical and subtropical countries of the world.[1] Deficiencies of folic acid, vitamin B_{12}, and iron are most acute in children and pregnant women. Infestation of the gastrointestinal tract with hookworm is of frequent occurrence in these regions.

The treatment of all anemias must be based, first of all, upon the elimination of the cause, and, second, upon the restoration of normal nutrition with respect to blood formation.

IRON-DEFICIENCY ANEMIA

Factors in causation. Iron-deficiency anemia is frequently designated as "hypochromic," which means low color, and "microcytic," which means that the cells are of small size. The chief lack is in the amount of hemoglobin within the cells. The number of cells may also be reduced but not as markedly

as is the hemoglobin content. This type of anemia is often referred to as "secondary" or "nutritional" anemia, but the term *nutritional* may also be applied to other types of anemia and is thus confusing. Although depletion of the iron stores is the chief causative factor, hypochromic anemia may occasionally occur coincident with marked protein deficiency. Hypochromic anemias may be grouped as below, depending upon the factor primarily responsible for initiating the deficiency.

I. Due to blood loss (most common cause in adults)
   A. Accidental hemorrhage
   B. Chronic diseases, such as tuberculosis, ulcers or intestinal disorders, when accompanied by hemorrhage
   C. Excessive menstrual losses
   D. Excessive blood donation
II. Deficiency of iron in the diet during period of accelerated demand
   A. Infancy—rapidly expanding blood volume
   B. Adolescent girls—rapid growth and onset of menses
   C. Pregnancy and lactation
III. Inadequate absorption of iron
   A. Diarrhea, as in sprue, pellagra
   B. Lack of acid secretion by the stomach
IV. Nutritive deficiencies such as severe protein depletion

BLOOD LOSS. Whenever hypochromic anemia occurs in adult males or in women past the menopause, blood loss, as from a bleeding ulcer or other cause, must always be suspected. Menstrual losses by some women may be sufficiently great to result in anemia, especially if the diet is poorly selected. The range of such losses has been found to be 2.28 to 78.96 mg.[3] The repeated donation of blood likewise could be a significant factor in anemia causation unless a liberal diet relatively rich in protein and iron were taken.

Whenever there is a loss of blood, fluid is quickly drawn in from the tissues to maintain the blood volume. The hemoglobin level and red cells are thus reduced in concentration, but the individual with adequate stores quickly replenishes the levels so that anemia is not evident unless hemorrhage is prolonged or repeated. From 3 weeks to 3 months may be required to replenish the losses from the donation of 1 pint of blood.

IN INFANCY. The full-term infant born of a well-nourished mother has a sufficient hemoglobin supply for the first 2 or 3 months of life, after which iron-rich foods should be added to the milk diet. In babies whose mothers had a poor intake of iron, the amount of hemoglobin available in the infant's growing body will be inadequate. Anemia occurs especially in premature infants, in twins, and in babies of high birth order.

As the body increases in size, the blood volume also increases, so that the supply of iron must be increased through the inclusion of foods such as iron-enriched cereals, egg yolk, and strained meats. If the initial stores in the infant's body are low, iron supplementation in addition to the diet will probably be required.

IN ADOLESCENCE. Improved dietary measures have resulted in some decreased incidence of anemia in girls during adolescence. Many girls at this age even today select a poor diet, satisfy the whims of a freakish appetite, or maintain ill-advised reduction regimens with a resultant anemia. Continual emphasis is necessary on the fact that during adolescence there is an accelerated demand for iron to satisfy the still-increasing blood volume as well as to compensate for losses through menstruation. When pregnancy occurs during these years, it is indeed difficult for the young woman to meet the additional demands of the fetus.

Modification of the diet. Anemia is much more easily prevented than corrected. During periods of growth continual emphasis on the importance of a liberal intake of iron can do much to prevent the occurrence of iron-deficiency anemia. Once hypochromic anemia is present, diet alone is only slowly effective in restoring normal hemoglobin levels. However, the importance of improving the general nutritive state cannot be overemphasized since anemia, especially if long-standing, is usually accompanied by poor appetite and failure to maintain adequate nutrition. An optimum diet, plus supplements of iron prescribed by the physician, are considered as primary therapy for hypochromic anemia.

IRON. Usually, even with good planning, the iron level of the diet will range between 12 and 15 mg. When special emphasis is given to the inclusion of liver, dried fruits, dark-green leafy vegetables, and enriched or whole-grain cereals, it may be possible to increase the iron intake to approximately 20 mg. Even so, this daily level of intake is too low for rapid regeneration of hemoglobin; hence iron salts such as ferrous sulfate and ferrous gluconate are given orally. However, it is essential that the diet be corrected with respect to its adequacy in iron so that the patient may maintain adequate hemoglobin levels once his anemia has been treated. Whipple's extensive study[4] on the effectiveness of various foods in hemoglobin regeneration grouped foods as follows in descending order of potency.

I. Liver (except fish liver), kidney, gizzard
II. Peaches, apricots, prunes
Raisins, apples, grapes
Skeletal meats, sweetbreads, brains
III. Common vegetables
Whole-grain cereals, eggs
Cheese, milk, cream

PROTEIN. The diet should be adequate in proteins of high biologic value such as milk, cheese, eggs, and meat. Whenever there is any evidence of protein insufficiency in the body, a daily intake of 100 gm or more of protein is advisable.

ASCORBIC ACID. The absorption of iron is facilitated with a liberal intake of ascorbic acid.[5] At least 2 servings of citrus fruits and other ascorbic-acid rich foods are desirable daily.

MACROCYTIC ANEMIAS

Macrocytic anemias of nutritional origin are caused primarily by deficiency of folic acid and its active form folinic acid, or vitamin B_{12}, or both. The lack of either of these vitamins interferes with the synthesis of nucleic acid and nucleoproteins so that large, nucleated red cells (megaloblasts) are discharged into the blood circulation. Usually these cells contain normal or increased amounts of hemoglobin (hyperchromic), but the number of cells produced is sharply reduced so that the total circulating hemoglobin is much less than normal.

Pernicious anemia is caused by a lack of intrinsic factor in the gastric juice, and therefore vitamin B_{12} cannot be absorbed into the blood circulation. In the absence of the vitamin in the bone marrow the synthesis and maturation of the red blood cells are arrested. Red cell counts of 2.5 million per cubic millimeter or less are not uncommon, with a large proportion of these cells being macrocytic.

Pernicious anemia occurs chiefly in middle-aged to elderly persons. Patients have a lemon-yellow pallor, anorexia, glossitis, achlorhydria, abdominal discomfort, frequent diarrhea, weight loss, and general weakness. Numbness of the limbs, coldness of the extremities, and difficulty in walking are manifestations of neurologic changes in the untreated patient.

Modification of the diet. Until Minot and Murphy[6] introduced liver therapy in 1926, pernicious anemia was invariably fatal. Their use of large amounts of liver started the search for the factor in liver which was responsible for the improvement observed in patients. Liver extract replaced the liver diet and was in turn superseded by vitamin B_{12}. When given parenterally, vitamin B_{12} produces marked hemopoietic response in doses as small as 1 to 5 mcg. The vitamin is ineffective when given orally; however, the addition of a preparation of intrinsic factor promotes absorption, although oral therapy cannot be used exclusively. Although folic acid therapy improves the blood picture, it has no effect on the associated neurologic symptoms. It should never be substituted for vitamin B_{12} in the treatment of these patients. True pernicious anemia is a permanent defect and must be adequately treated for the duration of the patient's life.

The patient who has pernicious anemia usually presents a picture of general nutritional deficiency. While the anemia itself is controlled with injections of vitamin B_{12} or liver extract, the dietary management is directed toward maintaining the patient in good nutrition and in improving the general sense of well-being. The following considerations may be applied to the planning of the diet.

PROTEIN. The protein allowance may be increased to 100 gm depending on the degree of deficiency (see High-Protein Diet, p. 476).

FAT. The absence of acid in the stomach retards digestion. There are preferably kept at moderate or low levels, with emphasis on their s from highly emulsified sources.

ENERGY. Calories are usually increased to facilitate utilization of the tein and to restore weight to normal.

MINERALS AND VITAMINS. Since general nutritional deficiencies occasioned by poor dietary intake in the past are prevalent, the diet should be planned to include a liberal intake of minerals and vitamins. Supplements of iron and sometimes of the vitamins, especially the B-complex, are sometimes ordered. They improve the general nutritional status but do not substitute for therapy with vitamin B_{12} or liver extract, nor do they affect the course of the anemia itself.

CONSISTENCY. A sore mouth, anorexia, or irritation of the gastrointestinal tract may necessitate a soft or even liquid diet until the symptoms diminish or disappear. Special care must be taken to insure that such diets are nutritionally adequate.

Other macrocytic anemias. Because macrocytic anemias occur in a number of situations it is first essential to determine the cause before effective therapy can be instituted.

1. Following gastrectomy, the absence of intrinsic factor impairs the absorption of vitamin B_{12}. This anemia responds to parenteral therapy with vitamin B_{12}.

2. The so-called pernicious anemia of pregnancy is caused by a folic acid deficiency and may be treated orally with this vitamin. It is not a permanent defect.

3. Macrocytic anemia of infancy is believed to be caused by inadequate conversion of folic acid to folinic acid as a result of an insufficient intake of ascorbic acid. It is likely to be observed in scurvy and is treated with liberal amounts of ascorbic acid and folic acid.

4. Gastrointestinal disorders such as celiac disease in children or sprue in adults interfere with the absorption of many nutrients including folic acid and vitamin B_{12}. Therapy with folic acid and vitamin B_{12} is preferred to that with folic acid alone.[7] See page 543 and page 686 for further discussion of these conditions.

PROBLEM AND REVIEW

1. What is the normal red cell count for a woman?
2. What is hemoglobin? What is its normal value for the woman?
3. What food factors are necessary for the production of hemoglobin and cells?
4. What is meant by anemia? What are some of the etiologic agents?
5. Hypochromic anemia is characterized primarily by a lack of hemoglobin. What nutrients are especially involved? Under what circumstances is it likely to occur?
6. Iron is the most important nutrient in the treatment of hypochromic anemia. What factors may interfere with its efficient use?

. What foods are good sources of iron?
8. Why are high-iron diets impractical?
9. What other food factors require consideration in the diet for iron-deficiency anemia?
10. Pernicious anemia is due to the absence of the intrinsic factor in the gastric juice. What symptoms are usually present which may complicate dietary treatment?
11. What is the most effective treatment for pernicious anemia?
12. List the dietary principles for feeding a patient with pernicious anemia.
13. *Problem.* Plan a diet for a patient with hypochromic anemia including 15 mg or more of iron (without the use of liver) and 100 gm of protein.

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UNIT XIII
Diet in Miscellaneous Disorders

Chapter

45 DIET IN ALLERGIC AND SKIN DISTURBANCES
Elimination Diets

Chapter 45

DIET IN ALLERGIC AND SKIN DISTURBANCES

Elimination Diets

Definitions, common allergens. Allergies represent the abnormal reaction of an individual to the food he eats, the air he breathes, or the substances he touches. Anything which produces an allergic reaction is known as an *allergen. Food allergies* may be defined as a sensitivity occurring in certain parts of the body to one or more specific foods. Usually the allergen is of a protein nature, but it is thought by some that carbohydrates, lipids, and various chemicals may also be sensitizing agents on occasion.

The discussion in this chapter is confined to food allergies. Any food may produce reactions in some individuals, but the most frequent offenders are generally stated to be eggs, milk, wheat, grapefruit, orange, corn, tomato, chocolate, potatoes, fish, and shellfish.

Foods unlike in flavor and structure but belonging to the same botanic group may result in allergic manifestations. For example, buckwheat is not of the cereal family but in a group which includes rhubarb. The sweet potato is not related to the white potato but is a member of the morning-glory family. Spinach, a frequent reactor, is in the same family with beets. The following botanic classification of a few common foods illustrates the relation of foods which at first thought appear to be dissimilar.

Cereal—wheat, rye, barley, rice, oats, malt, corn, sorghum, cane sugar
Lily—onion, garlic, asparagus, chives, leeks, shallots
Gourd—squash, pumpkin, cucumber, cantaloupe, watermelon
Cabbage and mustard—turnips, cabbage, collards, cauliflower, broccoli, kale, radish, horse-radish, water cress, Brussels sprouts

Manner of induction. Allergic reactions may be brought about by various means, as:

1. By ingestion of food or drugs.
2. By contact with foods, pesticides, drugs, adhesive, fur, hair, feathers, molds, fungi, etc.

3. By inhalation of pollens, dust, cosmetics, perfumes, molds, fungi.
4. By injection of vaccines, serums, antibiotics, hormones.

Some characteristics of allergies. Some individuals are only mildly sensitive and can eat a particular food for several days before characteristic symptoms develop, while others have violent reactions within 1 or 2 hours. Allergies appear to be closely related to one's physical and emotional status; reactions to a substance may occur in a stress situation but may not occur at another time. It has been observed that many food allergies tend to disappear during the course of psychiatric treatment.[1]

Heredity appears to play a role in allergy, but one does not inherit a sensitivity to a specific substance or an identical manifestation of the allergy. For example, a child born of a parent who suffers from asthma may not develop asthma but may have eczema or some gastrointestinal disturbances. The parent may be sensitive to wheat and the child to eggs, and so on.

The skin and mucous membranes are particularly sensitive to the offending substances. Since the substances may be carried by the circulation to all parts of the body, it is reasonable to expect that the manifestations will be many and varied.

1. Skin lesions such as urticaria, nettle rash, and eczema are among the most frequent symptoms of allergy.
2. Nausea, vomiting, and diarrhea are common gastrointestinal manifestations. Symptoms suggestive of colitis,[2] appendicitis, ulcers, and even gallbladder disease may be of allergic origin, and confusion in diagnosis results.
3. Head colds, asthma, and headaches may be caused by allergens.
4. Redness, swelling, burning, and itching of the eyes may occur independently or may accompany irritation of the nasal passages.
5. Canker sores and fever blisters occur when the individual eats certain foods to which he is sensitive.

Diagnosis of allergies. No single test is wholly reliable for the establishment of a diagnosis of allergy to any given food or foods. The procedures used include a careful history of the patient, skin testing, and dietary testing programs.

HISTORY. A complete history of the patient is clearly indicated. It must include the physical status, and conditions and events preceding the attack. A carefully kept record of food eaten and of the occurrence of symptoms is in many instances sufficient to establish what the offending factor may be. Individual likes and dislikes must be taken into consideration. One patient may dislike an important food and claim to be allergic to that food in order not to be called upon to eat it. Another may like a food sufficiently to be willing to risk an attack in order to eat it. Obviously, in any dietary testing one must eliminate the psychologic factors that may interfere with a correct interpretation.

SKIN TESTS. Skin tests include (1) the *scratch test,* in which a bit of suspected solution is dropped onto a scratch made on the back or arm of the patient; (2) the *intradermal test,* in which the suspected solution is injected underneath the skin; and (3) the *patch test,* in which the suspected powder or liquid is put on a filter paper which is placed on the skin, covered with cellophane, and held in place with adhesive. Readings are made at the end of 10 to 20 minutes, except in the patch test, where readings are made after 48 hours or more. If a red inflammation or hivelike wheal appears at the site of the scratch or point of contact, the material is suspected as an allergen. The tests are suggestive but not conclusive. A positive skin test does not necessarily mean that the patient is sensitive at the time to the material; it may represent a past sensitivity. Individuals who have intestinal manifestations of allergy may not react positively to skin tests.

PROVOCATIVE DIETS AND INTENTIONAL FEEDING. The use of a diet consisting exclusively of milk, egg, wheat, beef, orange, and potato has been described by Lee and Squier.[3] This diet is given for 1 week unless the patient's previous history definitely contraindicates its use. Since the foods are commonly involved in allergies, any disturbances are likely to show up within the week. If no symptoms occur, foods are added to this regimen, one at a time, as described on page 675. If symptoms do occur, other tests must be used.

The intentional feeding procedure[4] consists in completely eliminating the test food from the diet for a week, following which it is eaten by the patient in substantial amounts three or four times a week. The test is repeated for 2 consecutive weeks. A food is not considered to be positive if it produces reactions only once in the 3-week testing period. Intentional feeding helps to confirm positive skin tests and also helps to detect sensitivities where skin reactions were negative.

SYNTHETIC DIETS. Food allergies may sometimes be diagnosed quickly by means of synthetic diets.[5,6] Such diets are made up of amino acids, sugar, salt mixtures, vitamin concentrates, water, and in some cases emulsified fats; none of the constituents of the feeding will produce allergy. The feeding is given by mouth or by tube feeding. The formulas are unpalatable, so that only patients with major allergic manifestations are likely to have the fortitude to give the regimen the necessary trial.

Patients who are allergic to food show marked improvements with the synthetic diet in a few days, while those who are sensitive to materials other than food will not improve. If it has been ascertained that food is responsible for the allergy, the feeding can be continued over a longer period of time, adding first one and then another of the important foods to determine which ones may be safely included and which ones should be omitted.

ELIMINATION DIETS. Various systems of elimination diets, one of which is quoted on pages 673–74, have been successful in the diagnosis of food allergies. Each group of diets is so planned that common allergens are eliminated from one or more of the diets. The successful use of the diet depends on a strict adherence to the prescribed list of foods.

ELIMINATION DIETS*

DIET 1	DIET 2	DIET 3	DIET 4
Rice	Corn	Tapioca	Milk†
Tapioca	Rye	White potato	Tapioca
Rice biscuit	Corn pone	Breads made of any combination of soy, Lima bean, and potato starch and tapioca flours	Cane sugar
Rice bread	Corn-rye muffins		
	Rye bread		
	Ry-Krisp		
Lettuce	Beets	Tomato	
Chard	Squash	Carrot	
Spinach	Asparagus	Lima beans	
Carrot	Artichoke	String beans	
Sweet potato or yam		Peas	
Lamb	Chicken (no hens)	Beef	
	Bacon	Bacon	
Lemon	Pineapple	Lemon	
Grapefruit	Peach	Grapefruit	
Pears	Prunes	Peach	
	Apricot	Apricot	
Cane sugar	Cane or beet sugar	Cane sugar	
Sesame oil	Mazola oil	Sesame oil	
Olive oil‡	Sesame oil	Soybean oil	
Salt	Salt	Salt	
Gelatin, plain or flavored with lime or lemon	Gelatin, plain or flavored with pineapple	Gelatin, plain or flavored with lime or lemon	
Maple syrup or syrup made with cane sugar flavored with maple	Karo corn syrup	Maple syrup or syrup made with cane sugar flavored with maple	
	White vinegar		
Royal baking powder	Royal baking powder	Royal baking powder	
Baking soda	Baking soda	Baking soda	
Cream of tartar	Cream of tartar	Cream of tartar	
Vanilla extract	Vanilla extract	Vanilla extract	
Lemon extract		Lemon extract	

* ROWE, A. H.: *Elimination Diets and the Patient's Allergies*, 2nd ed. Lea & Febiger, Philadelphia, 1944.

† Milk should be taken up to 2 to 3 quarts a day. Plain cottage cheese and cream may be used. Tapioca cooked with milk and milk sugar may be taken.

‡ Allergy to it may occur with or without allergy to olive pollen. Mazola oil may be used if corn allergy is not present.

SAMPLE MENUS FOR ELIMINATION DIETS

DIET 1

BREAKFAST
Half grapefruit with or without sugar
Rice Krispies with pear juice or maple syrup
Lamb patties
Lemonade, hot or cold; or grapefruit juice*

LUNCHEON OR SUPPER
Sautéed lamb liver (using sesame oil)
Boiled rice
Carrots
Rice bread or biscuits
Grapefruit marmalade or maple syrup
Molded pear in lemon gelatin
Grapefruit juice or lemonade

DINNER
Lamb chop or roast lamb
Baked sweet potato or yam
Spinach
Lettuce with French dressing (sesame oil, lemon juice, salt)
Rice bread or biscuit
Grapefruit marmalade or maple syrup
Fresh pear
Lemonade or grapefruit juice

DIET 2

BREAKFAST
Sliced peaches on corn flakes or corn-meal mush
Bacon
Rye toast or rye muffins (whole rye flour only)
Pineapple or apricot jam
Prune, pineapple, or apricot juice*

LUNCHEON OR SUPPER
Baked or fried chicken (using Mazola)
Harvard beets (white vinegar, sugar, cornstarch)
Rye-corn muffins
Pineapple or apricot jam
Sliced pineapple
Pineapple, apricot, or prune juice

DINNER
Sliced chicken
Baked squash
Asparagus
Ry-Krisp or rye bread
Pineapple or apricot preserves
Stewed apricots or prunes
Pineapple, apricot, or prune juice

DIET 3

BREAKFAST
Half grapefruit with or without sugar
Bacon
Muffins, using soybean, Lima bean, or potato flour
Apricot, peach, or grapefruit marmalade or maple syrup
Tomato juice, grapefruit juice or lemonade*

LUNCHEON OR SUPPER
Beef broth
Beef patties
Baked white potato
Sliced tomatoes
French dressing (soybean oil, lemon juice, salt)
Biscuits made of Lima bean, potato, or soybean flour
Apricot or peach preserves
Tomato juice, grapefruit juice or lemonade

DINNER
Roast beef
Carrots and peas (no cream sauce)
String beans
Grapefruit with French dressing (no lettuce)
Lima bean, soybean, or potato bread
Grapefruit marmalade
Apricot tapioca
Tomato, grapefruit, or apricot juice, or lemonade

* If the patient remains symptomfree on the diet being used for 5 to 7 days, tea may be added as a beverage. In the same manner coffee may be added.

The patient is first placed on the diet which, on the basis of skin tests and a dietary history, is least likely to produce allergic reactions. The diet will be used from 1 to 3 weeks, unless severe reactions have occurred in the meantime. A second diet is then tried for a similar period. Two to 3 weeks are usually necessary to give time for previous allergic manifestations to wear off and for any possible new reactions to appear. If there has been no adverse reaction to two or more diets, all foods on the combined lists may be used. On the other hand, when untoward symptoms appear, another diet is used until all diets have been tried. If the patient shows no improvement on any of the diets of a given regimen, the allergy is probably not of food origin.

Treatment of food allergy. Restricted diets or desensitization may be used in the treatment of food allergy. For severe allergic manifestations, adrenocorticotropic hormone or cortisone is sometimes used for relief of symptoms.

RESTRICTED DIET. If improvement has occurred on an elimination diet, foods may be added, one at a time, to the allowed list of foods. Several days must elapse between the addition of each new food. Moreover, a given food should be tested on at least two, preferably three, occasions before it is permanently added to, or eliminated from, the diet.

If a single food such as strawberries or grapefruit is implicated, it is easy to omit this food from the diet. On the other hand, common foods like milk, eggs, and wheat may be hidden in a great variety of dishes. The successful treatment of the allergy thus necessitates a knowledge of the exact composition of any foods that are eaten. It is advisable to set up lists of foods that may contain the offending factors. Such lists are given on page 676 for milk, eggs, and wheat.

Careful reading of labels must become a way of life for allergy patients, but even this does not fully suffice for all foods on the market. No listing of ingredients is required on the labels of foods for which a standard of identity has been established by the Food and Drug Administration (see Chapter 21).

Dietary adequacy becomes a matter of great concern when important foods are eliminated for a long period of time. For example, if milk cannot be used, additional amounts of meat may be included to provide the necessary amounts of protein; calcium and riboflavin supplements will be indicated in such a situation.

The allergy to major food groups also poses a problem in food preparation. If wheat must be eliminated, soy, potato, rye, and rice flours may be used, but they do not possess the gluten characteristics which result in light-textured breads. A publication by the American Dietetic Association, "Allergy Recipes," is useful for its suggestions on food preparation.

DESENSITIZATION consists in decreasing the sensitivity to a given substance by giving minute doses of the allergen in gradually increasing amounts. This procedure is useful in those instances where a major food, such as eggs or milk, is involved; it is a tedious routine and is usually not practical for minor allergies.

No hard and fast rules can be given, but the initial doses are extremely minute and are determined by the degree of reaction. If severe reactions occur at any time during the hyposensitization, the next dose should not be increased, and the progression to larger amounts must be more gradual. Once hyposensitization is begun, the intervals between doses must not be too long lest the hyposensitivity be lost.

For the treatment of allergies in children, see Chapter 46.

DIET WITHOUT WHEAT*

FOODS TO AVOID

Beverages—Cocomalt, malted milk, Mellin's food, Nestlé's food, Postum; beer, gin, whisky

Bread—all breads, including rye and oatmeal, hot breads and muffins, corn bread, baking-powder biscuits, etc.; gluten bread; matzoth, pretzels, and zwieback. Note: 100 per cent rye bread, crackers, and wafers may be used. Bread may be made from soy, rice, corn, potato flours.

Cereals

All-bran	Kix	Puffed Wheat
Beemax	Krumbles	Ralston cereals
Bran flakes	Maltex	Shredded Wheat
Cheerios	Mello-wheat	Wheatena
Crackels	Muffets	Wheat flakes
Cream of Wheat	New oats	Wheat germ
Farina	Pablum	Wheaties
Grape-Nuts	Pep	Wheatsworth
Grape-Nuts flakes	Pettijohn's	Wheat Chex

Crackers and cookies

Desserts—cakes, cookies, doughnuts, pies, ice-cream cones

Flour in any form, including graham, white, or whole-wheat

Griddle cakes, waffles; either homemade or commercially prepared mixes

Gravies or sauces thickened with flour

Macaroni, noodles, spaghetti, or vermicelli

Meat prepared with flour, bread or cracker crumbs, such as croquettes and meat loaf or stews thickened with flour or made with dumplings

Meats prepared commercially, such as frankfurters, sausages, or meat loaf in which wheat may be used as a filler

Salad dressings in which flour is used for thickening

DIET WITHOUT EGGS*

FOODS TO AVOID

Eggs in any form

Bread and rolls containing egg, such as sweet rolls, griddle cakes, waffles

Cakes

Candy as chocolate, fondant, nougat

Cocomalt

* Adapted from *Diet Manual.* Nutrition Department. The Presbyterian Hospital, New York City, 1957.

FOODS TO AVOID

Cookies
Custard
Eggnogs or other egg drinks
Hollandaise sauce
Ice cream
Marshmallows
Mayonnaise
Meat prepared with egg as meat loaf, breaded meat
Meringue
Muffins
Noodles
Ovaltine
Pies such as coconut, cream, custard, lemon, pumpkin
Pretzels
Puddings containing eggs
Zwieback

DIET WITHOUT MILK*

FOODS TO AVOID

Milk in all forms including fresh, evaporated, dry, malted, buttermilk
Bread with milk added (includes most commercial breads)
Butter
Cake or cookies made with milk
Caramels
Cheese
Chocolate candy
Cocomalt
Cream
Cream of Rice
Cream sauces
Cream soups
Custards
Gravy made with milk, cream, butter, or margarine
Ice cream
Margarine
Mashed potatoes
Ovaltine
Piecrust made with butter or margarine
Pies, soft or cream type
Puddings made with milk
Sherbets
Vegetables seasoned with butter or margarine, or creamed
Zwieback

DISEASES OF THE SKIN

The quality of the diet is a determining factor in skin health. Deficiency of one or more vitamins is known to produce various cutaneous disorders. For example, there are the dermatitis associated with pellagra and resulting from lack of niacin, the eruptions which accompany severe vitamin-A deficiency, and the cheilosis of riboflavin lack, to mention but a few. Some individuals may be allergic to certain substances and thus manifest skin disorders such as eczema or urticaria.

Many bizarre diets have been prescribed for skin diseases. Needless restrictions are often made when there is no proven association between the disorder and the ingestion of the food. Adolescent boys and girls who are especially prone to *acne vulgaris* are particularly likely to eliminate nutritionally important foods in a vain attempt to correct a skin condition.

* Adapted from *Diet Manual*. Nutrition Department. The Presbyterian Hospital, New York City, 1957.

The best diet that can be prescribed in skin disorders is one which is nutritionally adequate—that is, it should include sufficient milk, eggs, meat, fruits, vegetables, enriched or whole-grain cereals and breads, and butter or margarine. The consumption of these foods will usually accomplish a great deal more than the hit-or-miss elimination of certain foods.

Whenever allergy is suspected as a cause for cutaneous diseases, it is essential to determine the offending agent as described in the preceding part of this chapter. No single food or group of foods predominates in producing allergic skin disorders.

High-fat and concentrated carbohydrate diets have been considered to have unfavorable effects in certain skin diseases, but the evidence is not conclusive. There is no harm in the exclusion of candies and sweets, fried foods, chocolate, and rich desserts from the diet, but improvement through such limitation is by no means assured. As a matter of fact, when the Four Food Groups are eaten in the needed amounts, there is less desire to consume these rich foods.

Attention should be directed to improving the general hygiene, including regular meal hours, sufficient fluid intake, adequate rest, proper elimination, and psychologic support.

PROBLEMS AND REVIEW

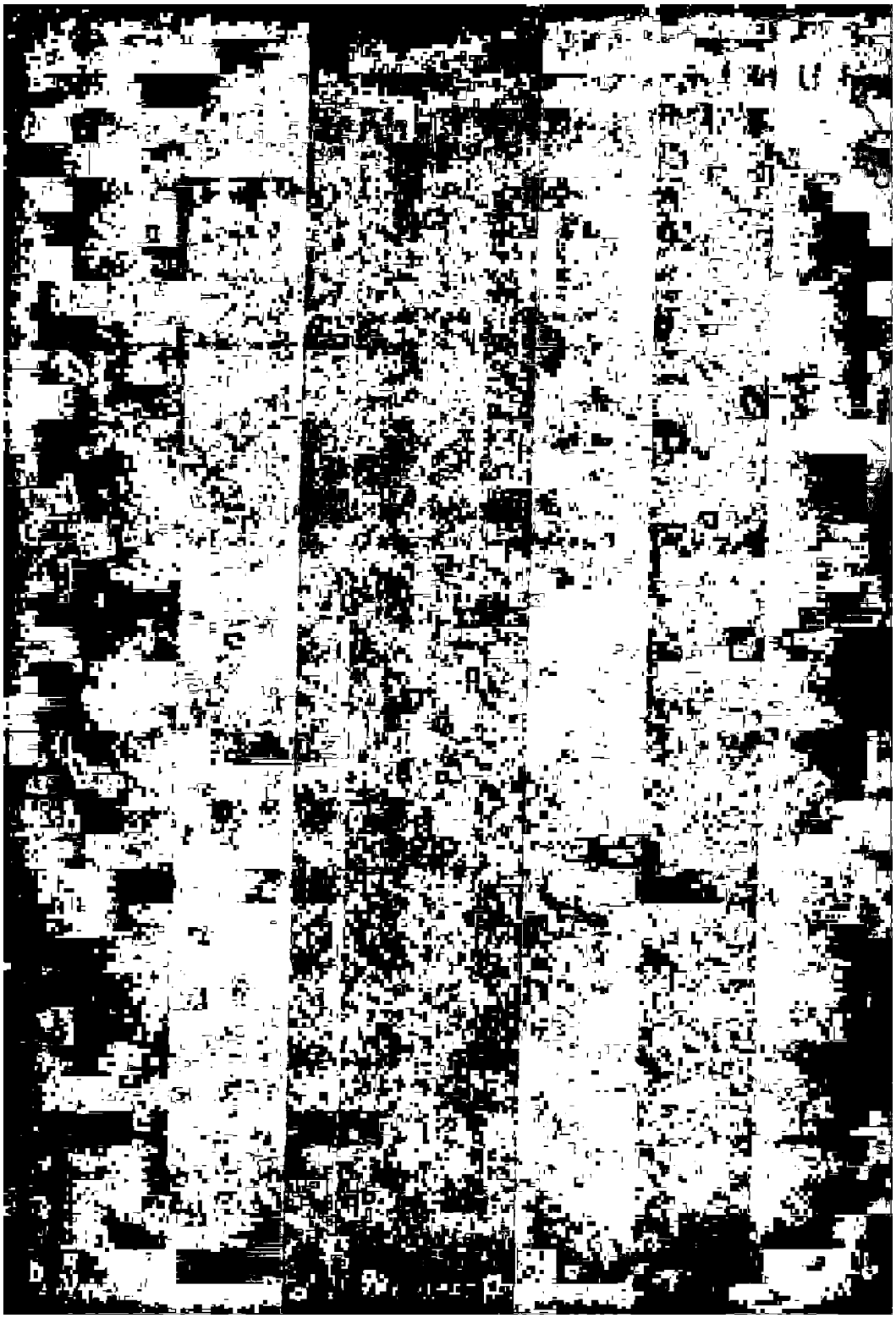
1. Name some of the characteristic symptoms of allergy.
2. Name five foods to which a great number of allergies are due. Name some foods which rarely cause sensitivity.
3. What is meant by skin test; elimination diet; provocative diet; intentional feeding?
4. What are the principles for the construction of elimination diets? What are some of the shortcomings of many of these diets?
5. *Problem.* Plan a day's menu for a patient who is sensitive to wheat, potatoes, and grapefruit.
6. *Problem.* Prepare a list of foods which a patient should avoid if he is allergic to corn.
7. What recommendation could you make to a 15-year-old girl who has acne vulgaris?
8. *Problem.* Prepare a table which shows the nature of skin disorders when a diet is markedly deficient in each of the following: protein, essential fatty acids, vitamin A, riboflavin, niacin, ascorbic acid. Under what circumstances would you expect these changes in the skin to become apparent? What is the incidence of these disorders in the United States?

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UNIT XIV
Diet in Children's Diseases

Chapter

46 NUTRITION IN CHILDREN'S DISEASES
Starch- and Fat-Restricted Diets

47 INBORN ERRORS OF METABOLISM
Phenylalanine-Restricted Diet; Galactose-Free Diet

Chapter 46

NUTRITION IN CHILDREN'S DISEASES
Starch- and Fat-Restricted Diets

Discussions in several chapters in this text provide the basis for the feeding of infants and children in illness: normal nutritional needs (Chapters 23 and 24), the factors influencing food acceptance (Chapter 15), and the nutritional care and rehabilitation of sick people (Chapters 27 and 28). Those dietary regimens for diseases common to adults and children may be adjusted according to the child's needs by consulting programs described in preceding chapters. This chapter will include a description of problems pertaining especially to children; the inborn errors of metabolism will be discussed in Chapter 47.

Although the principles of normal and therapeutic nutrition that apply to the adult are also applicable to the sick child, additional factors that must be carefully considered for the child are (1) growth needs; (2) stage of physical, emotional, and social development; (3) the presence of physical handicaps in some; and (4) the more rapid nutritional deterioration which occurs.

Feeding problems of the sick child. Like adults, children face many obstacles in illness. Eating a satisfactory diet may be difficult because of fatigue, nausea, lack of appetite occasioned by the illness and by drugs, and pain. Children often regress to an earlier stage of feeding; for example, the child who has learned to accept chopped foods may refuse them, or the child who can feed himself may refuse to eat unless someone feeds him. Older children especially may experience a sense of failure and express it by excessive eating or refusal to eat. Illness produces emotional tensions in the child as well as in the adult. When the child must be placed in a hospital, he is also faced with the separation from his home and his parents. The principles of feeding the normal child apply in even greater degree to the child who is ill.

Insofar as possible the feeding program should establish a pattern of continuity with that to which the child is accustomed. A record of the child's feeding history is a first requisite so that the normal or therapeutic diet makes allowances for individual likes and dislikes. The period of a child's illness is no time in which to introduce new foods or to provide equipment that the child does not know how to handle.

Even though careful menu planning takes into consideration the usual

likes of children and includes variations in both flavor and textures, foods may be refused. The illness itself and the strange environment are sufficient cause for such refusal; sometimes portions are a bit too large, or there may be a slight change in the flavoring or texture of a familiar food. Regardless of the reason for refusal, nothing can be gained by trying to force a child to eat. If the personnel responsible for the care of the child maintain a consistently relaxed and pleasant atmosphere, the child will sooner or later respond favorably to the care given him. (See Figures 46–1 and 46–2.)

For preschool and school children who are not confined to bed, group feeding is particularly useful since children, like adults, enjoy companionship at meals, learn to get along with one another, and may show improvement of appetite.



FIG. 46–1. The child who requires a modified diet learns important essentials of the diet through the use of food models and setting up examples of meals she likes. Although the parents assume responsibility for supervision of the dietary regimen, they know that the child must be an active participant in making menu decisions. (*Courtesy, Dietary Department, University Hospitals, University of Wisconsin Medical Center, Madison.*)

WEIGHT CONTROL

Obesity. Children, like adults, become overweight because they eat in excess of their daily requirements. The first step toward the correction of the obesity is a determination of the reason for overeating.[1] Many children are fat



FIG. 46–2. A guiding hand and a little encouragement will improve food intake greatly. Sick children away from home need the security of familiar foods and the understanding and affection of nurses, dietitians, and others. (*Courtesy, Mrs. Elizabeth Wilcox and The Babies Hospital, New York City.*)

because their mothers have assumed an overprotective attitude and have fed their children large quantities of food in the mistaken notion that it was necessary. For example, a child may have been ill at one time and had eaten poorly; the extra amounts of high-calorie foods that were fed to the child during convalescence may not have been reduced so that as a result he continued to gain weight. Then again, large amounts of concentrated foods, such as candy, have frequently been used by the mother as a bribe. The mother thus retains an intimate hold on her child who craves more and more sweets. The fat child is often an unhappy child who may be eating simply for the solace he obtains from food.

Because the energy requirements of children are relatively high, their diet is usually less restricted than that for adults. About 1200 to 1800 calories may be included, depending upon the stature and activity of the child. Liberal protein, mineral, and vitamin allowances are essential so that tissue and stature development are not adversely affected. The low-calorie diet described in Chapter 32 may be used as a basis for planning the child's diet. To this diet should be added 1 cup of milk daily so that the child receives his

quota of 1 quart. Vitamin-D concentrates are prescribed if the milk is not fortified.

It is vital that the child (and his mother) realize what a loss of weight may mean to him. For some children this means emphasis on good appearance, poise, and gracefulness; for others it means greater participation in sports; and for still others it implies the approbation of fellow playmates and schoolmates. The physician, nurse, and dietitian who are guiding the child's weight-reduction program must show understanding of the child's problems and must maintain interest through a careful follow-up of the progress being made.

Underweight. The child who fails to show normal gains in weight and height usually tires easily, is irritable and restless, and more susceptible to infections. As in the correction of obesity, the cause for underweight must first be sought so that treatment may be properly directed. The diet is corrected with respect to its adequacy of the essential nutrients, after which increases in the caloric level may be made gradually. A reasonable amount of outdoor exercise and regulated rest are important elements of the weight-gaining program. For high-calorie diets see Chapter 32.

DIARRHEA IN INFANTS AND CHILDREN

Diarrhea occurring in infants and children may be functional or organic and is caused by the same factors as in adults. Probably most acute diarrhea is accounted for by improper handling of the food supply, especially milk. The incidence is several times as high in bottle-fed as in breast-fed infants and is greatly increased during the summer months when it is traceable to unsanitary preparation or inadequate refrigeration of food, including infant formulas. Greater emphasis on education of parents in the preparation, sterilization, and storage of formulas has resulted in a markedly decreased incidence and mortality.

Serious consequences follow diarrhea in infants under 1 year of age if treatment is not prompt. The large loss of fluids and electrolytes quickly leads to dehydration, fever, loss of kidney function, and severe acidosis if electrolyte loss is chiefly through the intestinal tract. There may also be marked vomiting with a loss of acid, in which case there may be no acidosis but a lowering of total body anions and cations.

Modification of the diet. When mild diarrhea occurs in breast-fed infants, it is usually sufficient to discontinue breast feeding entirely for 12 to 24 hours and to provide weak tea or 5 per cent glucose at 3- or 4-hour intervals. At the end of the first 12 hours, the infant is permitted to nurse for a few minutes after taking the tea or glucose. The time of nursing is gradually increased as improvement occurs.

Artificially fed infants are given only weak tea or glucose solution until the diarrhea appears to be lessening—usually about 24 to 48 hours—after which

skim milk or skim lactic acid milk may be given at half strength. Since adequate intake of fluid is important, the glucose solution or water should be continued until the infant can tolerate the full volume of formula. Both the quantity and concentration of the formula should be increased only gradually so that diarrhea will not become more severe.

When diarrhea in infants is severe, it is essential to correct the dehydration and acidosis by the administration of alkali, fluids, amino acids, glucose, and vitamins in water-soluble preparations by parenteral means. Only water, weak sweetened tea, glucose solution, or amino acid solutions are permitted by mouth. Convalescence may be prolonged, and the diet must be increased cautiously. Skim and then whole lactic acid milk are especially useful.

Scraped apple or apple powder has been useful in the treatment of diarrhea in infants and older children. The apple powder may be mixed with water or with milk, if milk is tolerated. A thick paste is prepared using 4 level teaspoons of apple powder and a small quantity of boiled and cooled water. When the paste is smooth, it is gradually diluted with liquid until the volume equals 8 ounces. This quantity is taken every 3 to 4 hours, as directed by the physician.

The treatment of diarrhea in older children is similar to that for adults, namely, the omission of food during the first day or two, the gradual introduction of low-residue foods (Chapter 34), and progression to a soft diet.

CELIAC DISTURBANCES

The celiac syndrome includes several disturbances, which are characterized by intolerance to dietary gluten, starch, or fat. True or idiopathic celiac disease may be mild (starch intolerance) or severe. Cystic fibrosis of the pancreas presents many of the symptoms of celiac disease as a result of inadequate or absent secretion of pancreatic juice. Kwashiorkor (Chapter 5) or severe dietary deficiency bears many similarities to the syndrome, as does also sprue in adults (Chapter 36).

Mild celiac disease (starch intolerance). This condition is characterized by abdominal distention, chronic diarrhea, and growth failure. It occurs more frequently than severe celiac disease. The amylase concentration in the duodenum is low, thus resulting in considerable amounts of undigested starch in the stools. Fat is present in abnormal amounts in the feces but disappears after varying periods of treatment. The diet must be restricted for years as described below for celiac disease, but more liberal amounts of fat may be permitted than in the initial stages of treatment for severe celiac disease.

Severe celiac disease. Classic celiac disease occurs in children as early as 6 months of age but is seen more frequently during the second year of life. It may occur up to the age of 5 years. The many instances of multiple cases in a family point to a hereditary factor. Celiac disease is chronic in character and

presents these symptoms: (1) a marked enlargement of the abdomen; (2) wasting of the tissues, particularly about the buttocks and groin; (3) severe loss of weight and retardation of growth; (4) loss of muscle tone; (5) loss of appetite, vomiting, and the development of secondary anemia; (6) behavior changes ranging from irritability and evidences of fatigue to hysterical outbursts; (7) pale, foul, excessively bulky stools which may be semifluid in character.

Consistently, the absorption of carbohydrate is impaired in celiac disease, accounting for the presence of large amounts of undigested starch in the stools. Fat digestion is normal because there is sufficient bile and pancreatic lipase, but the absorption of fat is reduced to from 65 to 85 per cent of the ingested fat.[2] The normal rate of absorption is about 90 to 95 per cent.

Poor absorption of fat interferes with the absorption of the fat-soluble vitamins and also of calcium and iron. Tetany, osteoporosis, rickets, or hypochromic anemia has been observed in some patients. The excessive loss of sodium and potassium in periods of severe diarrhea may lead to dehydration, shock, and acidosis. Protein deficiency is of common occurrence probably because dietary protein is used in large part to meet the energy needs of the body.

Gluten-induced enteropathy. Several Dutch workers[3] and others in England[4,5] observed that the amount of gluten of wheat consumed was closely correlated with the amount of fat excreted in the feces. Most patients with celiac disease are now known to be sensitive to the protein in wheat, especially gliadin, and to show improvement when a gluten-free diet is given. A number of theories have been proposed to explain the etiology. Most likely a congenital deficiency of one or more proteolytic enzymes in the small intestine leads to the faulty hydrolysis of proteins, and the concomitant excretion of starch and fat in the stools. The gluten-induced enteropathy of young children and the nontropical sprue of adults are believed to be manifestations of the same disease at different age periods (see Chapter 36).

Cystic fibrosis. This congenital disturbance affects the exocrine glands, that is, the glands which discharge their secretions to the outside of the body. Large amounts of mucus may obstruct the bronchi, the nasal passages, and the ducts leading to the gastrointestinal tract. The sweat contains an excessive amount of salt. Lack of pancreatic enzymes in many, but not all, patients interferes seriously with the utilization of protein, fat, and carbohydrate. As much as 50 per cent of the protein and fat of the diet may be present in the feces. The chief signs noted in the patient are slow growth in spite of a large appetite, bulky stools, chronic bronchitis, and frequently signs of deficiency of fat-soluble vitamins. Death may occur from malnutrition or bronchopneumonia.

Modification of the diet. The principles and stages for diet in the celiac syndrome have been fully described by Mike and are given in part below. When gluten-induced enteropathy has been established, the adaptation of this

regimen to the wheat-, oat-, rye-free diet should be made (see Chapter 36). Stages I and II of Mike's diet plans include no gluten, but small amounts are added in each of the succeeding stages; thus, these would be omitted for the patient sensitive to gluten.

BASIC PRINCIPLES OF DIET IN THE CELIAC SYNDROME*

CELIAC DISEASE	FIBROCYSTIC DISEASE
CALORIES	
Acute phase: 120 to 200/kg body weight; an excess to compensate for past and present fecal loss and failures in absorption; formula calories may cover the entire caloric needs in crisis, and be two thirds of the total as the patient improves; *a very ill child requires frequent feedings,* every 2 to 3 hours day and night; soon after the acute phase of the disease, even for the very young, solids are added. After acute phase: About 20 per cent above normal calculated requirements; gradual return to normal requirements.	All ages and conditions: 50 to 75 per cent above normal requirements Newborn period: 150 to 200/kg body weight; the same as the celiac patient in the acute phase. Older child: 120 to 150/kg body weight; between meal feedings are needed, especially for the older child, to prevent fatigue and excessive hunger; it may be necessary to use six small meals for some individuals.
PROTEIN	
Acute phase: 6 to 8 gm/kg body weight daily. After acute phase: Gradual return to normal calculated requirements; allergies are not uncommon; therefore the use of fish, particularly shellfish, should be restricted.	All ages and phases: 6 to 8 gm/kg body weight daily; an excess is required at all times to compensate for the great loss; additional amino acids are required as part of the protein for infants under one year; this can be achieved by using *Probana* formula.
SIMPLE CARBOHYDRATES AND STARCHES	
Planned to make up the remaining calories. Acute phase: Use only formula initially, then increase the use of well-tolerated, relatively simple carbohydrates; avoid the use of starch; patients originally having the severe phase should not have starch liberalized for six months to one year after the last severe bout of diarrhea.	Planned to make up the remaining calories. Acute phase and under one year of age: As outlined under the acute phase of celiac disease.

* Arranged from Mike, E. M.: "Practical Management of Patients with the Celiac Syndrome," *Am. J. Clin. Nutrition,* 7:463, 1959.

CELIAC DISEASE (Cont.)

Mild phase (starch intolerance): After about 14 months of age, more liberal use of cane sugar is tolerated; *gradual* introduction of selected starch follows; there may be an intolerance to gluten in which case wheat, rye, oats, and barley would be avoided; the effect of new foods should not be judged until they have been given one week *or longer,* since the intolerance may not be manifested immediately; during an infection and in very hot weather, relapses may occur, requiring a return to a more restricted diet for a week or more; some restrictions may be required for years, as influenced by the clinical picture of the child and laboratory data; gluten-containing foods are poorly tolerated; there is individual variation, and they should be introduced on a trial and error basis.

FIBROCYSTIC DISEASE (Cont.)

Over one year of age if not acutely ill: Gradually introduce starch; the selection is to be governed by the ability to chew as well as the socioenvironmental needs; the quantity is limited to assure an adequate intake of other important foods. This will vary with the age and appetite of the individual child; in this phase there is no intolerance to starch.

Note: The quantity of foods should never be restricted by the adult's attitudes, but foods should be offered to the point of satiety of the patient.

FAT

Acute phase: Steatorrhea is present; the fat content of the diet is to be low; avoid visible fats and restrict to fat in the formula and a few selected foods; skim and whole milks, raw or pasteurized, and evaporated milks are not tolerated; however, protein milk, boiled skim and some types of dried skim milks are taken well; the fat in egg yolk and lean meat is not considered excessive and should be included in the diet.

Mild phase (starch intolerance): The tolerance varies; utilization is generally increased if the gluten content of the diet is initially kept low and the added fats are unsaturated (corn, cottonseed, soybean, sesame, and olive oils); progression to other fats, and a more liberal use of all fats and oils is made with clinical improvement of the patient.

The fat content of the diet is to be low; limited absorption and tolerance is present; restrict intake to fats contained in the natural foods which help to provide the optimal dietary essentials as well as aid in planning a varied and practical menu; *if the patient is doing well and* is near adolescence, limited amounts of creamy peanut butter, mild cheese, lean ham, and crisp bacon (drained) can be used; homogenized milk may be used when away from home, as in school; some older patients may tolerate homogenized milk instead of skim milk.

Patients with normal duodenal enzymes: Fats are not restricted unless increased stools and digestive disturbances are produced.

ROUGHAGE

Acute phase: Excessive roughage is not tolerated; the residue of puréed foods is not excessive.

Acute phase: Same as in celiac disease.

Over two years of age: There is no intolerance; the use is governed by

CELIAC DISEASE (Cont.)

Mild phase: Puréed foods are used for a longer period than for the well child. It is not uncommon to find undigested foods and colored foods excreted; do not restrict the offending foods; raw vegetables and additional raw fruits are added when there has been a marked clinical improvement —about three to four years of age.

FIBROCYSTIC DISEASE (Cont.)

the ability to chew.

VITAMINS

Aqueous multivitamin preparation; about 20 drops (1.2 ml), or 2 capsules daily; (vitamin A to be between 10,000 to 20,000 units); in mild phase about 10 drops or 1 capsule may be adequate.	About 20 drops or 2 capsules daily; (vitamin A to be between 10,000 to 20,000 units).
B complex (Lederplex): 2 to 4 teaspoons daily, or 2 to 4 capsules.	Same, depending on formula.
Vitamin K: given when evidence of bleeding exists (prolonged prothrombin time).	Same.

SALT

Normal intake.	All age groups: increased intake up to 6 gm daily, in warm or hot weather; salt may be added to food or beverage or given as NaCl tablets after meals.

IRON

When indicated, use 10 mg of elemental iron per kilogram body weight; give with food other than milk.	Usually not indicated.

PANCREATIN

Not required.	Required for all patients with pancreatic deficiency; dosage varies with age and the number of meals scheduled. *Powder*—½ to 1 gm (½ teaspoon) in each bottle or 1 to 2 gm (1 teaspoon) with each meal on a three-meal-a-day plan. *Tablets*—325 mg each. Give 1 to 3 tablets with each meal; older patients may require only 1 to 2 tablets as determined by the fat in the stools. *Granules*—¼ to ½ teaspoon with each meal on a three-meal-a-day plan.

The following stages are a suggested guide for planning the diet, but it must be emphasized that individual needs must receive first consideration. In addition to suitable modification for the celiac syndrome, the age and growth needs of the child must be constantly considered.

*Formula: Probana** to provide ⅔ to ¾ or all of the calories. The *Probana*-to-water ratio should never be more concentrated than 1:4 by volume.

*Hi Pro** or *Protein Milk** to supply ⅔ to ¾ of the formula calories may be used. The remaining formula calories are provided by glucose and/or banana flakes or powder.

I. TWO TO 4 MONTHS OF AGE. In addition to the formula, introduce the following foods gradually. This diet is known as the *strict no-starch, high-protein, low-fat diet*. See meal plan on page 692.

Cheese—cottage, uncreamed with jelly or honey
Dessert—plain gelatin
Egg—yolk
Fruit—scraped raw apple, apple juice, applesauce; banana or banana flakes; strained grapefruit or orange juice
Meat—beef or liver, strained or finely ground
Vegetables, all puréed—green beans, carrots, squash, tomato juice

II. FOUR TO 14 MONTHS OF AGE. This diet is known as *no-starch, high-protein, low-fat diet*. See meal plan on page 692.
Continue the formula and all foods from stage I. Add the following:

Desserts—fruit ices, fruit whips with egg white, rennet desserts, meringues
Eggs—whole, not more than three each day
Fruit—scraped raw pear; puréed apricots, cranberries, peaches, pears, pineapple; strained juices of apricot, cranberry, grape, lemon, lime, pear, pineapple, tangerine
Meat—lean chicken, heart, kidney, lamb, turkey, veal; fresh boneless fish (add with caution for celiacs), low-fat canned salmon, tuna
Sweets—honey, clear jelly, marshmallow, sugar, syrup, hard candy
Vegetables—puréed asparagus, beets, peas, spinach, Swiss chard
Miscellaneous—salt, flavoring extracts

III. FOURTEEN MONTHS TO 2 YEARS OF AGE. This diet is known as *low-starch, high-protein, low-fat diet*. For patients with cystic fibrosis, a formula made of double-strength nonfat dry milk may be used. Those patients with celiac disease may be given a formula of boiled skim or homogenized milk. Selected foods with starch are allowed in restricted amounts if the gluten intake is not restricted. See meal plan on page 692.

Allow all foods from stages I and II, with the following additions or modifications:

Cereal foods—1 serving three times daily of any *one:* puffed cereals, 2 to 3 tablespoons; arrowroot crackers or social tea biscuits, 2 to 3; zwieback; Melba toast;

* *Probana* and *Protein Milk* by Mead Johnson & Co., Evansville, Indiana; *Hi Pro* by Jackson-Mitchell Pharmaceuticals, Inc.

SUGGESTED MEAL PLANS FOR FIRST THREE STAGES OF DIET

STRICT NO-STARCH HIGH-PROTEIN LOW-FAT	NO-STARCH HIGH-PROTEIN LOW-FAT	LOW-STARCH HIGH-PROTEIN LOW-FAT
BREAKFAST		
Citrus or apple juice (strained) Ripe banana, banana flakes or applesauce Eggs—no added fat Uncreamed skim milk cottage cheese or meat, if desired Formula	Citrus juice (strained) Ripe banana or other fruit from list Eggs—no added fat Uncreamed skim milk cottage cheese or meat, if desired Formula	Citrus juice (strained) Ripe banana or other fruit from list Eggs—no added fat Uncreamed skim milk cottage cheese or meat, if desired Starch—1 serving Milk or formula
DINNER AND SUPPER		
Finely ground or strained canned beef or liver (2 or more tablespoons) Cheese from list may be used for *one* meal Puréed string beans, carrots or squash (1 or more tablespoons) Dessert: gelatin desserts, applesauce, scraped raw apple, ripe banana, or banana flakes Formula	Finely ground or strained canned lean meat, poultry (or fish); *cut off all visible fat;* broil, boil, or roast Cheese from list or egg may be used for *one* meal Puréed cooked vegetable Dessert: puréed fruit should be used for *one* meal Formula	Finely chopped or ground lean meat, poultry or fish; *cut off all visible fat;* broil, boil, or roast Cheese from list or egg may be used for *one* meal Cooked, fresh, frozen, or canned vegetable (puréed or chopped, dependent on age) Dessert: fruit should be used for *one* meal *Starch*—1 serving Milk or formula
EVENING		
Formula	Formula	Milk or formula
BETWEEN-MEAL FEEDINGS		
Dependent on appetite	Dependent on appetite	Any foods on diet list, except starch in excess of allowance, if they do not interfere with the appetite at mealtime *Note:* These feedings should always be planned for those with cystic fibrosis

crisp toast, ½ slice. If gluten is restricted, all wheat cereals and breads must be avoided. (See Chapter 36)
Fruits—seedless grapes; cooked or canned apricots, peaches, pears need not be puréed at this stage
Meat—shellfish
Milk—skim or homogenized as tolerated
Vegetables—all cooked, but need not be puréed; add broccoli tops and cauliflower tops
Miscellaneous—cocoa

IV. TWO TO 4 YEARS OF AGE. This diet is known as *moderate-starch, high-protein, low-fat diet.*
Allow all foods permitted on stage III, with the following additions:

Cereal foods—cooked cereals; plain bread, saltines, soda crackers; macaroni, noodles, spaghetti, rice
Desserts—angel food or sponge cake, lady fingers, puddings
Fats—for celiac patients only—corn, cottonseed, olive, sesame, and soybean oils
Milk—homogenized for celiac patients; skim for pancreatic deficiency
Soups—cream
Vegetables—potato

V. THREE TO 6 YEARS OF AGE. At this stage raw fruits and vegetables may be gradually introduced by trial and error. Those foods which cause discomfort should be avoided. Celiac patients, but not those with pancreatic deficiency, may be given creamy peanut butter, vegetable shortening, and finally ice cream and butter.

VI. OVER 6 YEARS OF AGE. The nutritional needs of the celiac patient are about the same as those of the normal child, and all foods of the family may be introduced gradually. The B-complex vitamins should be continued, and aqueous multivitamins should be given at the same levels as for the well child.

The patient with pancreatic deficiency needs a high-protein, high-calorie, moderately low-fat diet with additional vitamin-B complex, and aqueous multivitamins. Pancreatin must be continued. Some of those patients must continue to use a rigidly restricted fat diet.

DIABETES

The first patient treated with the insulin prepared by Banting and Best in January, 1922, was a 14-year-old diabetic boy. Marble[6] estimates that approximately one of every 2000 children under 15 years of age is diabetic.

Comparison with adult diabetes. The disease in children differs in a number of important respects from that in adults. The onset of symptoms is usually

more sudden and violent, and the disease tends to increase in severity during the period of growth. In contrast to the adult, obesity is uncommon; in fact, most diabetic children have a history of underweight. All diabetic children need insulin, since there appear to be few if any functioning cells of the islands of Langerhans. The maintenance of control between acidosis on the one hand and hypoglycemia on the other is often difficult because of the greater frequency of infections and the erratic physical activity. The additional nutrient needs for growth and the varying activity from time to time necessitate frequent dietary adjustments.

Although the life-span of diabetic children has improved greatly, the incidence of degenerative diseases is unusually high after 10 to 20 years. The possibilities of diminished vision and even blindness, of coronary artery disease, and of kidney disease during the prime of life are serious, and as yet unsolved, problems.

Psychologic considerations. Too often the child and his parents as well feel that he is somehow different from other children and that there is a certain stigma attached to the diabetic state. If the child experiences insulin reactions, he will be afraid to participate in the activities of other children, and he may become more dependent upon his parents. The diabetic adolescent is likely to be especially difficult to control. Like other adolescents he may rebel against authority, and one of the ways in which he may show his independence is through breaking his diet.

The guidance of the child in all aspects of his development, not only in the treatment of the diabetes, requires great patience, forbearance, and understanding on the part of the parent and physician. The child and the parent must recognize the interrelationship of diet, insulin, and activity and the importance of regulation. It is equally important that the child learn—and his parents understand—that he can take his place in the family and society just as does the nondiabetic child. Nelson states: "The child who is not physically, mentally and socially able to compete with his colleagues cannot be considered an adequately treated diabetic child."*

Modification of the diet. The principles of dietary modification for the diabetic child are similar to those for the adult (see Chapter 38). The nutritive requirements are the same as those for the normal child of the same age, size, and activity (see Chapter 24). Briefly, these needs are as follows:

CALORIES: to maintain desirable rate of growth; usually about 35 to 40 calories per pound desirable weight.

PROTEIN: 1.5 gm per pound if under 3 years of age; 1 gm per pound for older children.

CARBOHYDRATE AND FAT: 40 to 45 per cent of the calories from carbohydrate with the remaining calories from fat. Some clinicians restrict carbohydrate to 225 or 250 gm per day, or even less, in which case the fat level is proportionately higher to ensure adequate caloric intake.

* Nelson, W. E.: *Textbook of Pediatrics*, 8th ed. W. B. Saunders Company, Philadelphia, 1964, p. 1324.

The additional calcium requirements are easily met when 3 to 4 cups of milk are included daily. Other minerals and vitamins are provided in satisfactory amounts when the exchange lists are used as the basis of meal planning. Children should receive vitamin D either in milk or as a supplement.

The diet prescription should be adjusted periodically to make allowances for satisfactory growth. A reasonable meal constancy from day to day is desirable. Between-meal snacks should be included. It is better that a child receive a snack before activity to forestall the possibility of insulin reaction.

Opinions differ as to the degree of control that should be exercised. Some clinicians maintain that chemical control is important if degenerative complications are to be avoided. Others use the "free" diet, allowing the child to eat all family foods but usually restricting concentrated sweets and high-carbohydrate desserts. Enough insulin is given to metabolize food for normal growth and to avoid ketosis, but hyperglycemia and glycosuria are disregarded.

Insulin. The slowly acting insulins, especially lente and isophane, are most commonly used. For many children a small dose of insulin is needed before dinner or in the evening, as well as before breakfast, in order that morning hyperglycemia may be controlled. In addition, regular insulin is sometimes included with the morning injection. The oral sulfonylurea compounds are not suitable for juvenile diabetics, although phenformin used with insulin sometimes results in better control.

Education of the child and his parents. When the child is old enough to accept instruction, he should always be included in the planning of his diet and his care. Regardless of opinions concerning clinical or chemical control, most pediatricians agree that close adherence to a diet at the beginning provides security and guidance for the child and the parent during the period of adjustment to the disease. Jackson[7] recommends that the initial diet provide few substitutions until the patient is thoroughly accustomed to it; then the diet is gradually liberalized with respect to food choice until the meal exchange lists are used with ease.

A diet planned within the scope of the meal exchange lists possesses the advantages of including nutritive essentials, keeps the child reasonably well controlled with respect to a normal blood sugar and the usual absence of urine sugar, and yet is not so restrictive that the child breaks the diet too frequently. Some pediatricians recommend that the diet be weighed initially until the parent and the patient are accustomed to portion sizes and that weighing of food be practiced from time to time as a check on the amounts of food. Otherwise, the use of household measurements suffices.

Diabetic camps in many areas of the country have provided an unusual educational opportunity for children to learn more about the care of themselves with respect to their disease and also to learn the important social adjustments with other children. Such camps are well staffed with recreational leaders, nurses, dietitian, physicians, and laboratory technicians.[6,8]

NEPHROTIC SYNDROME

The nephrotic syndrome includes so-called pure lipoid nephrosis and the nephrotic phase of glomerulonephritis. This rare syndrome occurs in young children at an average age of 2½ years. Its onset is usually insidious and is characterized by marked edema, heavy proteinuria, serious depletion of plasma proteins, especially the albumin fraction, and elevated blood cholesterol. In lipoid nephrosis hematuria, hypertension, and azotemia are absent. Some children after months or even years may recover completely, but many progress to the terminal stages of nephritis or succumb to infections.

The persistent edema is often so marked that it seems as if the skin would break. It may mask a severe state of undernutrition which becomes apparent only as diuresis takes place. The administration of ACTH or cortisone has resulted in a great reduction of edema in most instances where it has been tried.

Modification of the diet. Patients with nephrosis have a particularly poor appetite, and every attempt must be made to serve foods that are acceptable to the child. Foods concentrated in protein and in energy value must be emphasized.

ENERGY. Unless the caloric intake is great enough to supply the body's energy needs, effective tissue regeneration will not take place. The needs should be based on the child's desirable weight rather than on his actual weight.

PROTEIN. About 3 to 4 gm protein per kilogram body weight is suitable for the preschool child and 2 to 3 gm per kilogram for school-age children.

SODIUM. When there is excessive edema, the sodium may be restricted (see Chapter 42). Unsalted foods are poorly accepted so that prolonged restriction is usually undesirable.

ALLERGY

The designation of allergy has been used frequently for those conditions resulting from a sensitivity to a food. With the increased understanding of hereditary diseases, it is now apparent that many so-called allergies are, in fact, the failure to metabolize a given nutrient because of the congenital deficiency of one or more enzymes. There remain, however, many diseases which are not yet explained on any such basis and which are classified as allergies.

Foods are responsible for the majority of allergies in children under 3 years of age. The chief offending foods are milk, eggs, wheat, white potatoes, chocolate, and oranges. When the child is young, it is relatively simple to determine which food is responsible by allowing only milk and crystalline vitamins. If a food other than milk is responsible, the symptoms, such as eczema, will be

relieved in a few days; but if milk or nonfood allergy is responsible for the disturbance, no improvement will take place.

When the symptoms of allergy are mild, it is always necessary to consider the relative importance of the allergic disturbance in relation to the diet of the child. It is better management, for example, to treat a mild case of eczema locally than to subject the child to the dangers of an inadequate diet with its far more serious consequences.

For older children, the diagnosis of allergy is accomplished by means of skin tests and the usual elimination diets, and the treatment is planned as for adults (see Chapter 45).

Milk sensitivity. From 0.3 to 7 per cent of all children are sensitive to milk, according to various estimates.[9] In many instances this may be associated with infection and emotional stress; in others genetic factors may be a cause (see Galactose Disease and Lactose Intolerance, Chapter 47).

The response to the ingestion of milk is almost immediate in some and may lead to colic, spitting up of the feeding, irritability, diarrhea, and respiratory disorders. A delayed reaction may occur hours to days following the ingestion of milk, and thus it becomes difficult to determine the exact cause. Recently, the incidence of hypochromic anemia in some infants has been attributed to sensitivity to milk.[9] Following the ingestion of milk by these sensitive infants, some blood is lost from the gastrointestinal tract. This may average several milliliters per day and may go unnoticed until the anemia becomes apparent months later. Some infants may have a sufficiently high intake of other iron-rich foods so that the anemic tendency is counteracted.

DIETARY TREATMENT. Sometimes it is only necessary to change the form of the milk to improve tolerance—that is, boiled, powdered, acidulated, or evaporated milk may be satisfactory when fresh cow's milk is not. In other instances goat's milk may be an effective substitute for cow's milk, but occasionally the child will tolerate no milk whatsoever.

A number of formulas containing no milk have been found to be satisfactory.[10] A formula containing cooked rice, strained beef, Dextrimaltose, lard, salt mixture, and vitamins has been recently described.[11] The tolerance to milk improves in many infants, but others need to continue a milk-free diet indefinitely.

FEEDING HANDICAPPED CHILDREN

Cerebral palsy. Various crippling conditions occur as the result of brain damage. The feeding problems depend upon the type of crippling present.[12]

REVERSE SWALLOWING WAVE. When the motor system of the tongue and throat is affected, food is not pushed back to the throat, but the tongue motion pushes the food forward. Initially such children must be tube fed, but in time they learn to put food at the back of the tongue and by tilting the head back-

ward learn to swallow. These children often become severely undernourished because feeding is such a prolonged process. Concentrated foods with maximum protein and caloric value should be emphasized to keep the volume to a minimum. Vitamin and mineral supplements are usually required.

ATHETOIDS are those who are constantly in motion and who thus burn up a great deal of energy. They require a high-calorie diet but even so they may fail to gain weight. The high-caloric requirement also accelerates the vitamin requirement.

SPASTICS are very limited in their activity, and they may also be indulged in eating by their parents. Consequently they gain excessive amounts of weight, and the obesity in turn further restricts their ability to get around. These individuals require marked restriction of caloric intake without jeopardizing the intake of protein, minerals, and vitamins.

Cleft palate. Surgery for cleft palate is often not completed for several years. In addition to the needs for normal development, the infant and child must build up reserves for surgery, the promotion of healing, and the development of normal healthy gums and teeth. According to Zickefoose[13] the major problems of feeding these children may be met in the following ways:

1. Infants may have difficulty in sucking, but most of them learn to use chewing movements to get the milk out of the nipple. An enlarged nipple opening is helpful. Some babies may be fed with a medicine dropper or a Brecht feeder.
2. To counteract the tendency to choke, liquids should be taken in small amounts and swallowed slowly.
3. More frequent "burpings" are necessary because of the large amount of air which may be swallowed.
4. Spicy and acid foods often irritate the mouth and nose and should be avoided. If orange juice is not well taken, ascorbic acid supplement should be prescribed.
5. Among the foods which may get into the opening of the palate are peanut butter, peelings of raw fruit, nuts, leafy vegetables, and creamed dishes. Some children have no difficulty with any foods.
6. Puréed foods may be diluted with milk, fruit juice, or broth and given from a bottle with a large nipple opening. Some babies accept purées well if they are thickened with vanilla wafer or graham-cracker crumbs.
7. The time required for feeding may be long and requires much patience on the part of parent and nurse. For the older child, five or six small meals may be better than three.

When surgery has been performed, a liquid or puréed diet is offered until healing is complete.

Mental retardation. Some five million persons in the United States are estimated to be mentally retarded. Of these, about 75 per cent have an I.Q. between 51 and 75 (educable) and are designated as "high-grade." Approximately 20 per cent of the mentally retarded are "middle-grade," that is, they

have an I.Q. between 21 and 50 (trainable). The "low-grade" individual with an I.Q. below 20 is believed to account for 5 per cent of the mentally retarded and presents the problems in feeding.

The nutritional requirements of the mentally retarded child and adult are like those of the individual of normal mental development. The nurse can help parents to understand the problems of feeding by giving encouragement and support.

The mentally retarded child may be kept on the bottle too long, thus increasing the difficulties of introducing other foods. The child may eat very slowly, and feeding may be messy. Hand sucking and vomiting are not uncommon.[14] To obtain adequate food intake for growth may require frequent, small feedings, and certainly an abundance of patience and ingenuity. One must strike a balance between overprotectiveness and lack of caring.

The retarded individual, like the normal person, has an active emotional life. He feels the shunning of others and his failure to achieve, but will respond to loving attention.[15] He resists new foods, has definite likes and dislikes, and finds it difficult to manage eating. He responds to the color of foods and like all children is fond of sweets.

When the individual is able to feed himself, he should be permitted to do so even though feeding may be messy. Food must be presented in a form that can be easily managed. Foods may be eaten with the fingers for a long time until simple utensils can be managed. The child unable to support himself should be held in a sitting position while he is being fed.

PROBLEMS AND REVIEW

1. What dietary problems may be anticipated in children who must be hospitalized? How can these problems be overcome?
2. How can a school child be helped to adjust to a prolonged therapeutic diet?
3. *Problem.* Adjust a 1500 calorie diet of an adult so that it will be suitable for a 12-year-old boy. In what ways would you try to effect acceptance of this diet?
4. What dietary considerations would apply for a 7-year-old child with scarlet fever?
5. *Problem.* List a number of ways in which you could encourage a boy with rheumatic fever to take an adequate diet.
6. *Problem.* Plan six high-calorie afterschool and bedtime snacks which could be added to the regular diet of a teen-age girl who is 20 pounds underweight.
7. What changes in diet might be indicated for an infant who is constipated? A 4-year-old child?
8. What are the similarities between celiac disease and cystic fibrosis? What differences are there?
9. *Problem.* Plan a day's meals for a 3-year-old child with celiac disease who is receiving a moderate-starch, high-protein, low-fat diet. How would you modify this diet for the child with pancreatic deficiency?
10. List the differences between diabetes in children and in adults.
11. What arguments can you give for, and against, chemical control in childhood diabetes?
12. Enumerate the essential points in the instruction of the child and/or his parent with respect to diabetes.
13. What is the effect of physical activity on the control of diabetes in the child?

14. Prepare a plan for the organization of a diabetic club for children. Include suggestions for meetings for such a group.

15. A diabetic child is invited to a birthday party. What plans can be made so that the child may eat at this party?

16. *Problem.* For a 2-year-old child with nephrosis plan a suitable diet containing 50 gm protein and 1200 calories. How would you modify the diet for 500 mg sodium?

17. List several ways in which milk intolerance may be manifested. What substances in milk have been shown to produce such sensitivity? List three products that may be used satisfactorily in place of a milk formula.

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Chapter 47

INBORN ERRORS OF METABOLISM

Phenylalanine-Restricted Diet; Galactose-Free Diet

Many professional and lay groups have united in their efforts to understand the nature of the ever-growing number of inborn errors of metabolism and to seek methods of prevention and treatment. To the physician, the problems are those of diagnosis, of early detection before damage has occurred, and of effective treatment. To the biochemist falls the task of identifying the metabolic defect so that a possible rationale of therapy can be developed. To the nurse and dietitian fall the practical aspects of nursing care and of dietary planning and implementation. The problem of control through genetic counseling belongs to the geneticist. Most of all, to the parent of a child affected the problem is immediate and urgent; in some disorders treatment is effective, but in others no remedy is available.

Nature of inborn errors. The term *inborn error* was coined at the beginning of this century by Sir Archibald E. Garrod who wrote a book in which he described four diseases of a hereditary nature.[1] These were alkaptonuria, a defect of phenylalanine metabolism in which a metabolite excreted into the urine becomes dark upon standing; albinism, also a defect in phenylalanine metabolism characterized by a lack of pigmentation; cystinuria, or an excessive excretion of cystine because of a defect in the renal tubules which prevents the reabsorption of the amino acid cystine; and pentosuria, characterized by the presence of pentose in the urine owing to the lack of an enzyme in metabolism.

Inborn errors of metabolism include a large number of disorders that originate in one or more mutations of the gene so that normal function is disrupted. More recently these diseases have been referred to as *genetic diseases* or as *hereditary molecular diseases*.[2] The effects of genetic mutation vary widely and may alter the metabolism of specific amino acids, carbohydrates, lipids, or minerals. They may affect the synthesis of a body product; they may interfere with the transport of materials across a cell membrane; they may produce toxic effects on tissues because of the accumulation of intermediate products.

Some errors of metabolism result in no serious limitations upon the individual; others lead to rapid changes in the central nervous system so that mental retardation is severe; still others may be lethal shortly after birth. Some become evident a few days after birth, but others may show no signs until late adult life.

Many of the inborn errors of metabolism are characterized by serious mental retardation if the condition is not treated promptly. During the first years of life the brain is developing so rapidly that any interference with its growth cannot be fully corrected at a later time. Thus, diagnosis at a very early age is important if effective treatment is to take place before serious damage has occurred. Inexpensive screening tests may be applied to some conditions during the first weeks of life. Several conditions for which dietary treatment has been successful are discussed in this chapter.

PHENYLKETONURIA

Phenylketonuria was first diagnosed by Asbjörn Fölling, a Norwegian biochemist, in 1934, and has been successfully treated with a low-phenylalanine diet since 1952. When the disorder is discovered early in infancy and is treated with the low-phenylalanine diet, the child is not doomed to a life of mental retardation.

Incidence. About 1 per cent of all patients in mental institutions are estimated to be phenylketonurics. About one child in each 10,000 births has phenylketonuria, although one person in 50 is a carrier of the trait.

Phenylketonuria is transmitted by an autosomal recessive gene. Thus, each of the parents would have one defective gene and would be clinically normal. Each birth from the mating of two heterozygotes involves a one in four chance that the child will be phenylketonuric, two chances that he will be a heterozygote but clinically normal, and one chance that he will be entirely normal.

Biochemical defect and clinical changes. An enzyme, phenylalanine hydroxylase, is missing in the phenylketonuric individual. As a consequence the hydroxyl (OH) grouping cannot be incorporated into the phenylalanine molecule to form tyrosine. Several products accumulate in the blood circulation and are excreted in the urine. One of these, phenylpyruvic acid, is a ketone which accounts for the naming of the condition. It reacts with ferric chloride to give a vivid green color, thus forming the basis for the widely used "diaper" tests. Another intermediate product is phenylacetic acid which accounts for the characteristic "wild," "gamey," or "mousy" odor from the skin and urine of these patients.

Mental retardation in untreated subjects is usually severe with most patients having an intelligence quotient below 50. The child appears to be normal at birth but within the first few days or weeks of life the various intermediate products of faulty phenylalanine metabolism accumulate and can be detected in the blood and urine. If treatment is not initiated promptly progressive irre-

versible brain damage occurs. Although the faulty phenylalanine metabolism is clearly understood as the cause of the brain damage, it is not yet known just how this change takes place.

Because of the block in tyrosine formation, the production of pigments is reduced. Consequently, these children are usually blond, blue eyed, and have a fair skin, even though their parents may be of darker skin, eye, and hair coloring. Eczema is a common finding.

The behavior of untreated children is considerably altered. They are hyperactive, wave their arms, rock back and forth, and grind their teeth. They show poor coordination, are irritable, immature, and overdependent. At times they may have seizures. Their behavior can be extremely trying even to the most loving parents.

Modification of the diet. A low-phenylalanine diet is the only effective treatment for phenylketonuria. When it is instituted early in the infant's life, normal mental development can take place. After 3 years of age, little improvement in mental development is to be expected since the brain damage has already occurred and cannot be reversed. However, even for the older child the phenylalanine-restricted diet is believed to be of some benefit in modifying the behavior characteristics.

The diet should be adjusted in phenylalanine content from time to time in order to supply the normal growth requirements for this essential amino acid. In addition, the diet must be fully adequate in all nutrients. The recommended allowances for protein, energy, and phenylalanine are summarized in Table 47–1.

Table 47–1. Phenylalanine, Protein, and Calories Recommended for Various Age Groups of Phenylketonuric Patients*

Age	Phenylalanine *mg per pound*	Protein *gm per pound*	Calories *per pound*
0–3 months	20–22	1.75–2.0	60–65
4–12 months	18–20	1.5	55–60
1–3 years	16–18	32 gm total	50–55
4–7 years	10–16	40 gm total	40–50

* Acosta, P. B.: "Nutritional Aspects of Phenylketonuria," in *The Clinical Team Looks at Phenylketonuria*, Revised. Children's Bureau, U.S. Department of Health, Education, and Welfare, Washington, D.C., 1964, p. 45.

The allowances for protein and calories are essentially the same as those of the Recommended Dietary Allowances for normal children. Some clinicians allow slightly more protein and calories initially since the source of protein is casein hydrolysate rather than natural protein.

The phenylalanine allowance may require adjustment to maintain the blood levels within a normal range. Some decrease in the requirement per unit of body weight is noted with increasing age.

MINERALS AND VITAMINS. The formula for young infants is supplemented with ascorbic acid and vitamin D according to the usual schedule set up for normal infants. As foods are gradually introduced they will supply some ascorbic acid. Niacin supplementation is desirable since the conversion of tryptophan to niacin may be insufficient. The full calcium requirement is met by the low-phenylalanine formula, but the older child who fails to take all of the formula may require a calcium supplement.

Management of the diet. The satisfactory treatment of the phenylketonuric child requires the team approach of the physician, nurse, biochemist, dietitian, and others. (See Figure 47–1.) The blood and urine must be tested from time to time for phenylalanine since too high a level indicates inadequate restriction and the possibility of damage to the brain, while too low a level of phenylalanine in the blood would be indicative of inadequate amounts for normal growth. The diet is so unlike a normal diet that many problems are encountered in its administration. A skillful approach by physician, nurses, and dietitian is required to achieve acceptance on the part of the parent as well as the child.



FIG. 47–1. Successful treatment of many diseases requires coordinated services to the patient in the home. A physician, public health nurses, physical therapist, and nutritionist discuss problems of home care. (*Courtesy, Community Nursing Services, Philadelphia.*)

LOFENALAC. Proteins contain 4 to 6 per cent phenylalanine which is far in excess of that tolerated by children with phenylketonuria. Lofenalac,* a casein hydrolysate from which 95 per cent of the phenylalanine has been removed, is the basis for the dietary regimen. This preparation contains unsaturated fat, carbohydrate, some vitamins, and minerals. It is a completely satisfactory substitute for milk and other protein foods from a nutritional point of view.

* Lofenalac,® Mead Johnson & Company, Evansville, Indiana.

Lofenalac is the only source of protein for the infant not yet receiving other foods and continues to provide 85 per cent of the protein needs of the older child

MILK contains about 55 mg phenylalanine per ounce and is used as a source of this essential amino acid for the first few months until other phenylalanine-containing foods are introduced. From 1 to 2 ounces of milk are used, always incorporated into the Lofenalac formula lest the child acquire a taste for milk.

DIET LISTS. Serving lists have been developed in which all foods within a given groups will provide the same amount of phenylalanine, protein, and calories when given in the specified amounts. (See Table 47–2.)

Table 47–2. Phenylalanine, Protein, and Caloric Content of Serving Lists Used on Restricted Phenylalanine Diets*

	Phenylalanine mg	Protein gm	Calories
Lofenalac, 1 measure (1 tablespoon)	7.5	1.5	43
Vegetables	15	0.3	5
Fruits	15	0.2	80
Breads	30	0.5	20
Fats	5	0.1	45
Desserts (special recipes required)	30	2.0	270
Free foods	0	0.0	varies
Milk (per ounce)	55	1.1	20

* Acosta, P. B.: "Nutritional Aspects of Phenylketonuria," in *The Clinical Team Looks at Phenylketonuria*, Revised. Children's Bureau, U.S. Department of Health, Education, and Welfare, 1964, p. 40.

The child's daily protein, calorie, and phenylalanine requirements are established according to his age and weight. Once the prescription has been determined, the amount of Lofenalac required to meet the protein and calorie need can be calculated. The day's allowance for phenylalanine is completed by adding the necessary amount of milk for the young infant, or the appropriate amounts of foods from the serving lists for the older child. (See Table 47–3.)

The diet should be progressed as for a normal infant and child. That is, fruits, vegetables, and cereal foods from the allowed lists are introduced as the child grows. Lofenalac may be incorporated with other foods as the child grows. A variety of recipes have been developed for such use.

Dietary counseling. Eating problems are encountered frequently in phenylketonuric children. These may be the result of great parental anxiety and feeling of guilt. The parent may overemphasize diet and allow it to dominate the relationships with the child. Initially, the acceptance of Lofenalac may be poor. If it is forced at first, or if the parent or brothers and sisters indicate dislike for the diet, the child may continue to refuse the formula. It is best to offer the formula at the beginning of the feeding when the child is hungry, and

Table 47–3. Serving Lists for Phenylalanine-Restricted Diet*

Food	Amount
Vegetables—15 mg phenylalanine per serving	
Asparagus	1 stalk
Beans, green, cooked	3 tbsp
junior	2 tbsp
strained	2 tbsp
Beets, cooked	3 tbsp
strained	2 tbsp
Cabbage, raw, shredded	4 tbsp
Carrots, raw	½ large
canned	4 tbsp
junior	3 tbsp
strained	3 tbsp
Cauliflower	2 tbsp
Celery, raw, 5 in. stalks	2 stalks
Cucumber, raw	⅓ medium
Lettuce, head	2 leaves
Mushrooms, cooked	2 tbsp
Okra, pod, cooked	1 pod
Onion, green	2 medium
mature	¼ medium
Parsley	2 sprigs
Pumpkin, cooked	2 tbsp
Radish	3 small
Spinach, cooked	1 tbsp
creamed, junior and strained	2 tbsp
Squash, summer cooked	4 tbsp
Squash, winter, cooked	2 tbsp
junior	6 tbsp
strained	3 tbsp
Tomato, raw	¼ small
canned	2 tbsp
juice	2 tbsp
Turnip	4 tbsp
Yam or sweet potato, strained	2 tbsp
Fruits—15 mg phenylalanine per serving	
Apple, raw	2 medium†
Apricots, canned	2 halves
dried, halves	4 large†
juice	¼ cup
Apricot-applesauce,	
junior	10 tbsp
strained	10 tbsp
Avocado	2 tbsp
Banana, 6 in. long	½†
Cantaloupe, diced	½ cup†
Dates, dried	2
Fruit cocktail, canned	2 tbsp
Grapefruit, sections or juice	⅓ cup
Grapes, green, seedless	20 medium
Guava, raw	⅓ medium
Grape juice	⅓ cup
Lemon or lime juice	3 tbsp
frozen, diluted	½ cup
Mango	½ small
Orange	1 medium†
Papaya, cubed	¼ cup
juice	½ cup
Peach, raw,	1 medium†
canned in syrup	1½ halves
junior	7 tbsp
strained	5 tbsp
Pear, raw	1⅓ medium†
canned in syrup	3 halves
junior	10 tbsp
strained	10 tbsp
Pear-pineapple, junior	
and strained	7 tbsp
Pineapple, raw	⅓ cup
canned in syrup	1½ small slices
juice	½ cup
Plums, canned	1 medium
with tapioca, junior	7 tbsp
with tapioca, strained	5 tbsp
Popsicle with fruit juice	2 medium
Prunes, dried	2 large†
juice	⅓ cup
strained	3 tbsp
Raisins, dried	2 tbsp†
Strawberries	3 large
Tangerine	⅔ small
Watermelon	⅓ cup
Breads and Cereals—30 mg phenylalanine per serving	
Barley cereal, Gerber's dry	2 tbsp
Biscuits‡	1 small
Cereal food, Gerber's, dry	2 tbsp
Corn, cooked	2 tbsp
Cornflakes	⅓ cup
Crackers, Barnum animal	6
Crackers, graham	1

* Arranged from Acosta, P. B.: "Nutritional Aspects of Phenylketonuria," in *The Clinical Team Looks at Phenylketonuria*, Revised 1964. Children's Bureau, U.S. Department of Health, Education, and Welfare Washington, D.C., 1964, pp. 40–44.

Table 47–3. Serving Lists for Phenylalanine-Restricted Diet (Continued)

Food	Amount
Crackers, soda	1
Crackers, saltines	2
Cream of Rice, cooked	2 tbsp
Cream of Wheat, cooked	2 tbsp
Hominy	3 tbsp
Hominy grits, cooked	3 tbsp
Mixed cereal, Pablum, dry	3 tbsp
Muffin, pineapple‡	2
Oatmeal, Gerber's, strained	2 tbsp
Pablum, dry	2 tbsp
Popcorn, popped	⅓ cup
Potato, white	2 tbsp
Rice, cooked	2 tbsp
Rice Flakes, Quaker	⅓ cup
Rice Krispies, Kellogg's	⅓ cup
Rice Pablum	4 tbsp
Rice, Puffed, Quaker	⅓ cup
Sugar Crisps	¼ cup
Wheat, Puffed, Quaker	⅓ cup
Yam, sweet potato, cooked	2 tbsp
Fats—5 mg phenylalanine per serving	
Cream, heavy	1 tsp
Mayonnaise	2 tsp
Olives, ripe	1 large
Desserts—30 mg phenylalanine per serving	
Cake‡	1/2 of cake
Cookies—rice flour‡	2
corn starch‡	2
Cookies, Arrowroot	1½
Ice Cream—chocolate‡	⅔ cup
pineapple‡	⅔ cup
strawberry‡	⅔ cup
Jello	⅓ cup
Puddings‡	½ cup
Sauce, Hershey	2 tbsp
Wafers, sugar, Nabisco	6
Free foods—negligible phenylalanine; may be used as desired	
Apple juice, Applesauce	Count as fruit if more than 1 cup
Butter	
Candy	
butterscotch	
cream mints	
fondant	
gum drops	
hard	
jelly beans	
lollipops	
Cornstarch	
Gingerbread‡	
Guava butter	
Honey	
Jams, jellies, marmalades	
Margarine	
Molasses	
Oil	
Pepper	
Popsicle (with fruit flavor only)	
Rich's topping	
Salt	
Sauces	
lemon‡	
white‡	
Sugar, brown or white	
Syrups, corn, maple	
Tapioca	
Foods to Avoid—very high in phenylalanine	
Breads	
Cheese, all kinds	
Eggs	
Flour, all kinds	
Meat, poultry, fish	
Legumes (dried peas, beans and seeds)	
Nuts	
Nut butters	
Milk (55 mg phenylalanine per ounce)	

† Miller, G. T., *et al.*: "Phenylalanine Content of Fruit," *J. Am. Dietet. A.*, **46**: 43, 1965.
‡ Special recipes required.

to avoid any show of concern if it is not fully accepted. When parents begin to see the improvement in the child, encouragement is provided for the considerable effort needed to maintain careful vigilance in its preparation.

Table 47–4. Restricted Phenylalanine Diets for Infants and Children*

Age	1 Month	8 Months	2 Years	4 Years
Weight, pounds	8	18	26	36
Diet prescription				
Phenylalanine, mg	160–176	324–360	416–468	360–576
Protein	14–16	27	32	40
Calories	440	810	1300	1700
Lofenalac, measures†	10	18	19	23
Water to make	24 oz	32 oz	24 oz	24 oz
Milk as necessary	1½ oz	1 oz	—	—
Vegetables, servings	—	2	4	4
Fruits, servings	1	1	4	4
Breads, servings	—	3	5	4
Fats, servings	—	—	1	1
Desserts‡, servings	—	—	—	1
Free Foods§	—	—	as desired	as desired
Nutritive values				
Phenylalanine, mg	172	325	417	447
Protein, gm	16.8	30.4	33.1	40.6
Calories	540	944	1302	1724

* Acosta, P. B.: "Nutritional Aspects of Phenylketonuria," in *The Clinical Team Looks at Phenylketonuria*, 1964. Children's Bureau, U.S. Department of Health, Education, and Welfare, Washington, D.C., p. 52.

† One measure = 1 tablespoon

‡ Special recipes are required for desserts.

§ If free foods are given in excessive amounts child may not consume proper amounts of other foods.

Both parents must receive detailed information concerning the amounts of phenylalanine permitted daily and the amounts of foods that will provide them. They should be asked to demonstrate the measurement and preparation of the formula. A program of home services is invaluable in assuring that the diet is being used as planned. (See Figure 47–2.) The public health nurse often supervises the home care and also consults with the dietitian or nutritionist in the planning and in problems of dietary management. Printed recipe materials should be carefully explained to the parent.

MAPLE SYRUP URINE DISEASE

This inborn error of metabolism derives its name from the maple syrup odor of urine, a valuable clue in the diagnosis. The disease is also known as *branched chain ketoaciduria*, a term which relates to the biochemical defect. It was first recognized in the United States in 1954 and since then has been described in several European countries and in Japan. It is believed to be transmitted as an autosomal recessive trait. The incidence is not known.



FIG. 47–2. A nutritionist discusses problems of dietary management within the home. She makes such visits upon the request of the public health nurse when problems of diet may be somewhat complex. (*Courtesy, Community Nursing Services, Philadelphia.*)

Biochemical defect and clinical changes. Three branched chain amino acids, namely, leucine, isoleucine, and valine, are normally metabolized to keto acids, and then further degraded through decarboxylation to simple acids. In maple syrup urine disease an oxidative decarboxylase enzyme in the white blood cells is missing. Because the carboxyl group cannot be removed, the amino acids and their keto acids accumulate in the blood and are excreted in excessive amounts in the urine. A metabolite related to isoleucine is believed to be responsible for the odor of the urine and of the sweat.

Infants appear normal at birth but begin to show symptoms within the first few days. They are unable to suck and swallow satisfactorily, respiration is irregular, and there are intermittent periods of rigidity and flaccidity. Seizures of the grand mal type may occur. If the infants survive, mental retardation is severe. Hypoglycemia has been observed in several patients and may be related to leucine sensitivity. Frequent infections lead to increased tissue catabolism and thus to a further accumulation of the offending metabolites in the circulation.

Dietary treatment. A diet restricted in leucine, isoleucine, and valine has given some encouraging results, but no commercial formula has yet been prepared. After the synthetic formula has reduced the high blood levels of leucine, isoleucine, and valine together with their incompletely metabolized products, small amounts of milk are added to provide for the growth requirements of the

infant. Weight gain will not proceed without some supply of the branched chain amino acids. Puréed carrots, applesauce, and brewer's yeast are among the other foods which have been used with the formula.[3]

HOMOCYSTINURIA

Cystathionine synthetase is an enzyme normally present in the brain and liver. It is essential for the conversion of homocysteine to cystathionine, which are intermediate products formed in the metabolism of methionine. When the enzyme is lacking, increased amounts of methionine and homocystine are found in the plasma, and large amounts of homocystine are excreted in the urine. Lack of the enzyme is an autosomal recessive trait.

Homocystinuria occurs almost as frequently as phenylketonuria. Severe mental retardation is present in almost all patients. The optic lens is dislocated in all patients, and glaucoma and cataracts occur in some. There is a weakness of the muscles of the pelvic girdle and a shuffling gait. Skeletal abnormalities include long extremities, osteoporosis, and curvature of the spine. Pulmonary embolism, thrombosis, and cerebral accidents are common.

Treatment. No adequate therapy is known for this enzyme deficiency. A low-methionine, high-cystine diet has been used and was found to be beneficial in reducing the methionine level of the blood, although it was not effective in raising the cystine level of the blood.

LEUCINE-INDUCED HYPOGLYCEMIA

A relatively rare inborn error of metabolism, leucine-induced hypoglycemia becomes apparent after about the fourth month of life. Convulsions may be the first indication of an abnormality. Infants with this disorder show some evidence of delayed mental development. Signs typical of Cushing's syndrome —acne, hirsutism, obesity, and osteoporosis—are often present.

When L-leucine is given in a test dose to the infant, a profound lowering of the blood glucose occurs in the leucine-sensitive infant. The exact reason for the increased sensitivity is not known. Among the several theories suggested, the most likely one appears to be that leucine may act as a stimulus to insulin production or as an enhancement of insulin utilization.

Dietary management. A diet low in leucine is used,[4] but the minimum leucine requirement of 150 to 230 mg per kilogram must be included. Since all protein foods are sources of leucine, a restriction of this amino acid places restrictions upon the inclusion of protein-rich foods. Fruits and vegetables are added to the diet according to the infant's normal feeding schedule. A small amount of carbohydrate (10 gm) is given 30 to 40 minutes after each feeding to counteract the hypoglycemic effect of the leucine.

DISACCHARIDASE DEFICIENCY

A lack of one or more disaccharidases in the intestine—lactase, sucrase, maltase, isomaltase—leads to an inability to hydrolyze the sugars that require these specific enzymes. Disaccharide intolerance occurs in infants and adults, and may be inherited or acquired. Among the conditions in which enzyme deficiency is secondary to disease are celiac disease, sprue, kwashiorkor, enteritis, cystic fibrosis of the pancreas, and malnutrition.[5]

Diarrhea and abdominal pain are characteristic symptoms of disaccharidase deficiency. The stools are large, watery, foamy, and have a low pH. The infant fails to gain weight and may have colic and distention.

When disaccharidase deficiency is suspected, a sugar tolerance test may be used to help establish the diagnosis. If an enzyme for the sugar being tested is missing, the glucose tolerance curve will be flat, thus indicating the inability to hydrolyze the sugar in the intestine so that the monosaccharides are absorbed into the circulation. When the offending sugar is given in such a test, the patient often responds with abdominal pain and diarrhea. The stools will contain the test sugar and lactic acid.

Lactose intolerance. Lactose malabsorption is frequently seen in adults, but there does not appear to be any association with intolerance in childhood. The diet for lactose intolerance is one which rigidly omits all sources of lactose. Since milk is the source of lactose in the diet, the infant must be given a substitute formula such as Nutramigen,* Sobee,* Mul-Soy,† or a meat-base formula.‡

When foods are added to the diet of the infant, care must be exercised to omit all foods that contain milk. These range from the obvious milk-containing foods such as puddings to sources likely to be overlooked for milk as an ingredient—for example, margarine, cold cuts, breads of many kinds, and others. See list on page 676.

Invertase-isomaltase deficiency. Patients who lack these enzymes must omit foods containing sucrose and certain types of starch. Most of the sucrose in the diet is derived from the addition of cane sugar during food preparation. Glucose may be substituted as a sweetening agent and would be the form of carbohydrate added to the infant formula. Some fruits and vegetables may contain enough sucrose to cause difficulty. Among these are apricots, bananas, dates, melons, oranges, pineapples, and peas.[5]

Through the action of amylase starch is hydrolyzed to maltose and isomaltose. When isomaltase is missing, further hydrolysis of isomaltose is impossible, although the maltose will be hydrolyzed to glucose. Wheat and potato starches yield some isomaltose upon hydrolysis; corn and rice starches

* Nutramigen® and Sobee® by Mead Johnson & Co., Evansville, Indiana.
† Mul-Soy® by the Borden Company, New York City.
‡ Meat-base formula by Gerber Products Company, Fremont, Michigan.

yield much smaller amounts of isomaltose. Thus, wheat and potato starches should especially be avoided, although some corn and rice starches may be tolerated.

GLUCOSE-GALACTOSE MALABSORPTION

Inability to absorb glucose and galactose poses some problems in dietary planning inasmuch as the carbohydrates which yield these sugars must also be avoided. A formula utilizing calcium caseinate, corn oil, fructose, mineral salts, and vitamins has been described.[5] The fructose content varies from 4 to 8 per cent. By the seventh month the amount of fructose in the formula may be reduced and small amounts of fruits and vegetables added. By the end of 1 year the infant is taking meat, fish, and selected vegetables and fruits in addition to the formula. Usually the child is able to tolerate the foods of a regular diet by the time he reaches the age of three, but some restriction is placed upon the amounts of foods that yield glucose and galactose during digestion. One glass of milk, two or three sandwiches, and two small potatoes may be tolerated by this time. When the tolerance is exceeded, diarrhea reappears. Patients with this deficiency will need some dietary adjustment throughout life.

GALACTOSE DISEASE

Galactose disease is caused by the absence of an enzyme (galactose-1-phosphate uridyl transferase, sometimes abbreviated P-Gal-transferase) which is needed in the liver for the conversion of galactose to glucose. Galactose is derived from the hydrolysis of lactose in the intestine. It is absorbed, but must be converted to glucose before the body can utilize it. The enzyme defect is inherited as an autosomal recessive trait.

Clinical changes. The disease becomes apparent within a few days after birth by such symptoms as anorexia, vomiting, occasional diarrhea, drowsiness, jaundice, puffiness of the face, edema of the lower extremities, and weight loss. The spleen and liver enlarge, and in some there may be evidences of liver failure within a short time leading to ascites, bleeding, and early death. Mental retardation becomes evident very early in the course of the disease, and cataracts develop within the first year. Urine tests show the presence of galactose, albumin, and amino acids. A galactose tolerance test helps to establish the diagnosis.

Dietary treatment. Milk is the important dietary source of lactose which in turn yields galactose. Human milk is especially high in galactose, and thus the breast-fed infant who lacks the necessary enzyme shows symptoms very early. The substitution of a nonmilk formula leads to rapid improvement as a

rule. All of the symptoms disappear except that mental retardation which has already occurred is not reversible. Damage to the central nervous system is greatest during the first few weeks and months of life when growth is rapid. Therefore, the prompt initiation of therapy can scarcely be overemphasized.

A number of nonmilk formula products are available. These include Nutramigen, Sobee and Mul-Soy, and a meat-base formula. Some pediatricians do not use the soybean preparations since stachyose, a tetrasaccharide in soybeans, is believed to be hydrolyzed to galactose. Others have used such formulas with success. The maintenance of a galactose-free diet may be monitored by testing red blood cells of the infant for their content of galactose-1-phosphate transferase.

The formulas are supplemented with calcium gluconate or chloride, iron, and vitamins. Since milk is the only food which supplies lactose, other foods may be introduced into the infant's diet at the appropriate times. These include breads, crackers, and cereals made without milk, eggs, meat, poultry, fish, fruits, vegetables, and gelatin desserts. All foods that contain milk must be rigidly excluded: most commercial breads, cookies, cakes, puddings, pudding mixes, some ready-to-eat cereals, all cheeses, cream, ice cream, butter, margarine churned with milk, chocolate, cold cuts, and others. See the list of foods to avoid in allergy to milk, page 677. Liver, brains, and pancreas store galactose and are usually avoided. The question remains whether the stachyose present in soybeans, beets, Lima beans, and peas is hydrolyzed to galactose.

As with phenylketonuria, dietary counseling is of paramount importance. Infants accept the substitute formulas quite well, but older children may refuse them for a time. Parents must avoid showing too much anxiety about refusal of food. They need to become thoroughly familiar with lists of foods that contain milk and must learn to read labels with care. The diet is successful only when repeated opportunities are available for follow-up, whether in the clinic or in the home. Such follow-up visits not only reinforce dietary instruction but provide encouragement to the parents. Blood galactose determinations are essential to establish that normal limits are not being exceeded.

WILSON'S DISEASE

Hepatolenticular degeneration, or Wilson's disease, is a hereditary disorder transmitted by an autosomal recessive gene. The characteristic defect is a low serum level of ceruloplasmin, a copper-containing protein of the blood. The consequence of this defect is an increased absorption of copper from the intestinal tract and an increased deposit of copper in the brain, liver, and kidney. Because of renal intoxication by the copper, there is a marked aminoaciduria and a negative phosphate balance.

Clinical findings. The onset of symptoms is correlated with the time required for sufficient copper to accumulate in the tissues to produce damage.

They may appear as early as four or five years of age, or as late as the thirties. In some patients ascites, jaundice, liver enlargement, and neurologic involvement are observed. The common neurologic signs include indistinct speech, a fixed unblinking stare, hypertonus or rigidity, tremor, seizures, and dementia. The most important physical sign is the Kayser-Fleischer ring, a golden brown discoloration seen in the eye.

Treatment. An agent which chelates with copper of the diet is used, thereby reducing the amount of copper absorbed. The normal range of copper intake is about 2 or 3 mg, with the traces of copper being distributed in most foods. Foods especially rich in copper include organ meats, shellfish, mushrooms, legumes, whole-grain cereals, bran, chocolate, and nuts. A paucity of data on the copper content of foods introduces difficulty in planning a diet that is reliably low in copper. Moreover, the maintenance of nutritive adequacy is difficult when copper-containing foods are omitted. Treatment cannot yet be considered to be fully successful.

PROBLEM AND REVIEW

1. What is phenylalanine? In what way is its function modified in phenylketonuria?
2. What is Lofenalac? Why is it necessary to include some source of phenylalanine in the diet of the infant with phenylketonuria? What food source may be used?
3. Why is prompt diet therapy essential for the treatment of phenylketonuria and other errors of metabolism?
4. *Problem.* Plan a diet appropriate for an infant with phenylketonuria who is five months old and who weighs 14 pounds. Calculate the phenylalanine, protein, and calorie content of the diet.
5. Outline the essential points to be covered in the counseling of the parents of a patient with phenylketonuria or galactosemia.
6. Examine the labels of proprietary compounds such as Nutramigen, Sobee, Mul-Soy, and Lofenalac. What supplements to these formulas are required? What is the cost of a formula for one day for a four-month-old infant weighing 12 pounds?
7. Examine the labels of a variety of packaged foods in a market, and prepare a list of those which contain milk.
8. What is the principal defect in galactose disease? In lactose intolerance?
9. Why is carbohydrate given after meals to infants who are sensitive to leucine? What class of foods must be restricted when a low-leucine diet is to be used?
10. Plan a menu for one day for a school boy who has an invertase-isomaltase deficiency.

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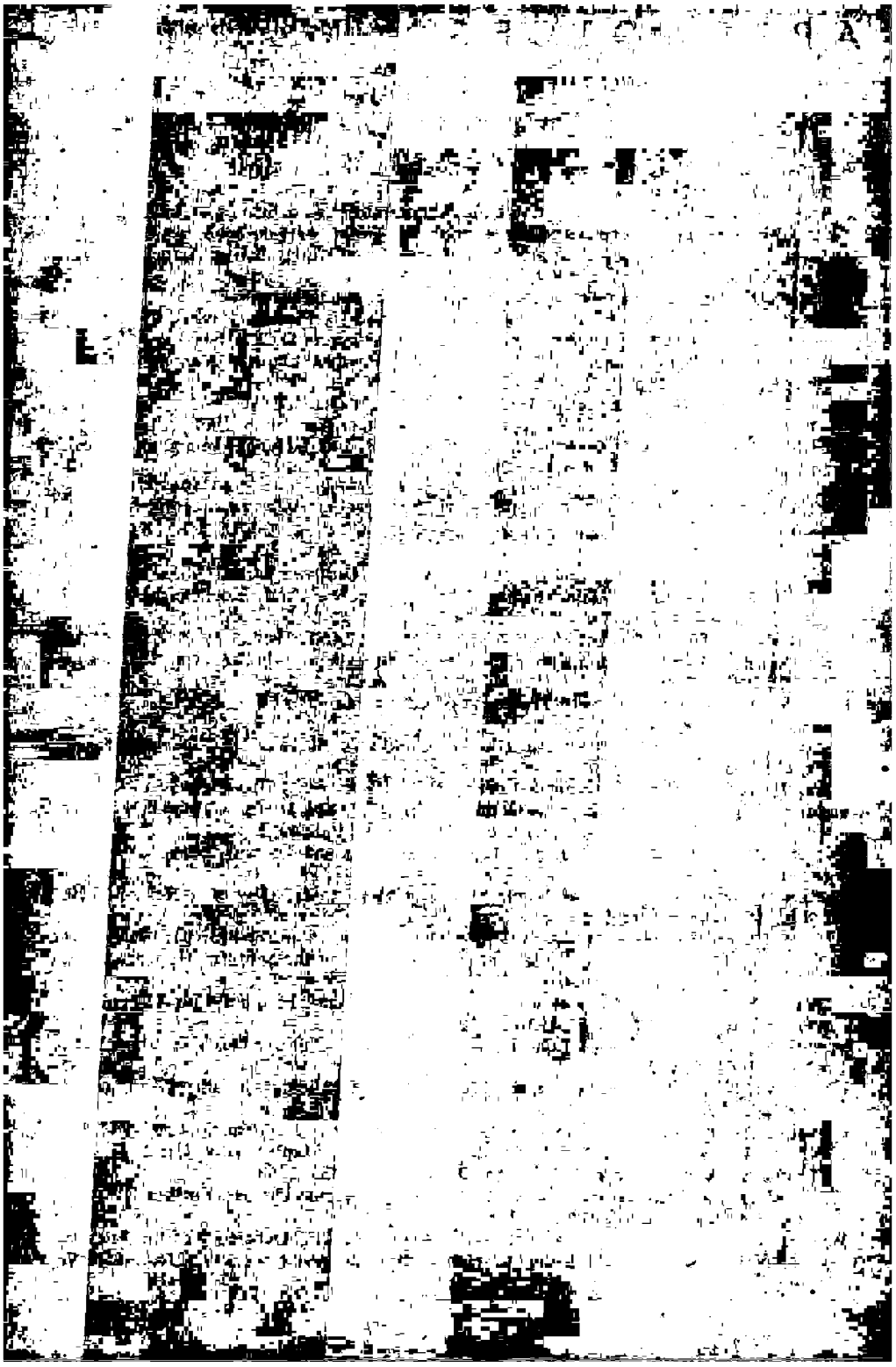
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RECIPES

FOREWORD

Purposes. The recipes presented in this text serve several aims: (1) they illustrate the applications of the principles of food preparation as discussed in Chapter 19; (2) they serve as a guide to the nurse in answering many questions posed by patients concerning foods; and (3) they suggest a variety of ways in which foods may be prepared for modified diets. The recipes use basic ingredients found in most home kitchens and require little time and experience to achieve a good product.

Using the recipes. Before beginning any food preparation it is essential to read the entire recipe carefully in order to become familiar with the procedure, and to ascertain that all ingredients are on hand. When foods are to be baked, the oven should be preheated, usually 5 to 10 minutes, so that the oven temperature has been reached before food is placed into it.

All measurements in recipes are level. Correct measurements require a standard 8-ounce measuring cup divided into fourths and thirds, and standard measuring spoons. Nests of measuring cups—¼, ⅓, ½ and 1 cup—are ideal for measuring dry ingredients and soft fats. Liquids are more easily measured in a heat-resistant glass cup which has a space above the full-cup line to prevent spilling. The cup should be kept at eye level to be sure that the meniscus of the liquid is on the desired line.

All-purpose flours now on the market should be stirred with a spoon but need not be sifted before measuring. Dry ingredients are spooned lightly into the measure and leveled off with the edge of a knife. Never dip the cup into the ingredient, or tap the cup to shake it level.

Soft fats are spooned into the measure and packed in to remove air spaces. The measure is then leveled off with a knife. Cold hard fats are measured by displacement of water. For example, if a recipe specifies ⅓ cup fat, measure ⅔ cup water and add fat until the water line comes to the full-cup measure.

BEVERAGES

Beverages may be reinforced for nutritive value in various ways or may be modified for therapeutic needs.

Calories. 1. Use light cream for part or all of the milk.

2. Add 1 to 2 small dips of ice cream to milk beverages.

3. Substitute 2 to 3 teaspoons glucose for each teaspoon cane sugar, thus increasing the caloric value of the beverage.

Protein. 1. One to 3 tablespoons nonfat dry milk may be added to each glass of milk beverage.

2. Whole egg, egg white, or egg yolk may be used in fruit juices or in milk ilk beverages.

Low Fat. For low-fat diets:

1. Use skim liquid or dry milk.
2. Use white of egg only.
3. Omit cream.

TEA

Tea is made by infusion; that is, it is never boiled. Bring freshly drawn cold water to the boiling point. Scald an earthenware or china pot. Allow 1 level teaspoon tea or 1 tea bag to each cup of boiling water. Put tea in pot, and pour boiling water over leaves. Cover closely, and allow to stand from 1 to 3 minutes according to the strength desired. Serve immediately with sugar, lemon, cream, or milk. Tea should never be reheated.

ICED TEA

Prepare hot tea using a double quantity of tea leaves. When steeped, pour over crushed ice. Garnish with a slice of lemon or a sprig of mint. Serve with lemon or cream, and sugar.

GENERAL INSTRUCTIONS FOR PREPARING COFFEE

1. Select grind of coffee suitable for type of coffee maker—coarse for boiling, medium for percolation, fine for drip, and very fine for vacuum methods.

2. Use freshly roasted and ground coffee. Keep coffee tightly covered and in a cool place.

3. Use pot of right size for amount of coffee to be made.

4. Measure 2 level tablespoons ground coffee for each measuring cup of water. Use freshly boiled water.

5. Serve beverage immediately after it has been brewed. Never reheat coffee.

6. Keep pot scrupulously clean. Rinse pot immediately after use. Wash with hot soapy water. Rinse with hot water.

BOILED COFFEE

2 tablespoons ground coffee
2 teaspoons egg white
¼ cup cold water
1 cup boiling water

Method. Mix coffee with egg white and half of cold water, place in pot, and pour freshly boiling water over coffee. Allow to simmer for 3 minutes. Remove

from direct heat and add remaining cold water to settle grounds. Allow to steep from 5 to 7 minutes. Strain and serve in heated coffee pot.

PERCOLATED COFFEE

Place measured coffee in upper part of pot, water in lower section, and put over flame, or attach plug if electric percolator is used. When percolation begins, lower flame so that the process will continue slowly rather than violently for 5 to 10 minutes. The strength of the beverage depends upon the length of time it is allowed to percolate.

DRIP COFFEE

Put coffee basket over lower portion of pot and measure coffee into it. Measure freshly boiled, bubbling water and pour over the coffee. Cover and allow to filter through. Remove coffee basket, cover lower pot, and serve immediately.

COCOA

2 teaspoons cocoa
1 to 2 teaspoons sugar
¼ cup water
¾ cup milk

Method. Mix cocoa with sugar and water. Cook to a thick syrup over direct flame. Add milk and heat to the scalding point. Beat briskly with a Dover beater to avoid formation of scum. Serve with or without whipped cream.

Reinforcements. Protein: One to 2 tablespoons of dried milk may be mixed with the sugar and cocoa.

HOT CHOCOLATE

¼ square bitter chocolate
1 tablespoon sugar
¼ cup boiling water
¾ cup milk

Method. Melt the chocolate in top of double boiler over hot water; stir in the sugar and water gradually, and boil 1 minute over direct flame. Add milk, heat over hot water to scalding point, and beat briskly with egg beater until beverage is smooth. This may be served with whipped cream, or a marshmallow may be placed in cup before pouring the chocolate.

COCOA SYRUP (CHOCOLATE SAUCE) (about 1½ cups)

1 cup sugar
1 cup cocoa
⅛ teaspoon salt
1½ cups boiling water
½ teaspoon vanilla

Method. Mix sugar, cocoa, and salt. Stir into boiling water and cook gently until of a creamy consistency. Cool, add vanilla, pour into jar, cover, and place in refrigerator.

Use 1 to 2 tablespoons of this syrup for each cup of milk beverage.

MILK PUNCH

½ cup milk
¼ cup cream
1 tablespoon whisky, sherry,
or
2 tablespoons strong coffee
1 egg white
2 to 3 teaspoons sugar
Few grains nutmeg or cinnamon

Method. Place the ingredients in shaker and shake a few minutes to mix them thoroughly. Pour over cracked ice; sprinkle cinnamon or nutmeg over top.

HIGH-PROTEIN MILK (basic recipe)

	For 1 quart	For 1 cup
Whole milk	3½ cups	¾ cup
Nonfat dry milk	1 cup	¼ cup

Method. Place milk in deep bowl. Sprinkle dried milk over it and beat with rotary beater until smooth. Allow to stand in a refrigerator for a few hours to permit foam to disappear. Serve ice cold.

Variations. 1. Add 1 tablespoon cocoa syrup to 1 glass of high-protein milk. Stir well.

2. Use skim milk for low-fat diets.

3. Add 2 tablespoons ice cream to each glass of high-protein milk.

CHOCOLATE MALTED MILK

3 tablespoons malted milk
¾ cup milk
2 teaspoons sugar
1 tablespoon cocoa syrup
¼ teaspoon vanilla

Method. Mix malted milk with a little cold milk to make a smooth paste. Add remaining milk, sugar, cocoa syrup, and vanilla. Beat briskly with a rotary beater until smooth. Pour over crushed ice.

Variations. To add protein: Beat whole egg with sugar and chocolate syrup; add to malted-milk mixture.

To increase calories: Add ¼ cup cream and 1 tablespoon vanilla or chocolate ice cream to finished drink.

To serve hot: Heat milk to scalding point before adding it to malted milk paste.

EGGNOG

1 egg
¾ cup milk
1 to 2 teaspoons sugar
Few grains salt
3 to 4 drops vanilla

Method. Beat egg well, and add milk, sugar, salt, and vanilla. Stir until sugar is dissolved. Strain to remove any shreds of unbeaten egg. Sprinkle with nutmeg, if desired.

Variations. One to 2 tablespoons cocoa syrup may be added to the eggnog for varied flavor. Malted-milk powder may also be used for variety.

High-protein eggnog: Beat 3 tablespoons nonfat dry milk into the prepared eggnog.

ORANGE OR GRAPEFRUIT JUICE

Method. Wash fruit and cut in half across sections. Extract juice with nonmetal hand squeezer or electric juicer. Remove any seeds. Do not strain except for low-fiber diets, since the pulp contains an important amount of ascorbic acid. Stir juice just before serving to keep the particles evenly suspended. Place glass in bowl of crushed ice, but do not add ice to the juice itself.

Frozen juices. Keep in freezer or freezing section of refrigerator until the can is opened. Add cold water according to the amounts stated on the can—usually 3 cans of water to each can of juice. Stir well until evenly suspended, and serve in 4-ounce glass.

Leftover juices. Keep in a closed container in the refrigerator. Little loss of ascorbic acid and of flavor occurs within 24 to 48 hours.

Key Rule for Fruitades

Kind of Juice	Amount *tablespoons*	Sugar *tablespoons*	Lemon Juice *tablespoons*	Crushed Ice	Water or Other Liquid
Orange	6	1	1	⅓ glass	Fill 8-ounce glass to ½ in. from rim
Pineapple	6	1	1	⅓ glass	Fill 8-ounce glass to ½ in. from rim
Grape	6	none	1	⅓ glass	Fill 8-ounce glass to ½ in. from rim
Grapefruit	6	1	none	⅓ glass	Fill 8-ounce glass to ½ in. from rim
Lemon	2–3	1	—	⅓ glass	Fill 8-ounce glass to ½ in. from rim

Method. Mix fruit juices and sugar. Pour over crushed ice. Add water to fill glass and stir well.

HIGH-CARBOHYDRATE LEMONADE

1 cup glucose
1 cup boiling water
¼ cup lemon juice
Crushed ice

Method. Dissolve glucose in boiling water. Cool, and add lemon juice. Add sufficient crushed ice to make 2 glasses (200 ml each).

Each glass of lemonade will contain approximately 100 gm of carbohydrate.

FRUIT PUNCH

½ cup orange juice
2 tablespoons lemon juice
¼ cup pineapple juice
1 tablespoon sugar
Carbonated water, or plain water, to fill glass

Method. Mix the fruit juices and sugar; pour over ⅓ glass crushed ice. Add carbonated water to fill glass.

Peach, pear, raspberry, strawberry, or grape juice may be substituted for the pineapple juice.

FRUIT JUICE WITH EGG WHITE

⅓ cup orange juice
1 tablespoon lemon juice
1 tablespoon sugar
1 egg white
⅓ glass crushed ice

Method. Add sugar to fruit juices. Clip egg white with scissors or silver knife and fork and add to fruit juice. Strain through fine strainer or double thickness of cheese cloth. Pour carefully over crushed ice and add water to fill glass. Stir with a fork instead of a spoon to avoid foam.

Any fruit juice such as grape, grapefruit, or pineapple may be used in place of the orange juice. Omit sugar when sweet juices are used.

EGG AND ORANGE JUICE

1 egg
1 tablespoon sugar
⅓ cup orange juice
2 tablespoons lemon juice
⅓ glass crushed ice

Method. Beat egg, sugar, and juices together and pour over crushed ice. The yolk and white may be separated, if desired; mix yolk, sugar, and juices, fold in stiffly beaten egg white, and pour over crushed ice.

PINEAPPLE EGGNOG

1 egg
1 tablespoon sugar
⅓ cup pineapple juice
1 tablespoon lemon juice
⅓ cup whipping cream

Method. Beat egg yolk and sugar together; add fruit juices. Fold in the stiffly beaten egg white and then the whipped cream. Pour over crushed ice.

QUICK BREADS, TOAST, AND SANDWICHES

Use enriched white flour unless other kinds of flour are specified. Assemble ingredients before starting the mixing process. Preheat oven for 10 minutes at the designated temperature. Grease pans before mixing is begun. Sift flour before measuring. Avoid overmixing, since muffins will be too compact and tunnels will appear throughout the muffin, while biscuits will not be light.

PLAIN MUFFINS (12 muffins)

2 cups flour
½ teaspoon salt
3 teaspoons baking powder
3 tablespoons sugar
1 cup milk
¼ cup oil
1 egg

Method. Sift flour, measure, and sift again with salt, baking powder, and sugar. Beat egg and mix with milk and oil. Pour into flour mixture, stirring quickly only until flour is moist (about 10 to 15 strokes). The batter need not be smooth and free of lumps. Fill paper muffin cups (or well-greased muffin tins) ⅔ full and bake from 15 to 20 minutes in a hot oven (425° F). When tins are very small, the temperature should be a little higher and the baking period shorter than required for average-size muffins.

Variations. (1) Add ½ cup raisins or nuts to dry ingredients and proceed as above. If dates are used, cut in strips and add to milk which has been heated; allow to cool before adding egg. Then proceed as in original recipe. (2) *Whole-wheat muffins.* Use 1 cup unsifted whole-wheat flour and ¾ cup white flour and proceed as in original recipe.

CORN-MEAL MUFFINS

1 cup corn meal (not too fine)
¼ cup flour
½ teaspoon baking soda
1 teaspoon salt
1 egg
1 cup buttermilk
1 tablespoon oil

Method. Mix dry ingredients. Beat egg and buttermilk together just enough to mix, and stir into dry ingredients. Add oil, and stir quickly just to remove lumps. Pour into well-greased muffin tins or cornstick pans. Bake in a hot oven (425° F) for 25 to 30 minutes.

SPOON BREAD* (serves 3 to 4)

¾ cup corn meal
1 teaspoon salt
3 tablespoons oil
1 cup boiling water
1 cup milk
2 eggs
2 teaspoons baking powder

Method. Mix corn meal, salt, and oil; add boiling water, beating until smooth. Add milk, well-beaten eggs, and baking powder. When well mixed, turn into a greased baking dish or pan and bake in moderate oven (350° F) for 40 to 50 minutes.

BAKING-POWDER BISCUITS (8 to 12 biscuits)

1 cup sifted flour
½ teaspoon salt
1½ teaspoons baking powder
2 tablespoons shortening
¼ to ⅓ cup milk

Method. Measure sifted flour into cup with a spoon, add salt and baking powder, and sift into mixing bowl. Mix in shortening with tips of fingers or cut in with two knives. Stir in milk to make a soft but not sticky dough. Knead gently on a lightly floured board for 20 to 30 seconds. Roll or pat to a thickness of ½ to ¾ inch; cut with a sharp knife into squares, strips, or triangles as desired. Place fairly close together on a lightly greased baking sheet and bake in a hot oven (425° F) 10 to 12 minutes, depending on thickness of biscuits.

Variations. (1) Use 2 tablespoons orange juice and ½ teaspoon grated orange rind in place of the milk. (2) Add 2 tablespoons grated cheese to dry ingredients just before the milk is added.

CINNAMON PINWHEELS (12–16 rolls)

1 recipe baking-powder biscuit dough (above)
2 tablespoons melted butter
¼ cup white or brown sugar
½ teaspoon cinnamon
Chopped nuts, if desired

Method. Prepare baking-powder biscuit dough as in preceding recipe. Mix sugar and cinnamon. Roll dough into a rectangle ¼ inch thick. Brush with melted butter, sprinkle evenly with sugar, cinnamon, and chopped nuts, if desired. Roll from long side of the rectangle, keeping roll firm but without crushing. Slice about ¾ inch thick, place cut side down about 1 inch apart in well-greased pan. Bake at 425° F for 10–15 minutes until light brown.

TOAST, DRY OR BUTTERED

Method. Use bread sliced ¼ to ½ inch thick. Cut into desired shapes before toasting. A toaster may be used, or the toast may be made in the broiling oven by placing the toast about 3 inches from the heat. Care must be taken to turn the bread before the surface becomes too dark. Well-made toast is golden brown on both sides, and should be slightly mellow in the center. Butter the toast as soon as it is made, if it is not to be served dry.

CINNAMON TOAST

1 slice bread
1 teaspoon butter or oil
2 teaspoons granulated sugar
¼ teaspoon cinnamon

* Courtesy of Sally F. Hill, Editor, Home Department, *The Progressive Farmer.*

Method. Cut bread in slices from ¼ to ⅓ inch thick. Remove crusts, and cut into desired shapes. Toast one side in the broiling oven, turn over, butter lightly, and spread with a mixture of the cinnamon and sugar. Return to broiler, and allow to heat until mixture blends lightly with the bread.

MILK TOAST

1 slice bread
1 teaspoon butter
½ cup hot milk
Few grains salt

Method. Toast the bread on both sides, and butter it; place in a deep plate, and pour the hot milk over it. Season with salt. For a variation, sprinkle toast with sugar and cinnamon, as for cinnamon toast, before adding hot milk.

GENERAL METHOD FOR SANDWICHES

Use bread 24-hours old. White, whole-wheat, rye, Boston brown, or nut bread may be used. Cut slices ½ inch thick for main-dish sandwiches and more thinly for tea sandwiches. Fresh bread will cut more easily if chilled (tightly wrapped) in a refrigerator for several hours.

Soften butter by allowing to stand at room temperature for 10 to 15 minutes, or work with a wooden spoon until soft. Depending upon the kind of sandwich to be made, mustard, chopped chives, horse-radish, onion, or parsley may be creamed with the butter, if desired.

Use any sandwich filling between slices of buttered bread. Crisp shredded lettuce or water cress, thinly sliced tomato, and mayonnaise may be used singly or in combination together with the selected fillings. Cut off crusts after spreading sandwich, and cut in strips.

Open-faced sandwiches may be prepared with any soft spread and eaten with a fork.

Tea sandwiches are made with thinly sliced bread and are cut in small assorted shapes They may be served open-face, using spreads such as cream cheese with a variety of flavor combinations, soft sharp cheese, fish, chopped chicken, or meat.

SUGGESTIONS FOR SANDWICH FILLINGS

Carrot, grated raw, mixed with mayonnaise and nuts; whole-wheat bread
Chicken or turkey, thinly sliced, or chopped with celery, mayonnaise, salt, pepper
Cream cheese, plain, or with
1. Marmalade or jelly
2. Olives, chopped, stuffed or ripe
3. Nut meats
4. Chopped preserved ginger, almonds
5. Chopped ham

Cheese, American or Swiss, with or without mustard, pickle
Cucumbers, sliced thinly, on brown bread
Eggs, hard cooked, and finely chopped and mixed with
1. Anchovy paste
2. Chopped celery, mayonnaise, salt, pepper

Fish: crab, lobster, salmon, shrimp, tuna
Jelly or marmalade

SUGGESTIONS FOR SANDWICH FILLINGS (CONT.)

Meat: cold sliced beef, pork, ham, luncheon meats
Peanut butter
1. With jelly or marmalade
2. With bacon
Tomato, bacon

CEREALS

Table R–1. General Rule for Breakfast Cereals

Type of Cereal	Amount of Cereal *tablespoons*	Liquid *cups*	Salt *teaspoons*	Time for Cooking *minutes*
Oatmeal	4	1	¼	Most cereals are now quick-cooking and require 3 to 15 minutes cooking time. Read instructions on package for cooking time.
Wheatena	4	1	¼	
Corn meal	2½	1	¼	
Farina	3	1	¼	

Method. Heat water to boiling point, add salt, and sprinkle in dry cereal, stirring until all the cereal has been added. Cook quick-cooking cereals over direct heat for the length of time specified on the package, stirring from time to time. Regular cereals may be cooked over direct heat if the heat is kept low, or they may be placed in a double boiler to continue cooking for the required length of time.

Variations. Nonfat dry milk may be used with the cereal to enhance flavor and nutritive value. Mix milk powder with cereal and add to the boiling water, allowing 2 to 4 tablespoons of dry milk for each cup of liquid. Dates or raisins may be added to cereal before serving.

GRUEL

½ cup well-cooked fine or strained cereal — ⅓ to ½ cup milk

Method. Mix hot strained cereal with hot milk and serve immediately. Sugar may be added if desired.

BOILED RICE

1 quart boiling water — ½ teaspoon salt
3 tablespoons rice

Method. Wash rice. Add salt to boiling water, and allow to boil briskly before adding the rice. Boil rice for about 20 to 30 minutes or until tender. Empty rice into a strainer. Pour hot water over rice until each grain is separate and distinct. Place strainer over a saucepan of hot water, taking care that the bottom does not touch the water. Cover loosely, allowing space for steam to pass through. Serve rice hot with butter, or as a breakfast cereal with milk, sugar, and cinnamon, as desired.

Variations. Rice may be combined with canned tomato sauce. or cheese sauce, page 749, covered with crumbs, and baked in a moderate oven for 15 to 20 minutes.

STEAMED RICE

3 tablespoons rice — ¼ teaspoon salt
1 cup boiling water

Method. Wash rice thoroughly. Boil water in top part of double boiler over direct flame. Add salt and rice, and boil for 2 to 3 minutes. Place in double boiler over hot water, cover, and cook until the rice has absorbed all the water. If not entirely tender when the water has been absorbed, add a little more boiling water and continue the cooking. Avoid adding too much water at a time or the rice grains will not stay separate. When rice is tender, lift top saucepan out of hot water and place for a few minutes over low flame to dry out.

MACARONI, SPAGHETTI, OR NOODLES

¼ cup broken macaroni
or
1 ounce spaghetti or noodles
1 quart or more boiling water
1 teaspoon salt

Method. Cook in boiling salted water for 9 to 12 minutes or until tender but not too soft. Drain and dress with sauce and seasonings.

To cook spaghetti without breaking into pieces, hold spaghetti in hand and dip ends into boiling water. As the spaghetti softens, continue to coil it under the boiling water.

Sauces. Cooked pastas may be dressed with canned tomato sauce, or cheese sauce, page 749. They may be turned into a casserole, covered with crumbs and grated cheese, and baked in a moderate oven for 15 to 20 minutes. (See recipe for Macaroni and Cheese, p. 731.)

CHEESE

Select a sharp variety of cheese for full, rich flavor in cooked dishes. Always cook cheese dishes at a low temperature. Melt cheese over hot water in a double boiler; or broil 4 to 5 inches from direct heat until it begins to melt. To facilitate melting and preparation of uniform mixtures, the cheese may be grated or shredded, or ground through a food chopper. One cup of grated cheese equals approximately ¼ pound.

CHEESE SOUFFLÉ

1 tablespoon butter
1 tablespoon flour
⅛ teaspoon salt
⅓ cup milk
⅓ cup grated cheese
1 egg

Method. Melt butter in top of double boiler over water. Add flour and salt, and mix to a smooth paste. Add milk, stirring constantly until thick. Mix cheese with white sauce, and cook until melted. Remove from hot water, and stir in unbeaten yolk of egg. Beat egg white until stiff but not dry, and fold into mixture. Pour into buttered baking dish, and set in a pan of hot water. Bake for about 45 minutes in a moderate oven (350° F.). Test by inserting tip of knife into center; if none adheres to knife, cooking is complete. Soufflé must be served immediately.

CHEESE FONDUE

⅓ cup milk
⅓ cup soft bread crumbs
⅓ cup American cheese cut into cubes
1 teaspoon butter
⅛ teaspoon salt
Pepper
1 egg

Method. Scald milk in top of double boiler; add bread crumbs, cheese, butter, and seasoning. Remove from stove, and add unbeaten egg yolk. Whip egg white stiff, and fold into mixture. Pour into a buttered baking dish, set in a pan of hot water, and bake in a moderate oven (350° F) for 30 to 40 minutes or until firm in center. Serve hot.

CREAMY CHEESE ON TOAST

½ cup milk
1 tablespoon flour
⅓ cup grated cheese
⅛ teaspoon salt
Pepper
1 slice bread

Method. Scald milk in double boiler; mix flour with a little cold water and stir into the hot milk. Add grated cheese, salt, and pepper, and cook until mixture is of the consistency of medium-thick white sauce. Toast bread, butter, and cut into cubes. Pour cheese sauce over toast cubes.

MACARONI AND CHEESE

¼ cup uncooked macaroni
½ cup medium white sauce (p. 748)
¼ cup grated cheese
1 tablespoon bread crumbs

Method. Cook macaroni for about 10 minutes in boiling salted water. Drain. Prepare white sauce and add grated cheese, stirring until cheese is melted. Combine macaroni with cheese sauce. Put into buttered baking dish, sprinkle with bread crumbs, and bake in a slow oven (325° F) until brown—about 15 minutes.

RAREBIT

⅛ teaspoon mustard
¾ cup grated cheese
¼ cup medium white sauce (p. 748)

Method. Add mustard and grated cheese to white sauce. Cook over hot water until cheese is melted. Serve immediately on toast or crackers.

For other cheese recipes see Cheese Omelet, page 737; Cheese Sauce, p. 749; Roquefort Dressing, page 748; Cottage Cheese Salad, page 747.

DESSERTS AND DESSERT SAUCES

EGG AND MILK DESSERTS

SOFT CUSTARD (about 1¼ cups)

1 cup milk
1 egg or 2 egg yolks
1½ tablespoons sugar
Few grains salt
¼ teaspoon vanilla

Method. Scald milk in top of double boiler. Beat egg, sugar, and salt together. Pour milk gradually over the egg mixture. Return to double boiler and cook over hot (not boiling) water, stirring constantly, until custard forms a coating on the spoon. Water in the lower part of the double boiler should not touch the upper pan because the custard will curdle if the egg is cooked at too high a temperature. Cool custard quickly by setting in a pan of cool water, stirring once in a while. Add vanilla and chill. Serve as dessert with whipped cream garnish, or as a sauce for fruit whips, stewed fruit, berries, or cake.

For diabetic diets. Substitute 1 saccharin or Sucaryl tablet for sugar in the above recipe. Protein 14 gm; fat 15 gm; carbohydrate 12 gm.

FLOATING ISLAND

1 egg white
Few grains salt
2 tablespoons powdered sugar
3 to 4 drops vanilla
Soft custard (see above)

Method. Whip egg white until stiff but not dry. Fold in salt, sugar, and vanilla. Pour chilled custard into serving dishes, and garnish with meringue. The meringue may be browned slightly in an oven, if desired.

BAKED CUSTARD

¾ cup milk
1 egg
1½ tablespoons sugar
Few grains salt
¼ teaspoon vanilla
Few grains nutmeg

Method. Scald milk. Beat egg, sugar, and salt together slightly. Stir in milk and vanilla, strain, and pour into custard cups. Sprinkle top lightly with nutmeg. Place cups in a deep baking pan, and surround with hot water to about half the depth of the cup. Bake in a moderate oven (350° F) until a knife blade inserted just off the center of the custard comes out clean—about 25 to 30 minutes. Care must be taken not to allow the water to boil because the egg proteins will separate, making a watery, unpalatable, and unattractive mixture. Serve either hot or cold, with or without whipped cream. If chilled before serving, custard may be turned out of cup into a fruit saucer or sherbet glass.

PINEAPPLE OMELET

1 egg
2 tablespoons lemon juice
¼ cup crushed pineapple
2 tablespoons sugar

Method. Beat egg yolk; add 1 tablespoon of the lemon juice, 1 tablespoon of the pineapple, and 1 tablespoon of the sugar. Beat white of egg until stiff but not dry, and fold into the yolk mixture. Butter a smooth frying pan and heat. Pour omelet into hot pan, and cook on top of stove until bottom of omelet is brown. Place in oven, and bake until mixture will not adhere to the finger tips. During the baking process, heat all remaining ingredients in small saucepan, and, when ready to serve, pour over omelet.

JUNKET

1 tablespoon cold water
½ rennin tablet
⅔ cup milk
1 teaspoon sugar
Few drops vanilla

Method. Crush rennin tablet and dissolve in water. Heat milk to 100° F. If milk thermometer is not available, test heated milk by allowing a drop of it to fall on inner side of wrist; if it is of the proper temperature, it will feel neither hot nor cold. Add sugar and vanilla. Stir dissolved rennin into milk, stirring for a few seconds only. Pour into molds promptly, and leave undisturbed until firm. Then place in refrigerator until needed.

Sweetened Junket powders in a variety of flavors are now available commercially. Package directions should be followed exactly.

For diabetic diets. Substitute 1 saccharin tablet (¼ grain) for the sugar. Protein 5; fat 6; carbohydrate 8.

STARCHY DESSERTS

BLANCMANGE (2–3 servings)

1 cup milk
1½ tablespoons cornstarch
1 egg
2 tablespoons sugar
⅛ teaspoon salt
½ teaspoon vanilla

Method. Scald ¾ cup milk in top of double boiler. Blend cornstarch and rest of milk until smooth, and add to the hot milk. Cook over hot water for 10 to 15 minutes, stirring constantly until thickening begins. Beat egg yolk slightly with sugar and salt. Add cooked mixture to egg gradually, return to double boiler, and cook for 1 minute. Add vanilla, and fold in stiffly beaten egg white. Pour into molds and chill. Unmold and serve with whipped cream, fruit sauce, fresh fruit, or chocolate or butterscotch sauce.

Variations. (1) For chocolate blancmange, add ½ square chocolate to milk before scalding; (2) ½ cup puréed banana and 1 teaspoon lemon juice may be added to pudding just before mixing with the egg yolk; (3) add 2 tablespoons coconut to plain or chocolate blancmange.

TAPIOCA CREAM (serves 2)

1 egg
3 tablespoons sugar
Few grains salt
1 tablespoon tapioca
1 cup milk
¼ teaspoon vanilla

Method. Beat egg white until foamy. Add 1½ tablespoons sugar gradually while beating with a rotary beater until mixture will stand in soft peaks. Set aside.

Mix egg yolk with remaining sugar and salt in top of double boiler. Add tapioca and milk. Cook over hot water, stirring frequently, until tapioca is transparent and mixture is slightly thick.

Pour hot mixture over the egg white, stirring constantly until blended. Add vanilla. Chill, and serve plain, with fruit, or with whipped cream.

Variation. For chocolate tapioca cream, add ½ square grated chocolate to milk mixture when cooking is started.

BAKED RICE PUDDING (serves 2)

1½ tablespoons rice
2 cups milk
2 tablespoons sugar
¼ teaspoon salt
¼ teaspoon nutmeg or cinnamon

Method. Wash rice thoroughly in cold water; add milk and other ingredients. Place in a buttered pan and bake in a slow oven for 2 hours, stirring from time to time as a scum forms on top of the milk.

VARIATIONS. (1) Raisins may be added to this pudding during the last half hour of baking. (2) This pudding may be cooked in a double boiler for 2 to 3 hours if it is not practical to bake it in the oven.

BREAD PUDDING (serves 2)

1 slice toast
1 cup milk
1 egg
1 tablespoon sugar
¼ teaspoon vanilla
Few grains nutmeg
Few grains salt

Method. Remove crusts from toast. Butter, and cut in cubes. Place in baking dish. Scald milk, and add to slightly beaten egg mixed with salt, sugar, and vanilla.

Pour over diced toast. Sprinkle with nutmeg. Set dish in pan of hot water, and bake in moderate oven (350° F) for about 30 minutes or until knife comes out clean when inserted into center of custard.

Serve hot with fruit sauce or cold with whipped cream.

APPLE BETTY

1 slice toasted bread
½ cup thinly sliced apple
3 tablespoons brown sugar
¼ teaspoon cinnamon
1½ teaspoons butter or oil

Method. Cover bottom of a small greased baking dish with small pieces of toasted bread, arrange half of apple slices over bread, sprinkle with half of sugar, and add a little cinnamon. Dot layer with butter and top with another layer of toast, apple, sugar, cinnamon and butter. Bake for about 20 minutes in a moderate oven. Serve hot with hard sauce or cream.

Variations. (1) Cover apple Betty before baking with ½ cup of soft custard (p. 731). Set in pan of hot water and bake at 350° F. (2) Any fruit may be used instead of apples.

GELATIN DESSERTS

Preparation of gelatin. Use granulated or flaked gelatin which is unflavored and unsweetened. Allow 1 level tablespoon of gelatin to 1 pint of liquid. Soak gelatin for 5 minutes in a small quantity of the cold liquid in order to swell the granules. Heat the remaining liquid and dissolve the gelatin in it.

To mold jelly. Large or individual molds may be used. Pour mixture into molds and set in cold place to congeal—about 2 hours for small molds and 4 hours for large molds. When jelly is congealed, set mold in a pan of lukewarm water for ½–1 minute. Loosen the jelly by inserting the point of a knife around the edge. Invert mold over center of dish. When foods such as fruit are added, the jelly must first be allowed to thicken in order that foods will not settle to the bottom of the mold. Fresh pineapple cannot be added to jelly because an enzyme in the fruit splits the gelatin so that congealing will not take place; stewed or canned pineapple may be used.

For diabetic diets. Jelly recipes may be used for diabetic diets if 1 saccharin tablet is substituted for the sugar in the recipe. The fruit or fruit juice used is subtracted from the allowance of a given meal.

LEMON JELLY (serves 2)

1½ teaspoons granulated gelatin
2 tablespoons cold water
¼ cup boiling water
¼ cup sugar
¼ cup lemon juice
½ cup cold water

Method. Soak gelatin for 5 minutes in cold water, add boiling water, and stir until dissolved. Add sugar, lemon juice, and cold water. Strain into molds, and place in refrigerator to congeal. Serve with plain or whipped cream, or custard sauce.

ORANGE JELLY (serves 2)

1½ teaspoons granulated gelatin
2 tablespoons cold water
¼ cup boiling water
3 tablespoons sugar
2 drops orange extract *or*
½ teaspoon grated orange rind
½ cup orange juice
2 tablespoons lemon juice

Method. Proceed as directed for lemon jelly.

SNOW PUDDING (serves 2)

Lemon jelly
1 egg white

Method. Prepare lemon jelly (above) and place the bowl in a pan of cracked ice. When the mixture begins to stiffen, fold in well-beaten white of egg, beating it in with a rotary beater until the mixture is stiff. Pour the mixture into a mold or individual glasses, and set in refrigerator to congeal. Unmold, and serve with soft custard.

Orange or grape-juice jelly may be used in place of the lemon jelly.

ORANGE CHARLOTTE (serves 2)

½ cup orange jelly
¼ cup cream, whipped

Method. Prepare orange jelly (p. 734), and pour it into a bowl surrounded with cracked ice. When it begins to stiffen, whip well, and fold in the stiffly beaten cream. Pour into molds or ice-cream glasses, and set in refrigerator to congeal.

Variations. (1) One stiffly beaten egg white may be substituted for the whipped cream. (2) The molds may be lined with sections of orange before putting the charlotte into them.

SPANISH CREAM (serves 2 to 3)

½ tablespoon granulated gelatin
2 tablespoons cold milk
⅔ cup scalded milk
1 egg
2 tablespoons sugar
Few grains salt
¼ teaspoon vanilla

Method. Soak gelatin for 5 minutes in cold milk and dissolve in scalded milk. Beat egg yolk slightly, and add sugar and salt. Stir milk mixture into egg, and cook in double boiler until slightly thickened. Remove top of double boiler from stove and place in cold water until the mixture is of the consistency of unbeaten egg white. Add vanilla. Beat egg white until stiff, with rotary beater, and fold into custard. Pour into individual molds and chill. Serve with whipped cream, if desired.

FRUIT WHIPS

GENERAL RULE FOR FRUIT WHIPS

¼ cup fruit pulp
2 tablespoons powdered sugar
2 tablespoons lemon juice
1 egg white
Few grains salt

Method. Cook apple, apricots, or prunes in a small amount of water until tender. Press through sieve, and measure ¼ cup for each serving. Add sugar and lemon juice. Whip egg white until stiff but not dry, and fold into the fruit pulp. Serve with a soft custard sauce or with cream.

Fresh fruit such as strawberries or peaches can be mashed and sieved. Lemon juice is not necessary for fresh-fruit whips.

For diabetic diet. Substitute 1 saccharin tablet for the powdered sugar. Use fruit pulp from the diet allowance. One egg white will add 3 gm protein to the value of the fruit used.

SWEET SAUCES

BUTTERSCOTCH SAUCE (about 1¼ cups)

¾ cup brown sugar
½ cup light corn syrup
¼ cup water
3 tablespoons butter
⅛ teaspoon salt
½ cup coffee cream
½ teaspoon vanilla

Method. Mix sugar, corn syrup, water, butter, and salt in saucepan. Cook over low heat until a very thick syrup. Remove from the stove, cool, add cream and vanilla. Stir well, and serve cold as a sauce for ice cream or over cup cakes. Sauce may be served hot by reheating in a double boiler.

LEMON SAUCE (1 cup)

½ cup sugar
1 tablespoon cornstarch
1 cup boiling water
1½ to 2 tablespoons lemon juice
Grated rind of lemon
1 tablespoon butter

Method. Mix sugar and cornstarch, stir in the boiling water gradually, and cook 8 to 10 minutes, stirring continuously. Then add the lemon juice, grated rind, and butter. Serve sauce hot on puddings or cupcakes.

WINE OR FRUIT SAUCE (about ½ cup)

1 egg
½ cup powdered sugar
1 wineglass sherry wine or whisky *or*
½ cup orange juice and 1 tablespoon lemon juice
1 teaspoon hot milk

Method. Beat yolk and white of egg separately. Add sugar to yolk and beat until creamy. Add wine or fruit juice, fold in egg white, and add the hot milk last. Serve at once.

CHOCOLATE SAUCE

Use recipe for Cocoa Syrup, page 723.

EGGS

Only the freshest eggs should be used for the invalid dietary, since a single egg of poor quality may result in the patient's continued refusal to eat them. They should be cooked at a low temperature, since their proteins are easily toughened, and should be served immediately after being prepared.

POACHED EGG

1 egg
1 pint water
1 teaspoon salt

Method. Fill a small saucepan with water to a depth of 2½ inches, and add salt. Allow water to come to the boiling point. Break egg carefully into a saucer, and slip gently into the hot water; cover, and allow to stand for 5 to 7 minutes until white becomes opaque and of jelly-like consistency, and a thin white film forms over the yolk. Never allow water to boil after inserting the egg. Remove egg with a perforated spoon and serve on buttered toast.

Variation. Egg may be served on hot toast with cheese sauce, page 749.

CODDLED EGG

1 egg — Boiling water to cover egg

Method. Put water into small saucepan, and heat to boiling point. Place egg in water, and remove pan from flame. Allow to stand covered for 5 to 7 minutes. If very soft egg is desired, allow to remain in water for 3 to 5 minutes. Serve immediately.

HARD-COOKED EGG

1 egg — Water to cover egg

Method. Wash egg, drop in saucepan of cold water, and bring slowly to boil. Lower the flame so that water is kept at simmering temperature, and allow to cook for 20 minutes. Plunge into cold water to avoid discoloration of the yolk. Remove shell when entirely cold. The method used for coddled eggs (above) may be used by allowing the egg to remain in the water for about 40 minutes.

SCRAMBLED EGGS

2 eggs
2 tablespoons milk, cream, or tomato juice
¼ teaspoon salt
1 teaspoon butter

Method. Beat eggs slightly, add liquid and salt. Heat butter slowly in frying pan, and pour eggs into hot pan. Cook over low flame, and stir with spatula until creamy—about 3 minutes. Serve at once.

A double boiler may be used instead of the frying pan to ensure cooking at a low temperature.

CREAMY EGG ON TOAST

¼ cup milk
1 teaspoon butter
1 egg
⅛ teaspoon salt
1 slice buttered toast

Method. Heat milk with butter in double boiler to scalding temperature, stir in the beaten egg, and cook until mixture is of a creamy consistency. Season and serve on buttered toast.

PUFFY OMELET

1 egg
⅛ teaspoon salt
Few grains pepper
1 tablespoon water, milk, or tomato juice
1 teaspoon butter

Method. Separate yolk from white; beat yolk with liquid, salt, and pepper. Whip white until stiff but not dry, and fold into yolk mixture. Pour into a hot, lightly buttered pan, and cook slowly on top of stove, lifting edge of omelet to determine when it has become brown. As soon as brown, place pan in moderate oven and cook until the mixture will not adhere to the finger—about 5 minutes. Place on warm plate, making a crease down the middle of omelet, fold, and garnish with parsley. Jelly or chopped asparagus may also be used for a garnish.

Variations. (1) Add slice of crisply cooked and finely chopped bacon to top of omelet while baking. (2) One tablespoon of grated cheese may be added to egg yolk before folding in the egg white, or may be sprinkled over omelet during the cooking process. (3) When tomato juice is used, a tomato sauce may be poured over omelet at serving time.

FRENCH OMELET

2 eggs
¼ teaspoon salt
Few grains pepper
2 tablespoons water or milk
2 teaspoons butter

Method. Beat eggs slightly; add salt, pepper, and liquid. Melt fat in small frying pan and grease the bottom and sides well. Pour in the egg mixture and cook slowly, pricking the mixture with a fork during the cooking to allow the uncooked portions on top to reach the pan. Avoid scrambling. When the entire mixture reaches a creamy consistency and is light brown on the bottom, fold and turn onto hot plate. A very smooth pan is necessary for making omelets.

BAKED EGGS (SHIRRED EGGS)

1 egg
1 tablespoon cream
Salt
Pepper
Grated cheese, if desired
2 teaspoons bread crumbs

Method. Butter individual baking dish. Break egg into it. Add cream and season with salt and pepper. Sprinkle with grated cheese and bread crumbs. Set in pan of hot water and bake in a moderate oven (350° F) until the white is set—about 20 minutes. Sprinkle with paprika before serving.

EGG À LA GOLDENROD

1 tablespoon butter
1 tablespoon flour
¼ teaspoon salt
½ cup milk
1 hard-cooked egg
1 slice toast

Method. Make white sauce with butter, flour, salt, and milk. Separate white of the hard-cooked egg from yolk, chop white, and add to white sauce. Pour over the toast. Press the yolk through a strainer, covering the top of the toast. Garnish with parsley.

Variation. White and yolk may be chopped and added to the white sauce, and served as creamed eggs.

For other important egg dishes, see Beverages, pages 724–26; Custards, page 731; and Stuffed-Egg Salad, page 747.

FRUITS

All fruits should be washed before they are served. It is preferable to chill fruit (except bananas and pineapple) before cutting in order to minimize the chilling time after preparation and thus avoid discoloration and loss of nutrients. Canned fruit may be chilled in the can before opening. Frozen fruits should be allowed to thaw at room temperature before serving. This requires 3 to 4 hours if the fruit remains in the carton in which it was packed. Thawed fruits must never be refrozen.

BERRIES

Method. Remove undesirable berries and leaves. Place in sieve and wash berries under gently running water. Drain thoroughly. Strawberries and other berries may

be served with caps removed and sugar added just before serving. Specimen strawberries are sometimes offered with caps on, arranged on green leaves around a mound of powdered sugar, as a first course at luncheon. These large berries are eaten from the stem, which is held with the fingers.

FRUIT CUP

Method. A variety of fresh or canned fruit or a combination of both may be used for fruit cup. Sprinkle lemon juice on any raw fruits that discolor readily, such as banana, apple, peach, and pear. Chill fruit, cut in attractive pieces, and mix. A tablespoon of fruit juice, sweet cider, or wine may be added. Powdered sugar may be used for very tart fruits if desired. Garnish with a sprig of mint or fruit ice, if available.

The following are suggested combinations for fruit cup:

1. Orange sections—4; grapefruit sections—2; fresh pineapple—⅓ cup
2. Equal parts of fresh or canned pineapple, sweet cherries, sliced banana
3. Equal parts of peaches, pears, pineapple
4. Equal parts of oranges, diced apples, canned peaches, Tokay grapes
5. Equal parts of orange sections and sliced banana with grated coconut

GRAPEFRUIT OR ORANGE HALVES

Method. Select medium-size, thin-skinned grapefruit or large navel orange. Wash fruit and cut along line midway between stem and bud ends. Run sharp, pointed knife around each section, separating the pulp from the skin and inner membrane. Remove center and seeds and serve without sugar unless additional sweetening is desired. Grapefruit, like oranges, may also be served in sections.

BROILED GRAPEFRUIT

½ grapefruit
1 tablespoon sugar
1 tablespoon sherry (optional)
1 cherry

Method. Prepare grapefruit as described above. Sprinkle with sugar and place under broiler with moderate flame. When grapefruit is hot and beginning to brown at the edges, place on serving plate. Pour sherry over the fruit, garnish with a cherry, and serve immediately.

ORANGE OR GRAPEFRUIT SECTIONS

Method. Wash fruit and pare as you would an apple, using a sawing motion with the knife. Remove the white inner skin with the peel. Using a sharp, pointed knife, separate the sections from the dividing membrane without breaking sections.

APPLESAUCE

2 tart apples
1 to 2 tablespoons sugar

Method. Wash and pare apples. Cut into quarters and remove core. Add just enough water to keep the apple from scorching, cover, and cook slowly until apple mashes readily with a spoon—about 10 to 15 minutes. Add the sugar and beat well. The apple need not be peeled if the sauce is to be strained.

For serving at breakfast, no spices are added. Nutmeg, cinnamon, or lemon juice may be used for applesauce which is to be served as a dessert.

BAKED APPLE

1 apple
2 tablespoons sugar
1 teaspoon butter
¼ cup water
Dash of nutmeg

Method. Wash and core the apple, leaving the blossom end intact. Place in small pan or baking dish, and fill cavity in apple with the sugar and butter. Add water, and bake in moderately hot oven (375° F) for about ½ hour or until fruit can be readily pierced with a toothpick. This may be a breakfast dish or a simple dessert. It may be served warm or cold, with or without cream.

STEWED PEAR

2 pears
½ cup water
¼ cup sugar
1 slice lemon
1 small piece stick cinnamon or a few cloves

Method. Wash fruit and pare. Cut in half and remove core. Bring sugar and water to a boil, add the slice of lemon, cinnamon, and pear halves. Cover and cook gently until tender. If spices are omitted, the pears may be served when cold with 1 tablespoon crème de menthe.

STEWED DRIED FRUIT

4 to 6 prunes
or
4 to 6 apricot halves
or
3 peach halves
Sugar to taste

Method. Cover fruit with cold water, bring to a boil, and simmer gently for 25 to 30 minutes. Add sugar to taste, stir until dissolved, and cool the fruit. Prunes usually do not require additional sugar, but a slice of lemon may be cooked with them. Let fruit stand overnight in refrigerator before serving, if possible.

Stewed fruit may be served alone or with whipped cream. It provides a welcome variation when served on breakfast cereal.

MEAT, POULTRY, AND FISH

Only recipes for quickly cooked meats which require little preparation time are presented here, since the nurse will rarely be expected to prepare other cuts. For the preparation of meats requiring longer cooking such as roasts and stews, any standard cookbook may be consulted.

OVEN-BROILED STEAK, CHOPS, OR HAMBURGER PATTIES

Method. Heat broiling oven for 5 to 10 minutes, and grease the broiler rack. Wipe meat (except hamburger) with a damp cloth, and place on rack about 3 inches below the flame. Cook until brown on one side, season with salt and pepper, and turn. Continue to cook until done. The table on page 741 gives approximate broiling time for various cuts of meat. Lift meat to a hot plate, place 1 teaspoon butter on it, dust the surface with salt and pepper, and serve hot. Parsley may be used as a garnish.

For hamburger patties, shape ground meat in large or small cakes with as little handling as possible. Ground meat dries quickly, and overcooking should be avoided.

OVEN-BROILED HAM SLICE

Method. Preheat broiling oven for 5 to 10 minutes. Wipe meat and place on rack about 3 inches below the flame. Broil on one side, turn, and partially cook

the other side. Spread with brown sugar, if desired, and continue broiling until the sugar melts. Do not add salt.

PAN-BROILED STEAK, CHOPS, HAM SLICE, OR HAMBURGER

Method. Pan broiling is done on the top of the stove in a heavy frying pan. Without greasing the pan, place the meat in the pan, with or without preheating. Cook slowly until done, turning occasionally. Pour off the fat as it accumulates. Season with butter, salt (except ham), and pepper. Garnish with parsley and serve immediately.

If pork chops are being cooked, the pan should be covered after the chops have browned and cooking continued over very low heat until the chops are well done—25 to 30 minutes for 1-inch chops.

Table R–2. Time Table for Cooking Steaks and Chops

Kind of Meat	Cooking Time *minutes*
Steak, 1½ inches thick	8–15
Lamb chops, 1 inch	10–15
Lamb chops, 1½ inches	15–20
Ham, ¼ inch	8–12
Ham, ½ inch	15–20
Hamburger	6–12

VEAL CUTLET

1 egg yolk
1 tablespoon water
¼ pound veal cutlet
3 tablespoons bread crumbs
1 tablespoon fat

Method. Mix egg yolk with water; dip cutlet first in egg and then in bread crumbs. Sauté in slightly greased frying pan. Add ½ cup hot water, broth, or tomatoes, cover, and simmer about 30 minutes or until tender. Serve plain or with thickened sauce.

VEGETABLES AND MEAT EN CASSEROLE

½ cup diced cooked meat
½ cup mixed vegetables
Gravy

Method. Carrots, potatoes, onions, celery, and turnips are suitable for the vegetable mixture. Place meat and vegetables in a deep baking dish; season with salt and pepper. Cover with gravy and bake in a moderately slow oven (325° F) for ½ hour or more.

BROILED LIVER

1 slice veal or lamb liver, ½ inch thick
1 teaspoon butter
Salt and pepper

Method. Remove membrane and veins from liver, and wipe with a damp cloth. Preheat broiler for 5 to 10 minutes and grease the broiler rack. Dot liver with butter or cover with a strip of bacon. Broil under direct flame for about 5 to 8 minutes or until tender. Liver will be toughened if it is overcooked.

SAUTEED LIVER

1 slice liver ½ inch thick
Flour
Salt and pepper

Method. Remove outer membrane and veins from liver and wipe with a damp cloth. Dredge with flour and cook in a well-greased pan for 6 to 7 minutes, turning frequently. Liver may be served with strips of bacon or with sautéed onions.

Calves' liver is very tender, but beef, lamb, or pig liver is equally nutritious and much less expensive.

BACON

Method. Arrange bacon in a cold frying pan and cook over moderate flame until edges begin to curl. If the bacon has just been removed from the refrigerator, the strips may be separated as the bacon cooks. Turn each slice separately, and remove before fat of bacon looks dry. Pour off the fat as it accumulates. Place in pan lined with absorbent paper to drain. Properly cooked bacon is crisp and readily broken with a fork; if underdone, it will be tough and have to be cut with a knife.

MEAT BALLS (serves 3)

½ cup bread or cracker crumbs
¼ teaspoon salt
Pepper to season
⅛ teaspoon nutmeg
1 egg
½ pound ground lean beef
4 slices bacon
1½ cups tomato juice

Method. Mix ¼ cup of bread crumbs, salt, pepper, nutmeg, and slightly beaten egg with meat. Form in balls the size of a walnut, and roll in remaining crumbs. Line pan with bacon, place balls on top, and pour tomato sauce over all. Bake in moderate oven (350° F) from 20 to 30 minutes. Serve on hot platter garnished with parsley.

POULTRY

Ready-to-cook (eviscerated) poultry. Remove any pin feathers. Singe, if necessary. Remove bits of lung and kidney remaining in the cavity. Cut out oil sac if it has not been removed. Clean giblets and wash chicken and giblets.

Dressed (not drawn) poultry. To draw poultry, cut head off at shoulders; loosen craw at base of neck and remove. Cut off oil sac and vent above tail, and slit under the tail to remove the viscera, including the lungs. Hold under running water and wash well. Clean and wash the giblets.

STEWED CHICKEN

1 stewing chicken, cut in pieces
1 sliced onion
1 carrot, sliced
2 stalks celery, diced
1 bay leaf
Salt and pepper

Method. Add onion, carrot, celery, and bay leaf to about 1 quart water and bring to a boil. Drop pieces of washed chicken in water, and simmer for about 1 hour. Add seasonings and cook for about 1 hour or until tender. If chicken is to be used for salad or is to be creamed, allow it to cool in the broth before removing.

Fricassee chicken. Melt 4 tablespoons butter or chicken fat. Add 4 tablespoons flour and stir until well blended. Add 2 cups hot chicken stock gradually, bring to a boil, and season as needed with salt and pepper; 1 cup of milk, or milk and cream, may be substituted for 1 cup of chicken stock. Place pieces of chicken in gravy, and reheat before serving.

CREAMED CHICKEN

⅓ cup cooked diced chicken
⅓ cup sliced mushrooms, cooked or canned
½ cup medium white sauce (p. 748)
1 slice toast

Method. Mix chicken and mushrooms with hot white sauce; serve on one slice of toast. Garnish with parsley.

Variations. Creamed chicken may also be served in the center of a macaroni ring or ring of boiled rice, in croustades, pastry shells, or on waffles. Cold meat of turkey, fish, crab, lobster, or shrimp may be prepared by the same rule.

FRIED CHICKEN

2–3 pounds chicken
Flour
Salt and pepper
Fat for frying

Method 1. Have chicken cut in attractive pieces. Wash chicken, and wipe with a damp cloth. Roll chicken in flour to which salt and pepper have been added. Heat ½ inch of fat in a skillet. Add pieces of chicken, turning as necessary with a pair of tongs until brown—about 15 to 20 minutes. Cover and cook slowly until tender—15 to 30 minutes. Uncover during last 5 to 10 minutes of cooking to recrisp the skin.

Method 2. Roll washed chicken in flour, and season with salt and pepper. Drop pieces into deep hot fat (375° F) and fry until golden brown. Remove chicken and drain on unglazed paper.

OVEN-BROILED FISH

Method. Wipe fish with a cloth after washing thoroughly. Dot with butter, season with salt and pepper, and place skin side down on a greased broiler rack. Cook for 8 to 12 minutes or until fish is brown and flakes when touched with a pointed knife. Serve with parsley butter sauce or tartar sauce.

PAN-FRIED FISH

Method. Wash fish, and wipe with a cloth. Melt 1 tablespoon butter or fat in a frying pan. Dip fish in flour, season with salt and pepper, and sauté until brown on both sides.

CREAMED FISH

⅓ cup cooked or canned fish
½ hard-cooked egg
½ cup medium white sauce (p. 748)
1 slice buttered toast

Method. Flake the fish into small pieces, and add with chopped egg white to the cream sauce; pour over the toast. Press the egg yolk through sieve over the fish, and garnish with parsley or strips of pimento.

SALADS AND SALAD DRESSINGS

GENERAL RULES FOR PREPARATION OF SALADS

Prepare salads only a short time before serving in order to present the best appearance, texture, and flavor, and to conserve vitamin values.

All greens such as lettuce, water cress, romaine, chicory, endive, and escarole should be washed thoroughly in cold water and drained as much as possible. They are then placed in wax paper, aluminum foil, a plastic bag, or damp cloth, and chilled for 1 hour or more before use.

To prepare leaves of head lettuce, remove core of head with a sharp knife. Wash under cold running water to loosen leaves, and remove leaves carefully from the head. If the lettuce is not to be used immediately, the head should be drained thoroughly before storage, since excess moisture encourages discoloration of the leaves.

Chill all ingredients thoroughly before making the salad. Salad plates or bowls must also be cold.

Add salad dressings to salad at time of serving, except where ingredients are marinated with dressing to develop the flavor.

Season salads to taste; avoid flatness of flavor or excessive seasoning.

Drain fruits and vegetables well before combining with other salad ingredients. They should be cut in attractive pieces easily taken with a fork. Green pepper, pimento, and raw carrots used as a garnish should be finely shredded. Because many cut fruits discolor on standing, a stainless steel, silver, or glass knife should be used for cutting. Sprinkling fruits with a little acid such as lemon juice, or mixing immediately with salad dressing, when possible, also helps to retard discoloration.

Precise architectural arrangements of food on salad greens should be avoided. The "candle" salad and "wheel" arrangements, for example, are not in good taste.

VEGETABLE SALADS

Vegetable salads may be served as the first course of a meal, as a relish, as an accompaniment to the main course, or as a separate course following the main course.

RELISHES

Relishes are more appetizing when completely chilled and crisp. They should be prepared an hour or so before serving and kept in the refrigerator. Because of the loss of water-soluble minerals and vitamins, vegetables should not be allowed to stand in water for several hours.

Radishes. Wash carefully. Remove tips and leaves, retaining enough of stem for attractive appearance. To make radish roses, cut strips to resemble petals from the tip end toward the stem, being careful not to break off the cut portion. Keep in ice water until serving time.

Celery. Wash carefully. Serve hearts whole, or in individual stalks. To prepare celery curls, cut each stalk lengthwise in about five strips, and immerse in ice water until serving time.

Carrots. Wash and scrape. Cut thin strips, and chill thoroughly. Thin strips will curl if put immediately into ice water.

Cucumber. Wash and chill. Cucumbers may be peeled or not, as desired. Slice thinly. If serrated edges are desired, pull silver fork lengthwise along peeled cucumber to make parallel grooves; then slice.

MIXED GREEN SALAD

Method. Use a combination of well-dried, crisp, and thoroughly chilled greens such as lettuce, romaine, chicory, escarole, endive, tender spinach, dandelion greens, or water cress. Finely sliced radishes, cucumbers, carrots, or tomatoes, flowerets of cauliflower, or fine slivers of ham, tongue, cheese, chicken, or bacon are sometimes used with the greens.

Tear greens into small pieces before putting into wooden bowl. Pour French dressing over greens and toss lightly with two forks until greens are well coated with dressing. Serve immediately.

Greens are sometimes mixed at the table, or may be served to the patient in a bowl with a separate pitcher of French or other dressing.

SHREDDED CARROT AND CABBAGE SALAD

¼ cup shredded cabbage
¼ cup shredded carrots
French dressing
Salad greens

Method. Marinate cabbage and carrots with French dressing, and serve on salad greens.

STUFFED TOMATO

1 medium tomato
⅛ teaspoon salt
1 tablespoon diced cucumber
1 tablespoon diced celery
1 tablespoon chopped green pepper
2 teaspoons mayonnaise

Method. Remove skin from tomato by turning over flame until skin blisters. Cut slice from top and remove pulp, sprinkle inside with salt, and allow to drain. Fill cavity with mixture of cucumber, celery, green pepper, tomato pulp, and 1 teaspoon of the mayonnaise. Place on lettuce and garnish with thinly sliced rings of pepper and mayonnaise.

TOMATO JELLY

1½ teaspoons granulated gelatin
2 tablespoons cold water
1 cup canned tomatoes or tomato juice
2 tablespoons diced celery
3 cloves
1 tablespoon minced parsley
½ teaspoon salt
1 bay leaf
1 tablespoon mild vinegar

Method. Soak gelatin in cold water. Simmer remaining ingredients gently for 20 minutes; press through a sieve, and measure. Add water to make 1 cup liquid, and bring to a boil. Pour over the soaked gelatin and stir until gelatin is dissolved. Pour into molds, and chill until set.

Variation. One or more of the following may be added when the jelly begins to thicken: finely chopped or sliced celery, green pepper, olives, carrots, or flaked fish.

POTATO SALAD

½ cup cold, boiled, diced potato
2 tablespoons diced celery
1 tablespoon diced cucumber
1 tablespoon French dressing
1 tablespoon cooked dressing or mayonnaise
Lettuce
Radishes, parsley, or hard-cooked egg

Method. Marinate potato, celery, and cucumber with French dressing. Before serving, mix with cooked dressing and place on lettuce. Garnish with radishes, parsley, or hard-cooked egg.

COLESLAW (serves 4)

1 slice bacon
1 tablespoon vinegar
2 cups shredded cabbage
½ cup diced celery
1 tablespoon chopped onion
¼ cup cooked dressing
Salt and pepper

Method. Cut bacon into small pieces and cook until crisp enough to crumble, taking care not to allow any pieces to burn. Add vinegar to bacon. Pour over cabbage, celery, and onion and mix lightly. Add salad dressing or mayonnaise.

Variation. This may be made into a hearty salad by the addition of a hard-cooked egg.

FRUIT SALADS

Fruit salads may be served as an accompaniment to the main course of a lunch or dinner or as a dessert. When they are used at the end of a meal, they are frequently combined with nuts, whipped cream, or marshmallows. They are sometimes frozen in the freezing tray of a refrigerator.

ORANGE AND GRAPEFRUIT SALAD

4 sections orange
3 sections grapefruit
Lettuce or water cress
French dressing

Method. Section fruit according to the method described on page 739. Arrange alternate sections of orange and grapefruit on salad greens, and serve with French dressing.

WALDORF SALAD

1 apple
2 tablespoons English walnuts
2 tablespoons diced celery
2 teaspoons mayonnaise
Lettuce

Method. Select firm, tart apples. Pare, core, and cut apple into ½-inch cubes. Break the walnuts into pieces. Mix the ingredients together, and add mayonnaise. Place upon lettuce leaves or other salad greens.

COMBINATION FRUIT SALAD

1 slice canned pineapple
2 sections grapefruit
6 white grapes or cherries
Lettuce
Mayonnaise
1 orange cut in sections

Method. Dice pineapple, add shredded grapefruit, and grapes or cherries. Mix with mayonnaise. Arrange small inner leaves of lettuce on a salad plate. Pile mixture in center of lettuce. Arrange orange sections about the fruit mixture.

Variations. Jellied: Line mold with orange sections, and then fill with other ingredients. Pour over all a gelatin mixture of 1 teaspoon gelatin soaked in 1 tablespoon cold fruit juice and dissolved in ¼ cup boiling fruit juice. Pineapple juice from canned fruit may be used. Chill and serve, when jellied, with mayonnaise.

SALADS WITH PROTEIN FOODS

Salads that contain a protein food such as eggs, cheese, fish, or meat, may be used as the main course for luncheon or dinner. The protein is usually combined with a vegetable or fruit to give taste appeal.

STUFFED-EGG SALAD

1 hard-cooked egg
1 teaspoon anchovy paste
Green pepper
Lettuce leaves
Mayonnaise

Method. Cut egg lengthwise. Mash yolk through sieve, and add anchovy paste and a little mayonnaise. Return yolk paste to the white, and arrange on slices of green pepper. Place on lettuce, and serve with mayonnaise or any preferred salad dressing.

The anchovy paste may be omitted and the yolk mixed with cream and mayonnaise, and seasoned to taste.

COTTAGE-CHEESE SALAD

⅓ cup cottage cheese
1 teaspoon minced green pepper
Salad greens
French dressing
Paprika

Method. Mix cottage cheese with minced green pepper and serve on lettuce or other salad greens with French dressing. Garnish with paprika.

Variations. The above cottage-cheese mixture may be served with:

(1) Sliced pineapple, halves of pear or peach, as stuffing for prunes or apricots, or to accompany any fruit salad

(2) Sliced tomato, or whole tomato stuffed with the mixture

FISH SALAD

⅓ cup shrimp, flaked salmon, tuna crabmeat, or lobster
⅓ cup diced celery
1 tablespoon French dressing
1 tablespoon mayonnaise
Lettuce
½ hard-cooked egg
½ tomato

Method. Mix fish, celery, and French dressing. Chill for 1 hour, and mix with mayonnaise. Serve on lettuce and garnish with slices of hard-cooked egg and wedges of tomato.

Variation. A whole tomato from which the pulp has been removed may be stuffed with the above mixture.

SALAD DRESSINGS

Salad dressings may be stored in a refrigerator for future use, and therefore quantities larger than individual portions may be prepared. Dressings to which other foods have been added, as in Russian or Thousand Island dressings, should be mixed just before use.

COOKED DRESSING (about 1½ cups)

2 tablespoons flour
1 tablespoon sugar
1 teaspoon salt
½ teaspoon dry mustard
⅛ teaspoon red pepper
¾ cup hot water or milk
¼ cup mild vinegar
1 egg
2 tablespoons butter or other fat

Method. Mix flour, sugar, and seasonings and slowly add liquid. Cook until thickened, stirring constantly. Add vinegar, and blend well. Pour mixture over slightly beaten egg, and cook for 1 to 2 minutes longer. Add butter, and cool before using.

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FRENCH DRESSING (about 1¼ cups)

½ teaspoon salt
½ teaspoon paprika
⅛ teaspoon red pepper
1 to 2 teaspoons powdered sugar
¼ to ⅓ cup lemon juice or vinegar
1 cup salad oil

Method. Add dry ingredients to oil and lemon juice in jar. Cover closely, and shake briskly until emulsified, or place in a deep bowl, and beat well with a rotary beater. If the dressing is not to be used at once, shake well before serving.

Variations. (1) Add 1½ teaspoons onion juice and 2½ teaspoons Worcestershire sauce to 1 cup French dressing. (2) Add 1 finely chopped pimento, ½ green pepper, and 1 green onion.

MAYONNAISE (about 1½ cups)

1 egg yolk, or 1 whole egg
¼ teaspoon dry mustard
½ teaspoon salt
1½ tablespoons lemon juice or vinegar
1 cup salad oil

Method. Mix dry ingredients with egg. Add lemon juice, and stir well. With a rotary beater, beat in oil a few drops at a time until the mixture begins to thicken; then add in gradually larger quantities. Beat until stiff. If whole egg is used, increase salad oil to 1½ cups.

The emulsion may break because of too rapid addition of oil or incontinuous beating. If this occurs, beat an egg yolk in a clean bowl, and add the broken emulsion drop by drop until completely added; then continue to add the remainder of the oil.

Variations. (1) Add ½ cup Roquefort cheese to 1 cup of mayonnaise. (2) Mix equal quantities of whipped cream and mayonnaise.

SAUCES AND SOUPS

Table R–3. Proportions for White Sauces (1 cup)

Consistency	Milk *cups*	Fat *tablespoons*	Flour *tablespoons*	Salt *teaspoons*	Uses
Very thin	½	½	½	½	Cream soups made with starchy vegetables such as peas, Lima beans, corn
Thin	1	1	1	½	Cream soups made with nonstarchy vegetables
Medium	1	2	2	½	Cream soups, creamed vegetables, creamed meats or fish
Thick	1	3	3	½	Croquettes, soufflés

Method. Melt the fat in top of double boiler, and mix in the salt and flour to make a smooth paste. Add liquid gradually to the flour mixture, and continue stirring until thickened sufficiently. Cover, and cook for 10 to 15 minutes, stirring from time to time.

The sauce may also be made in this way: Melt fat in saucepan over direct heat. Add flour, and stir until smooth. Add liquid gradually, stir constantly, and cook over low heat until sauce comes to a boil.

VARIATIONS FOR WHITE SAUCE

Thickening agents may be varied if the following relationships are observed:
2 tablespoons browned flour equal 1 tablespoon raw flour. In order to brown flour, melt fat over direct heat, and add flour. Stir until brown over low heat.
⅔ tablespoon cornstarch equals 1 tablespoon raw flour.
1 teaspoon tapioca equals 1 tablespoon raw flour.
1 egg yolk equals 1 tablespoon raw flour.

Liquid may be varied by using cream, vegetable juices, or meat broths for part or all of the milk.

Flavorings may be varied by adding minced parsley, grated carrot, minced pimento, minced onion or chives, herbs, or spices such as mace, nutmeg, paprika, curry powder.

CHEESE SAUCE (1 cup)

¼ to ½ cup (1–2 ounces) grated American cheese
1 cup thin white sauce

Method. Heat white sauce over hot water, stir in grated cheese, and continue to stir until cheese is melted and completely incorporated.

MOCK HOLLANDAISE SAUCE

½ cup medium white sauce
1 egg yolk
1 tablespoon butter
1 tablespoon lemon juice

Method. Make white sauce in double boiler. Beat egg yolk slightly. Mix some of white sauce with egg yolk, and stir into the remainder of the white sauce. Add the butter and lemon juice; stir well and remove from heat.

This sauce is less likely to separate than a true hollandaise sauce, and is therefore recommended for the inexperienced cook.

SOUPS

Service of soups. All soups should be served in a heated cup or cream soup dish and covered when possible to retain maximum heat until eaten. Croutons may be placed in the soup at serving time, or Melba toast or crackers may be served on a separate plate.

BROTH WITH EGG

1 egg
⅔ cup hot broth

Method. Beat egg slightly. Add broth gradually to the egg, stirring continuously in order to avoid overcooking the egg. Serve immediately.

TOMATO BOUILLON

½ cup tomato juice
⅔ cup broth
Salt and pepper

Method. Mix the ingredients and bring to the boiling point. Serve in a heated container.

GENERAL METHOD FOR CREAM SOUPS

PREPARATION OF VEGETABLES

Allow ½ cup puree per serving of soup. This will require ¾ to 1 cup, or more, of cooked vegetable because of loss on the sieve. To prepare fresh vegetables:

carrots should be scraped and diced; potatoes pared and diced; celery or asparagus cut into 1-inch pieces; onions chopped; cauliflower broken into small flowerets; and spinach washed through several waters to remove all grit. Cook vegetables in about ½ cup boiling salted water until very tender. Press through a sieve. A blender may be used to reduce the vegetable to a smooth consistency, but if the soup is to be used on a diet in which fiber is restricted it may still be necessary to strain through a sieve.

Canned green peas, Lima beans, carrots, corn, and asparagus may be used for the purée. If they are not very soft, they should be cooked in their own juice before sieving them.

Purées for infant feeding may also be used in cream soups.

PREPARATION OF SOUP

2 teaspoons fat
2 teaspoons flour
½ teaspoon salt
¾ cup milk
½ cup vegetable purée (asparagus, carrot, green bean, Lima bean, corn, celery, pea, or spinach)

Method. Melt fat in top of double boiler and mix in the salt and flour to make a smooth paste. Add milk gradually to the flour mixture and continue stirring until thickened. Cook over hot water for 5 to 10 minutes. Heat vegetable purée and add gradually to the white sauce. Add a little milk if it seems too thick. Serve piping hot in covered soup dish.

Cream soups may be garnished with paprika, whipped cream, grated cheese, or minced parsley, chives, celery leaves, or green peppers.

CREAM OF TOMATO SOUP

¾ cup tomato juice
1 thin slice onion
2 whole cloves
¾ cup thin white sauce (p. 748)

Method. Simmer tomato juice with small slice onion and cloves for 5 minutes. Strain. Prepare white sauce and add hot tomato juice gradually while continuing to stir. If slight curdling should occur, beat vigorously with a rotary beater.

One-eighth teaspoon baking soda may be added to the tomatoes before mixing with the white sauce to minimize curdling; this practice, however, will reduce the ascorbic acid content.

Serve soup immediately in a hot covered soup dish. Chopped parsley, chives, or whipped cream may be used for a garnish.

CREAM OF POTATO SOUP

½ cup diced potatoes
2 to 3 slices onion
½ cup thin white sauce
1 sprig parsley or caraway seeds

Method. Boil potatoes and sliced onion together in about ½ cup water. When potatoes and onion are soft, rub through sieve with water in which they were cooked. Heat white sauce in double boiler, and add puréed potato mixture. Beat well; garnish with minced parsley or caraway seeds.

VEGETABLES

PREPARATION AND COOKING OF FRESH VEGETABLES

Select only fresh, crisp, ripe but not overmature vegetables. Use vegetables

as soon as possible after purchase to retain maximum vitamin content. Plan preliminary preparation as follows:

Spinach and other greens. Cut off roots and remove bad parts. Wash under running water or in several changes of water to remove all sand. Lukewarm water with a little salt added may be used for the first washings to help remove the sand, but the vegetables must not be allowed to soak.

Peas, beans, corn. Remove shells or husks just before these vegetables are to be cooked.

Broccoli, cabbage, cauliflower, Brussels sprouts. To remove any insects, cauliflower, broccoli, and Brussels sprouts may be soaked for a few minutes in salty water. Remove outer leaves just before use. Cook cauliflower whole or in flowerets. Quarter cabbage or shred. Remove base of sprouts. Peel off hard outer covering of stems of broccoli. Cut thick broccoli stems in half.

Root vegetables. Scrub with brush before peeling or scraping. Beets are usually cooked without peeling since there is less loss of color. Potatoes and sweet potatoes may also be cooked without removing the skin.

Boiling vegetables. Use a saucepan with a tightly fitting cover. Add vegetables to boiling water, using about ½ inch water in the pan. No water is needed for greens since the water clinging from the washing is adequate. Cover pan and bring to the boiling point as rapidly as possible. Boil gently until just tender. The addition of 1 teaspoon sugar improves the flavor of mature vegetables that have lost their sweetness.

Table R-4 gives approximate cooking time, but the time will vary depending upon the degree of maturity and the size of the pieces.

Table R-4. Cooking Time for Fresh Vegetables

	Cooking Time *minutes*		Cooking Time *minutes*
Artichokes	20–40	Corn on the cob	8–12
Asparagus, butts	15–25	Dandelion	10–20
tips	5–10	Eggplant	10–20
Beans, Lima	20–30	Kale	20–30
string	15–30	Kohlrabi	20–40
Beet greens	10–20	Okra	20–40
Beets		Onions	25–30
old	1–2 hours	Parsnips	30–40
young	30–45	Peas	10–20
Broccoli	20–25	Potatoes, Irish	20–30
Brussels sprouts	10–20	sweet	20–30
Cabbage		Rutabagas	20–60
quartered	20–30	Spinach and other greens	5–15
shredded	8–12	Squash, Hubbard	20–30
Cauliflower, flowerets	10–15	summer	5–15
whole	20–30	Tomatoes	5–10
Celery	20–30	Turnips, white	20–30

FROZEN VEGETABLES

For method of cookery, read carefully the directions which accompany vegetables. Preliminary thawing is not necessary except in the case of corn on the cob. Drop frozen vegetable into rapidly boiling salted water, and bring quickly to the boiling point. Cover, and cook until tender. The length of time for cooking is less than that for fresh vegetables.

CANNED VEGETABLES

Drain liquor from vegetables, and reduce volume by boiling. Then add vegetables, season to taste, and heat thoroughly. Liquor may be used in sauces, gravies, or soups if not boiled down and used with the vegetables.

SERVICE OF VEGETABLES

Vegetables may be served in a variety of ways: (1) *Buttered:* Add 1 to 2 teaspoons butter with a dash of salt and pepper to ½ cup diced and cooked vegetables. Minced parsley with potatoes or carrots, a dash of nutmeg with green beans, lemon juice with spinach, minced green pepper and pimento with corn, mint leaves with peas suggest a few of many possibilities for enhancing flavor and interest of vegetables. (2) *With cream:* Add 1 tablespoon hot cream to ½ cup of hot buttered vegetables. (3) *With sauces* of blending or contrasting flavor: (a) pour ¼ cup hot white sauce (medium) over ½ cup cooked vegetable: (b) cheese sauce (p. 749) is especially suitable for cabbage, cauliflower, asparagus; (c) hollandaise sauce (p. 749) lends a piquant flavor to asparagus, broccoli. (4) *Escalloped:* Mix ½ cup cooked vegetables with ¼ to ½ cup medium white sauce (p. 748). Place in a buttered baking dish, and cover with bread or cracker crumbs. Dot with butter, and bake in oven until crumbs are brown.

BAKED POTATO

1 medium-size potato
1 teaspoon butter

Method. Scrub potato with a brush; dry and slightly grease the surface. Place in a moderately hot oven (425° F) and bake about 45 to 50 minutes. The potato should feel tender under pressure. When done, make an incision of 1 inch in the skin and gently press the potato so that excess moisture can escape. Put butter in the cut and serve immediately.

BAKED STUFFED POTATO

1 potato
1 teaspoon butter
1 tablespoon cream or milk
Salt and pepper
2 teaspoons grated cheese
Paprika

Method. Bake potato as directed above. Cut thin slice from side of potato, and remove pulp from casing. Mash, and mix with butter and hot cream. Season with salt and pepper, and beat until creamy. Return to potato shell and sprinkle with cheese and paprika. Place in hot oven and cook until cheese is melted and browned.

MASHED POTATO

1 cooked medium-sized potato
1 teaspoon butter
1 tablespoon hot milk or cream
Salt and pepper

Method. Mash potato until free of lumps, add butter, hot cream, and salt and pepper to taste. Beat until creamy.

BAKED SQUASH

Squash (acorn or Hubbard)
Salt; pepper
1 teaspoon butter
1 teaspoon brown sugar

Method. Wash squash. Without cutting bake for about 30 minutes at 400° F. Cut squash in serving size pieces, remove seeds, and season with salt, pepper, butter, and brown sugar. Put pieces on a shallow pan, and continue baking for 20 to 30 minutes until very tender.

A medium acorn squash will serve two persons, while a Hubbard squash, depending upon size, will provide 6 or more servings.

BROILED TOMATO

1 teaspoon butter
1 tablespoon fine bread crumbs
Salt and pepper
1 tomato

Method. Melt butter, brown bread crumbs, and season with salt and pepper. Wash tomato, remove core end, and cut in half. Dust with salt and pepper, and sprinkle bread crumbs on each half. Place on greased broiler rack about 3 inches below direct flame. Broil for about 10 minutes or until tender.

WHOLE TOMATO STUFFED WITH RICE

1 medium-size tomato
2 tablespoons rice
1 teaspoon butter
Salt and pepper

Method. Remove the center from the tomato, dust the inside with salt and a very little pepper, and set aside. Boil the rice for about 20 minutes, drain, and add the tomato pulp, butter, salt, and pepper. Fill the center with rice. Set the tomato in a lightly buttered pan, and bake in a moderate oven 20 minutes.

TYPICAL RECIPES FOR FAT-CONTROLLED DIETS

In fat-controlled diets, the level of saturated fatty acids is kept as low as possible, and the level of polyunsaturated fatty acids is increased (see Chapter 41). Most of the recipes in this text and in standard cookbooks can be adapted to these diets by making the following adjustments.

1. Substitute corn, cottonseed, soybean, or other allowed oil for specified fat in any recipe which requires fat to be melted. If the fat is to be creamed with the sugar, or cut into other dry ingredients, special recipes are required; do not make a direct substitution.
2. Substitute skim milk for whole milk.
3. Count egg yolks as part of the week's allowance; for example, the recipe for baked custard on page 732 will yield two small custards, and one custard should be counted as ½ egg yolk toward the three allowed for the week.
4. Select very lean cuts of meat and trim off any visible fat. Remove skin from poultry.
5. Do not use whole milk, cream, butter, hydrogenated fats or other solid fats, or whole milk cheeses.

The recipes given below illustrate some ways in which the level of polyunsaturated fatty acids may be increased.

FRENCH TOAST (2 slices)

2 slices bread
2 egg whites
¼ cup milk, skimmed
4 teaspoons oil

Method. Beat egg white and milk until blended. Heat oil in skillet. Dip bread into egg-white mixture, coating both sides of slice. Brown in fat and turn; continue cooking until brown and crisp. Sprinkle with nutmeg or cinnamon, if desired; serve with syrup.

Per slice: 2 teaspoons oil

BAKING POWDER BISCUITS (12 biscuits)

2 cups flour
3 teaspoons baking powder
1 teaspon salt
⅓ cup oil
⅔ cup skim milk

Method. Mix dry ingredients. Combine oil and milk and pour all at once into flour mixture. Toss lightly with a fork until just blended, and turn out on to lightly floured board or a piece of wax paper. Knead lightly for 10 to 12 seconds. Roll or pat into a rectangle ½ inch thick. Cut into strips 2 by 1 inches, or 2-inch squares. Place on ungreased cookie sheet and bake at 450° F until surface is light golden brown, about 12–15 minutes.

Per biscuit: 1¼ teaspoons oil

GRIDDLE CAKES (12 4-inch cakes)

2 cups flour
1 tablespoon sugar
½ teaspoon baking soda
1 teaspoon salt
1 cup buttermilk
2 tablespoons oil

Method. Mix dry ingredients. Combine buttermilk and oil, and add to dry ingredients. Stir only to moisten. Heat griddle and brush lightly with oil. Pour about ¼ cup batter onto griddle. When bubbles appear throughout the cake, turn and brown the other side. Serve with syrup.

Per cake: 1 teaspoon oil (includes oil used in baking)

SAVORY RICE (3 servings)

1 tablespoon oil
½ chopped small onion
½ cup uncooked rice
¼ teaspoon salt
1 cup broth or bouillon
1 teaspoon finely chopped parsley

Method. Heat oil in skillet, add onion, and rice. Stir constantly while browning. Add hot broth and salt to rice. Cover and bring to a boil. Lower heat and cook until rice is tender and has absorbed all of the broth—about 15 to 20 minutes. Stir occasionally while cooking. Garnish with parsley.

Per serving: 1 teaspoon oil

LONDON BROIL (5 3-ounce servings)

1½ pounds flank steak
Marinade for meat (see below)

Method. Trim off all visible fat from meat. Pierce entire surface of meat on both sides with a fork, or score lightly with a sharp knife. Place in a flat pan and pour marinade over meat. Allow to marinate preferably overnight, but at least 3 hours, in refrigerator. Turn several times and brush surfaces with marinade.

About 10 minutes before serving time, place meat on broiling rack about 3

inches from flame. Brush surface with marinade and broil until browned—about 5 or 6 minutes. Turn, brush again with marinade and broil until done. When sliced, the center of the meat should be pink; overcooking toughens the meat.

Cut thin slices with a sharp knife, cutting diagonally across the fibers.

Per serving: 2 teaspoons oil

MARINADE FOR MEAT

¼ cup oil
2 tablespoons vinegar, wine, or lemon juice
½ teaspoon salt
½ bay leaf
½ teaspoon dried herbs (marjoram, savory, or sweet basil)
1 clove garlic, if desired

Method. Shake all ingredients together and pour over meat. Allow meat to marinate for at least 3 hours, turning several times. The marinade may be prepared in larger quantities and stored in a covered jar in the refrigerator for use from time to time.

POT ROAST

3 pounds lean pot roast (rump, eye round, round)
Marinade
2 tablespoons oil
4 medium potatoes, peeled
4 medium onions, peeled
4 medium carrots, scraped and quartered

Method. Trim off all visible fat. Pierce meat on all surfaces with a fork. Pour marinade over meat, and let stand in refrigerator overnight. Turn several times, and brush all surfaces with marinade.

Heat fat in Dutch oven, or heavy skillet with cover. Brown meat on all sides. Add any remaining marinade. Cover tightly and cook over low heat on surface of range or at 300° F in oven. Add small amount of water, if needed. At end of two hours add onions, potatoes, and carrots. Continue cooking for about 45 minutes to 1 hour, until vegetables are done. Season with salt.

Slice meat and arrange with carrots, onions, and potatoes. Garnish with parsley. Pour small amount of remaining juices over meat.

BROILED CHICKEN

½ broiler (¾ to 1 pound)
Salt and pepper
1–2 tablespoons oil
Parsley for garnish

Method. Wash chicken. Brush generously on all sides with oil or melted fat. Season with salt and pepper. Place skin side down on broiler 5 to 7 inches from heat. Regulate heat so that chicken just begins to brown in 10 minutes. Turn and brush with fat two or three times during cooking. Continue to cook until done —about 35 to 50 minutes. Chicken is done when meat in thickest part of drumstick cuts easily and has no tinge of pink. Remove skin, sprinkle with paprika and garnish with parsley and tomato slices.

Per serving: about 3 teaspoons oil

CHICKEN SALAD

⅓ cup diced chicken
¼ cup finely diced celery
1 tablespoon French dressing
⅓ cup white grapes or diced pineapple
2 tablespoons coarsely chopped walnuts
1½ tablespoons mayonnaise
Lettuce

Method. Marinate chicken, celery, and fruit with French dressing for one hour or more. Add nuts and mayonnaise and toss lightly. Season to taste and arrange in a lettuce cup.

Per serving: 6 teaspoons oil

SWISS STEAK (serves 6)

1½ pounds round steak
Flour
Salt and pepper
2 tablespoons oil
1 cup stewed tomatoes

Method. Pound as much flour as possible into the meat, season, and brown in hot fat. Add tomatoes; cover, and cook slowly until done—about 45 minutes to 1 hour. Serve with sauce in which it was cooked. Garnish with parsley.

MACARONI CASSEROLE

1 pound lean veal
2 small onions
3 tablespoons oil
1 6-ounce can tomato paste
1½ cups water
½ teaspoon salt
½ teaspoon oregano
1 cup uncooked elbow macaroni

Method. Trim off any visible fat from meat, and cut into ½-inch cubes. Slice onions. Heat oil in skillet, add meat cubes and onion, and brown, stirring occasionally. Add tomato paste, water, salt, and oregano. Bring to boiling point, cover, and simmer for 30 minutes.

While sauce is cooking prepare macaroni according to directions on page 748. Drain water from macaroni after 10 minutes cooking time. Combine macaroni and tomato-meat sauce. Place in oiled casserole and heat in oven at 350° F for 30 minutes.

Per serving: 2 teaspoons oil

ESCALLOPED POTATOES (4 servings)

4 medium potatoes
1 small onion
Salt
Pepper
Paprika
1 tablespoon oil
1¼ cups skim milk, scalded
2 teaspoons flour

Method. Peel potatoes and onion and slice thinly. Oil the bottom and sides of a one-quart casserole. Arrange half of potatoes in casserole, sprinkle with salt, pepper, paprika, and half of onion slices. Sprinkle half of oil over the top. Repeat with a second layer of potatoes and seasonings. Sprinkle flour over top surface. Add hot milk to within one-half inch of top surface of potatoes. Bake at 375° F for about 45 minutes, or until potatoes are tender.

Per serving: ¾ teaspoon oil

PANNED VEGETABLES (4 servings)

2 cups vegetables (any one of these: celery, cabbage, summer squash, carrots, string beans, broccoli, spinach or other greens)
4 teaspoons oil
Salt
Pepper
Herbs or spices, if desired (see p. 759)

Method. Prepare vegetables for cooking as described on page 750. Slice thinly. Heat oil in skillet. Add vegetables and brown slightly. Add seasonings and cover tightly. Cover tightly and cook over low heat for 15 to 20 minutes. The water ad-

hering to greens after washing is usually sufficient, but a small amount of water—2 to 4 tablespoons—may need to be added during cooking after other vegetables in order to avoid sticking.

When vegetables are almost cooked, remove cover and boil off any remaining water.

Per serving: 1 teaspoon oil

HARVARD BEETS

1 tablespoon oil	⅛ teaspoon salt
½ tablespoon flour	¼ cup mild vinegar
¼ cup sugar	½ cup sliced beets

Method. Combine oil, flour, sugar, and salt. Stir in vinegar gradually and cook over low heat for 10 to 15 minutes. Add sliced beets. Allow to stand in warm place until sauce takes on a rich red color before serving.

Per serving: 3 teaspoons oil (assuming all of sauce is eaten)

GLAZED SWEET POTATOES OR CARROTS

2 small sweet potatoes	3 tablespoons sugar, white or brown
or	1 tablespoon oil
4 carrots	1 teaspoon water

Method. Wash sweet potatoes or carrots. If carrots are used scrape off the skin before boiling; sweet potatoes are peeled after boiling. Boil in small amount of boiling salted water until tender; drain. Peel potato, and cut in half lengthwise. Put sugar, oil, and water in skillet and cook over slow heat until blended. Reheat potatoes or carrots in this mixture until they become glazed and slightly brown.

Variations. Carrots or potatoes may be placed in an oiled baking dish with the sugar and oil, and cooked in a slow oven for about 20 minutes.

TYPICAL RECIPES FOR SODIUM-RESTRICTED DIETS

Adaptation of recipes for sodium-restricted diets. Almost all recipes in this text and from standard cookbooks may be adapted to sodium-restricted diets by making certain very simple changes. The following important modifications apply.

1. Omit salt in any recipe.
2. Substitute low-sodium leavening agent whenever baking powder or baking soda are specified.
   - *a.* Potassium bicarbonate instead of sodium bicarbonate, using the quantity specified in the recipe
   - *b.* Sodium-free baking powder instead of regular baking powder. Most drug stores and many food stores which sell dietetic foods can supply one of several brands. If not available in the community, the druggist can prepare a baking powder using the following formula:

potassium bicarbonate	39.8 gm
cornstarch	28.0 gm
tartaric acid	7.5 gm
potassium bi-tartrate	56.1 gm

Use 1½ teaspoons sodium-free baking powder for each teaspoon regular baking powder.

3. Use unsalted fats: sweet butter, unsalted margarine, lard, hydrogenated vegetable fats, vegetable oils.

4. Substitute low-sodium ingredients for salted ingredients:

low-sodium (dietetic) tomato juice or canned vegetables for salted canned vegetables and juice
low-sodium (dietetic) bouillon cubes for regular bouillon cubes
low-sodium (dietetic) cheese for regular cheese; unsalted cottage cheese
plain gelatin for sweetened gelatin powders

5. Count any of the following ingredients as part of the day's food allowance since they are naturally high in sodium: milk, whole eggs, meat, fish, and poultry. For example, the recipe for blancmange (p. 733) makes 2 to 3 servings. From the day's food allowance one would subtract ½ cup milk and ½ egg. On the other hand, the amounts of egg and milk represented in one plain muffin (see below) would be so small that no allowance need be made except in severely restricted diets.

Low-sodium milk may be substituted for regular milk whenever diets are severely restricted (usually below 500 mg sodium). Unless calories or proteins are restricted in the diet, the low-sodium milk need not be subtracted from the day's allowance.

Egg yolks are much lower in sodium content than are egg whites. In many recipes an egg yolk (or two) may be used satisfactorily instead of one whole egg: for example, puddings, custard, mayonnaise, brownies.

6. Omit recipes that include bacon, ham, more than one egg white.

The following illustrates the adaptation of a recipe:

PLAIN MUFFINS (half recipe, p. 726)
(6 muffins)

1 cup flour	1 tablespoon sugar
Omit salt	½ cup milk
2¼ teaspoons sodium-free baking powder	2 tablespoons unsalted fat
	½ egg

Follow directions for preparation on page 726.

Seasonings for low-sodium diets. Since ancient times, herbs and spices have been used as medicines, perfumes, and for seasoning food. Many people today do not realize the intriguing flavors which can be given to foods by using them judiciously. Observation of the following simple rules in herb and spice cookery will yield satisfying results:

1. Begin experimenting with herbs and spices sparingly until you learn what they can do for food. Their effect can be subtle and illusive, but if used with a heavy hand they can be overwhelming.

2. Herbs and spices contain volatile flavors which are lost if they are kept too long. Buy them in small quantities and keep them tightly covered at all times.

3. Start with about ¼ teaspoon dried herbs in a dish for four people. When using fresh herbs, use about three to four times this quantity.

4. Cutting, crushing, or mincing fresh herbs brings out the volatile oils and true flavors.

5. For foods which are not to be cooked, such as vegetable juices, add herbs well in advance—even overnight—of serving time. The herbs may be tied in a cheesecloth bag and removed from the juice just before serving.

6. For a quickly cooked dish, or for a salad, moisten the herbs with a little milk, unsalted butter, lemon juice, or oil and add to the prepared dish; allow a salad to stand for about ½ hour before serving.
7. For dishes cooked a long time (soups and stews), add herbs during the last hour of cookery.

Herb, spice, and flavoring shelf. A complete list of flavoring aids is included on page 636. Until one is accustomed to using herbs and spices in cookery, one may wish to try a few at a time. The following might be used as a "starter shelf."

HERBS	SPICES	FLAVORING EXTRACTS
Basil	Cinnamon	Almond
Bay leaf	Cloves	Lemon
Chives	Curry	Maple
Marjoram	Ginger	Orange
Mint	Mustard, dry	Peppermint
Parsley	Nutmeg	Vanilla
Rosemary	Paprika	
Sage	Pepper	
Savory		
Thyme		

Suggestions for using herbs, spices, and garnishes in cookery. The suggestions presented here are useful for enhancing the flavor of foods for the family fare, but lend special interest to the sodium-restricted diet. Herb butters may be used to brush meats before broiling or to season cooked vegetables. To prepare herb butter:

Cream ½ cup unsalted butter. Blend in 3 tablespoons lemon juice and 2 tablespoons minced fresh herbs or 1 teaspoon dried herbs. This mixture may be kept in the refrigerator for a few days, or may be frozen.

MEAT, POULTRY, FISH, EGGS

Beef: bay leaf, lemon juice, marjoram, dry mustard, mushrooms, nutmeg, onion, green pepper, pepper, sage, thyme; currant or grape jelly
Chicken or turkey: basil, bay leaf, lemon juice, marjoram, onion, pepper, rosemary, sage, sesame seed, thyme; cranberry sauce
Lamb: curry garlic, mint, onion, oregano, parsley, rosemary, thyme; mint jelly, broiled pineapple
Pork: garlic, lemon juice, marjoram, sage; applesauce, spiced apples, cranberries
Veal: bay leaf, curry, dill seed, ginger, marjoram, oregano, summer savory; currant jelly; broiled apricots or peaches
Fish: bay leaf, curry, dill, garlic, lemon juice, mushrooms, mustard, onion, paprika, pepper
Eggs: basil, chives, curry, mustard, parsley, green pepper, rosemary, diced tomato

VEGETABLES

Add a dash of sugar while cooking vegetables to bring out flavor.
Asparagus: lemon juice, caraway, unsalted chopped nuts

Green beans: dill, lemon, marjoram, nutmeg, onion, rosemary; slivered almonds
Broccoli: lemon juice, oregano, tarragon
Corn: chives, parsley, green pepper, pimento, tomato
Peas: mint, mushroom, onion, parsley, green pepper
Potatoes: chives, mace, onion, parsley, green pepper
Squash: basil, ginger, mace, onion, oregano
Sweet potatoes: cinnamon, nutmeg; brown sugar
Tomatoes: basil, marjoram, oregano, parsley, sage

LOW-SODIUM BREAD

1 cup lukewarm water
3 tablespoons sugar
½ cake compressed yeast
2 tablespoons soft fat, unsalted
2¾ to 3 cups sifted flour

Method. Mix water and sugar in large bowl. Crumble yeast into mixture. Add fat and about half of the flour. Mix well. Add flour and stir to a soft dough. Turn out dough on a floured board, cover, and let stand for about 5 minutes. Knead dough until it is smooth and elastic. Place in a greased bowl large enough to permit the dough to double in bulk. Cover, keep in a warm place, and let rise until doubled in bulk—about 1–1½ hours. Knead again, and shape into a loaf. Place in a greased one-loaf pan, 9 × 5 × 3 inches. Let rise again and bake at 400° F for 30 to 35 minutes.

CINNAMON ROLLS

Dough for low-sodium bread
Soft unsalted butter
Brown sugar
Cinnamon
Unsalted nuts, chopped

Method. Prepare dough as for low-sodium bread above. After first rising, roll out dough into a rectangle to about ¼ inch. Spread with soft butter, sprinkle generously with brown sugar, cinnamon, and chopped nuts. Roll tightly, and slice in pieces 1 inch thick. Place cut side down on greased pan. Let rise until double in bulk. Bake in oven at 400° F for 15 to 20 minutes—light golden brown.

WAFFLES

1 cup scalded milk, regular or low-sodium
¼ cup soft fat
1 tablespoon sugar
1½ cups water
1 package compressed yeast
1 egg
3 cups sifted flour

Method. Mix milk, fat, and sugar. Add water, cooling the mixture to lukewarm temperature. Crumble yeast and mix well with milk mixture. Add slightly beaten egg. Stir in flour and mix until well blended. Allow batter to stand for 15–30 minutes until bubbles begin to form on surface. Bake on heated waffle iron.

If a freezer is available, the baked waffles may be frozen, kept wrapped in freezer paper, and reheated by placing the waffle in a toaster.

POPOVERS (6 large popovers)

2 eggs
1 cup milk, regular or low-sodium
1 cup sifted flour
1 teaspoon melted fat or oil

Method. Combine all ingredients in a mixing bowl and beat with a rotary beater until smooth. Butter (unsalted) custard cups well, and fill each about ⅔ with batter.

Place cups on a baking sheet and bake at 425° F until golden brown—about 35 minutes. Serve immediately.

One popover made with regular milk: 45 mg sodium.

MEAT LOAF

½ pound ground beef
¼ pound ground pork
¼ pound ground veal
2 tablespoons minced onion
⅛ teaspoon pepper
⅛ teaspoon sage
⅛ teaspoon dry mustard
⅛ teaspoon poultry seasoning
½ cup milk, warm
2 slices unsalted bread
1 egg
¼ cup dry bread crumbs, unsalted
½ cup tomatoes, unsalted

Method. Combine meat, onion, and seasonings and mix well. Soak bread in milk and add egg. Combine the meat and bread-milk mixtures, and shape into a loaf. Roll in dry bread crumbs, and place in loaf pan. Cover with tomatoes and bake at 350° F for about 1 hour. Baste with liquid in pan at 15-minute intervals.

PIECRUST (double crust)

2 cups flour
⅔ cup soft shortening, unsalted
4–5 tablespoons cold water

Method. Cut shortening into sifted flour with two knives or a pastry blender until the crumbs are the size of small peas. Add water, a tablespoon at a time, mixing in with a fork. Use just enough water to hold the ingredients together; the dough should not be sticky. Turn out on a lightly floured board. Divide dough in half and roll each piece into a circle to fit an 8-inch pie tin.

APPLE PIE

6–8 tart apples
¾ cup sugar
½ teaspoon nutmeg
1 tablespoon unsalted butter

Method. Pare apples, quarter them, and take out the core. Slice thinly and mix with sugar and nutmeg. Line piepan with one crust. Pile apples into crust. Place slits with a knife in the top crust so that steam can escape. Carefully place top crust over pie so that it fits evenly. Turn edges of top crust under the lower crust, and build up a fluted edge with a fork or with thumb and forefinger. Bake at 400° F for about 50 minutes—until crust is light brown and apples are cooked.

NORWEGIAN BUTTER COOKIES (about 3 dozen)

¾ cup unsalted butter
½ cup sugar
2 hard-cooked egg yolks
1 teaspoon grated orange rind
2 cups sifted flour

Method. Cream butter until light and fluffy, adding a little sugar at the time. Press egg yolk through sieve and blend with butter-sugar mixture. Stir in orange rind and sifted flour. Chill dough in the refrigerator. Break off small pieces of dough and roll to thickness of a pencil and about 5 inches long. Bring ends together and overlap as in a pretzel. Place on ungreased baking sheet, and bake for about 10 minutes at 375° F until set but not brown.

TABULAR MATERIALS

FOREWORD

Included in this section are 8 tables of the nutritive values of foods; 1 table defining the enrichment standards for breads and cereals by the Food and Drug Administration; 6 weight-height tables for age-sex categories; 2 tables of blood and urine constituents; a table of weight-measure equivalents; and a table showing yield of cooked meats.

The student should take time to review the arrangement and content of each of the tables so that he is able to refer to them rapidly and use them with skill. Probably more questions asked by the public pertain to the composition of foods than to any other aspect of nutrition. Tables of food values provide an invaluable reference source to answer such questions. Moreover, the quantitation of diets is possible only when nutritive values are known.

The uses of tables of food composition, as well as their limitations, have been described in Chapter 4. Tables A-1, A-3, and A-4 are for specific household measures of food. Other tables of nutritive values are stated for 100 grams of food. If a student, for example, wishes to determine the sodium content of 1 cup of milk, he will follow this procedure:

1 cup milk weighs 244 gm (see Table A–1)
100 gm milk contains 50 gm sodium (see Table A–6)

$$\frac{244 \times 50}{100} = 122 \text{ mg sodium in 1 cup milk}$$

TABLE A–1 EXPLANATION

Table A-1 is an alphabetic arrangement of items listed in the publication of the Consumer and Food Economics Research Division in 1964 *Nutritive Value of Foods*. A few additional items from Agriculture Handbook 8 *Composition*

of Foods—Raw, Processed, Prepared are also included. The explanation provided in the bulletin for this table is reproduced here in part:*

Weight in grams is shown for an approximate measure of each food as it is described; if inedible parts are included in the description, both measure and weight include these parts.

The approximate measure shown for each food is in cups, ounces, pounds, a piece of a certain size, or some other well-known unit. The measure shown can be calculated readily to larger or smaller amounts by multiplying or dividing. However, because the measures are approximate (some are rounded for convenient use), calculated nutritive values for very large quantities of some food items may be less representative than those for smaller quantities.

The cup measure refers to the standard measuring cup of 8 fluid ounces or ½ liquid pint. The ounce refers to 1/16 of a pound avoirdupois, unless fluid ounce is indicated. The weight of a fluid ounce varies according to the food measured. . . .

Nutritive values are shown for only the parts of food customarily eaten—corn without the cob, meat without bone, potatoes without the skin, American-type grapes without seeds and skin, European-type grapes without seeds. If additional parts are eaten—the skin of the potato, for example—amounts of some nutrients obtained will be somewhat greater than those shown.

For many of the prepared items, values have been calculated from the ingredients in typical recipes. Examples of such items are: Biscuits, corn muffins, oyster stew, macaroni and cheese, and custard and a number of other dessert-type items.

For vegetables and for toast, the values are shown for the food without any fat added, either during preparation or at the table.

For meat, the values are for the meat as cooked and drained and without drippings. For many cuts, values are shown for the meat both with and without the fat that can be trimmed off in the kitchen or on the plate.

* Consumer and Food Economics Research Division, Agricultural Research Service: *Nutritive Value of Foods.* Home and Garden Bull. 72, U.S. Department of Agriculture, Washington, D.C., 1964.

Table A–1. Nutritive Values of the Edible Part of Food

Item No.	Food, approximate measure, and weight (in grams)		Water		Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
1	Almonds, shelled	1 cup	142	5	850	26	77
2	Apples, raw, medium 2½-inch diameter, about 3 per pound[1]	1 apple	150	85	70	trace	trace
3	Apple brown Betty	1 cup	230	64	345	4	8
4	Apple juice, bottled or canned	1 cup	249	88	120	trace	trace
	Applesauce, canned:						
5	Sweetened	1 cup	254	76	230	1	trace
6	Unsweetened or artificially sweetened	1 cup	239	88	100	trace	trace
	Apricots:						
7	Raw, about 12 per pound[1]	3 apricots	114	85	55	1	trace
	Canned in heavy syrup:						
8	Halves and syrup	1 cup	259	77	220	2	trace
9	Halves (medium and syrup)	4 halves; 2 tablespoons syrup	122	77	105	1	trace
	Dried:						
10	Uncooked, 40 halves, small	1 cup	150	25	390	8	1
11	Cooked, unsweetened, fruit and liquid	1 cup	285	76	240	5	1
12	Apricot nectar, canned	1 cup	250	85	140	1	trace
	Asparagus:						
13	Cooked, cut spears	1 cup	175	94	35	4	trace
	Canned spears, medium:						
14	Green	6 spears	96	92	20	2	trace
15	Bleached	6 spears	96	92	20	2	trace
	Avocados, raw:						
	California varieties, mainly Fuerte:						
16	10-ounce avocado, about 3⅓ by 4¼ inches, peeled, pitted	½ avocado	108	74	185	2	18
17	½-inch cubes	1 cup	152	74	260	3	26
	Florida varieties:						
18	13-ounce avocado, about 3 by 4 inches, peeled, pitted	½ avocado	123	78	160	2	14
19	½-inch cubes	1 cup	152	78	195	2	17
20	Bacon, broiled or fried, crisp	2 slices	16	8	100	5	8
21	Bananas, raw, 6 by 1½ inches, about 3 per pound[1]	1 banana	150	76	85	1	trace

[1] Measure and weight apply to entire vegetable or fruit, including parts not usually eaten.

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
6	52	15	28	332	6.7	0	0.34	1.31	5.0	trace	1
—*	—	—	18	8	.4	50	.04	.02	.1	3	2
4	3	trace	68	41	1.4	230	.13	.10	.9	3	3
—	—	—	30	15	1.5	—	.01	.04	.2	2	4
—	—	—	60	10	1.3	100	.05	.03	.1	3	5
—	—	—	26	10	1.2	100	.04	.02	.1	2	6
—	—	—	14	18	.5	2890	.03	.04	.7	10	7
—	—	—	57	28	.8	4510	.05	.06	.9	10	8
—	—	—	27	13	.4	2120	.02	.03	.4	5	9
—	—	—	100	100	8.2	16350	.02	.23	4.9	19	10
—	—	—	62	63	5.1	8550	.01	.13	2.8	8	11
—	—	—	36	22	.5	2380	.02	.02	.5	7	12
—	—	—	6	37	1.0	1580	.27	.32	2.4	46	13
—	—	—	3	18	1.8	770	.06	.10	.8	14	14
—	—	—	4	15	1.0	80	.05	.06	.7	14	15
4	8	2	6	11	.6	310	.12	.21	1.7	15	16
5	12	3	9	15	.9	440	.16	.30	2.4	21	17
3	6	2	11	12	.7	360	.13	.24	2.0	17	18
3	8	2	13	15	.9	440	.16	.30	2.4	21	19
3	4	1	1	2	.5	0	.08	.05	.8	—	20
—	—	—	23	8	.7	190	.05	.06	.7	10	21

* Dashes show that no basis could be found for imputing a value although there was some reason to believe that a measurable amount of the constituent might be present.

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)		Water	Food Energy	Protein	Fat (total lipid)
		gm	per cent	calories	gm	gm
22	Barley, pearled, light, uncooked	1 cup	203	11	710	17	2
	Beans:						
	Dry, cooked or canned:						
23	Lima	1 cup	192	64	260	16	1
24	Red	1 cup	256	76	230	15	1
	White, with tomato sauce:						
25	With pork	1 cup	261	71	320	16	7
26	Without pork	1 cup	261	68	310	16	1
27	Lima, immature, cooked	1 cup	160	71	180	12	1
	Snap, green:						
	Cooked:						
28	In small amount of water, short time	1 cup	125	92	30	2	trace
29	In large amount of water, long time	1 cup	125	92	30	2	trace
	Canned:						
30	Solids and liquid	1 cup	239	94	45	2	trace
	Bean sprouts, raw:						
31	Mung bean	1 cup	90	89	30	3	trace
32	Soybean	1 cup	107	89	40	6	2
	Beef, trimmed to retail basis,[2] cooked:						
	Cuts, braised, simmered, or pot-roasted:						
33	Lean and fat	3 ounces	85	53	245	23	16
34	Lean only	2.5 ounces	72	62	140	22	5
	Hamburger (ground beef), broiled:						
35	Lean	3 ounces	85	60	185	23	10
36	Regular	3 ounces	85	54	245	21	17
	Roast, oven-cooked, no liquid added:						
	Relatively fat, such as rib:						
37	Lean and fat	3 ounces	85	40	375	17	34
38	Lean only	1.8 ounces	51	57	125	14	7
	Relatively lean, such as heel of round:						
39	Lean and fat	3 ounces	85	62	165	25	7
40	Lean only	2.7 ounces	78	65	125	24	3
	Steak, broiled:						
	Relatively fat, such as sirloin:						
41	Lean and fat	3 ounces	85	44	330	20	27
42	Lean only	2.0 ounces	56	59	115	18	4
	Relatively lean, such as round:						
43	Lean and fat	3 ounces	85	55	220	24	13
44	Lean only	2.4 ounces	68	61	130	21	4
	Beef, canned:						
45	Corned beef	3 ounces	85	59	185	22	10
46	Corned beef hash	3 ounces	85	67	155	7	10

[2] Outer layer of fat on the cut was removed to within approximately ½ inch of the lean. Deposits of fat within the cut were not removed.

Fatty Acids											
Saturated (*total*) *gm*	Unsaturated Oleic *gm*	Linoleic *gm*	Carbohydrate *gm*	Calcium *mg*	Iron *mg*	Vitamin A Value *I.U.*	Thiamine *mg*	Riboflavin *mg*	Niacin *mg*	Ascorbic Acid *mg*	Item No.
trace	1	1	160	32	4.1	0	0.25	0.17	6.3	0	22
—	—	—	48	56	5.6	trace	.26	.12	1.3	trace	23
—	—	—	42	74	4.6	trace	.13	.10	1.5	—	24
3	3	1	50	141	4.7	340	.20	.08	1.5	5	25
—	—	—	60	177	5.2	160	.18	.09	1.5	5	26
—	—	—	32	75	4.0	450	.29	.16	2.0	28	27
—	—	—	7	62	.8	680	.08	.11	.6	16	28
—	—	—	7	62	.8	680	.07	.10	.4	13	29
—	—	—	10	81	2.9	690	.08	.10	.7	9	30
—	—	—	6	17	1.2	20	.12	.12	.7	17	31
—	—	—	4	46	.7	90	.17	.16	.8	4	32
8	7	trace	0	10	2.9	30	.04	.18	3.5	—	33
2	2	trace	0	10	2.7	10	.04	.16	3.3	—	34
5	4	trace	0	10	3.0	20	.08	.20	5.1	—	35
8	8	trace	0	9	2.7	30	.07	.18	4.6	—	36
16	15	1	0	8	2.2	70	.05	.13	3.1	—	37
3	3	trace	0	6	1.8	10	.04	.11	2.6	—	38
3	3	trace	0	11	3.2	10	.06	.19	4.5	—	39
1	1	trace	0	10	3.0	trace	.06	.18	4.3	—	40
13	12	1	0	9	2.5	50	.05	.16	4.0	—	41
2	2	trace	0	7	2.2	10	.05	.14	3.6	—	42
6	6	trace	0	10	3.0	20	.07	.19	4.8	—	43
2	2	trace	0	9	2.5	10	.06	.16	4.1	—	44
5	4	trace	0	17	3.7	20	.01	.20	2.9	—	45
5	4	trace	9	11	1.7	—	.01	.08	1.8	—	46

Table A-1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)		Water		Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
47	Beef, dried or chipped	2 ounces	57	48	115	19	4
48	Beef potpie, individual pie 4¼ inch diameter	8 ounces before baking	227	55	560	23	33
49	Beef and vegetable stew	1 cup	235	82	210	15	10
50	Beets, cooked, diced	1 cup	165	91	50	2	trace
51	Beet greens, cooked	1 cup	180	94	33	3	trace
	Beverages, carbonated:						
52	Cola type	1 cup	240	90	95	0	0
53	Gingerale	1 cup	230	92	70	0	0
54	Biscuits, baking powder with enriched flour, 2½-inch diameter	1 biscuit	38	27	140	3	6
55	Blackberries, raw	1 cup	144	84	85	2	1
56	Blueberries, raw	1 cup	140	83	85	1	1
57	Bluefish, baked or broiled	3 ounces	85	68	135	22	4
58	Bouillon cube, 5/8 inch	1 cube	4	4	5	1	trace
59	Bran flakes (40 per cent bran) added thiamine	1 ounce	28	3	85	3	1
60	Brazil nuts	1 cup	140	5	915	20	94
	Breads:						
61	Boston brown bread, slice, 3 by ¾ inch	1 slice	48	45	100	3	1
	Cracked-wheat bread:						
62	Loaf, 1-pound, 20 slices	1 loaf	454	35	1190	39	10
63	Slice	1 slice	23	35	60	2	1
	French or vienna bread:						
64	Enriched, 1-pound loaf	1 loaf	454	31	1315	41	14
65	Unenriched, 1-pound loaf	1 loaf	454	31	1315	41	14
	Italian bread:						
66	Enriched, 1-pound loaf	1 loaf	454	32	1250	41	4
67	Unenriched, 1-pound loaf	1 loaf	454	32	1250	41	4
	Raisin bread:						
68	Loaf, 1-pound, 20 slices	1 loaf	454	35	1190	30	13
69	Slice	1 slice	23	35	60	2	1
	Rye bread:						
	American, light (⅓ rye, ⅔ wheat):						
70	Loaf, 1-pound, 20 slices	1 loaf	454	36	1100	41	5
71	Slice	1 slice	23	36	55	2	trace
72	Pumpernickel, loaf, 1 pound	1 loaf	454	34	1115	41	5

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
2	2	trace	0	11	2.9	—	0.04	0.18	2.2	—	47
9	20	2	43	32	4.1	1860	.25	.27	4.5	7	48
5	4	trace	15	28	2.8	2310	.13	.17	4.4	15	49
—	—	—	12	23	.8	40	.04	.07	.5	11	50
0	0	0	6	179[3]	3.4	9180	.12	.27	.5	27	51
—	—	—	24	—	—	0	0	0	0	0	52
—	—	—	18	—	—	0	0	0	0	0	53
2	3	1	17	46	.6	trace	.08	.08	.7	trace	54
—	—	—	19	46	1.3	290	.05	.06	.5	30	55
—	—	—	21	21	1.4	140	.04	.08	.6	20	56
—	—	—	0	25	.6	40	.09	.08	1.6	—	57
—	—	—	trace	—	—	—	—	—	—	—	58
—	—	—	23	20	1.2	0	.11	.05	1.7	0	59
19	45	24	15	260	4.8	trace	1.34	.17	2.2	—	60
—	—	—	22	43	.9	0	.05	.03	.6	0	61
2	5	2	236	399	5.0	trace	.53	.42	5.8	trace	62
—	—	—	12	20	.3	trace	.03	.02	.3	trace	63
3	8	2	251	195	10.0	trace	1.26	.98	11.3	trace	64
3	8	2	251	195	3.2	trace	.39	.39	3.6	trace	65
trace	1	2	256	77	10.0	0	1.31	.93	11.7	0	66
trace	1	2	256	77	3.2	0	.39	.27	3.6	0	67
3	8	2	243	322	5.9	trace	.24	.42	3.0	trace	68
—	—	—	12	16	.3	trace	.01	.02	.2	trace	69
—	—	—	236	340	7.3	0	.81	.33	6.4	0	70
—	—	—	12	17	.4	0	.04	.02	.3	0	71
—	—	—	241	381	10.9	0	1.05	.63	5.4	0	72

[3] Calcium may not be usable because of presence of oxalic acid.

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)			Water	Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
	White bread, enriched:						
	1 to 2 per cent nonfat dry milk:						
73	Loaf, 1-pound, 20 slices	1 loaf	454	36	1225	39	15
74	Slice	1 slice	23	36	60	2	1
	3 to 4 per cent nonfat dry milk:[4]						
75	Loaf, 1-pound, 20 slices	1 loaf	454	36	1225	39	15
76	Slice	1 slice	23	36	60	2	1
77	Slice, toasted	1 slice	20	25	60	2	1
78	Slice, 26 per loaf	1 slice	17	36	45	1	1
	5 to 6 per cent nonfat dry milk:[4]						
79	Loaf, 1-pound, 20 slices	1 loaf	454	35	1245	41	17
80	Slice	1 slice	23	35	65	2	1
	White bread, enriched:						
	1 to 2 per cent nonfat dry milk:						
81	Loaf, 1-pound, 20 slices	1 loaf	454	36	1225	39	15
82	Slice	1 slice	23	36	60	2	1
	3 to 4 per cent nonfat dry milk:[4]						
83	Loaf, 1-pound	1 loaf	454	36	1225	39	15
84	Slice, 20 per loaf	1 slice	23	36	60	2	1
85	Slice, toasted	1 slice	20	25	60	2	1
86	Slice, 26 per loaf	1 slice	17	36	45	1	1
	5 to 6 per cent nonfat dry milk:						
87	Loaf, 1 pound, 20 slices	1 loaf	454	35	1245	41	17
88	Slice	1 slice	23	35	65	2	1
	Whole-wheat bread, made with 2 per cent nonfat dry milk:						
89	Loaf, 1-pound, 20 slices	1 loaf	454	36	1105	48	14
90	Slice	1 slice	23	36	55	2	1
91	Slice, toasted	1 slice	19	24	55	2	1
92	Breadcrumbs, dry, grated	1 cup	88	6	345	11	4
93	Broccoli spears, cooked	1 cup	150	91	40	5	trace
94	Brownies, with nuts, home recipe, 2 by 1½ by 5/8 inches	1 piece	28	10	138	2	9
95	Brussels sprouts, cooked	1 cup	130	88	45	5	1
	Butter, 4 sticks per pound:						
96	Sticks, 2	1 cup	227	16	1625	1	184
97	Sticks, ⅛	1 tablespoon	14	16	100	trace	11
98	Pat or square (64 per pound)	1 pat	7	16	50	trace	6
99	Buttermilk, cultured, from skim milk	1 cup	246	90	90	9	trace

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
3	8	2	229	318	10.9	trace	1.13	0.77	10.4	trace	73
trace	trace	trace	12	16	.6	trace	.06	.04	.5	trace	74
3	8	2	229	381	11.3	trace	1.13	.95	10.8	trace	75
trace	trace	trace	12	19	.6	trace	.06	.05	.6	trace	76
trace	trace	trace	12	19	.6	trace	.05	.05	.6	trace	77
trace	trace	trace	9	14	.4	trace	.04	.04	.4	trace	78
4	10	2	228	435	11,3	trace	1.22	.91	11.0	trace	79
trace	trace	trace	12	22	.6	trace	.06	.05	.6	trace	80
3	8	2	229	318	3.2	trace	.40	.36	5.6	trace	81
trace	trace	trace	12	16	.2	trace	.02	.02	.3	trace	82
3	8	2	229	381	3.2	trace	.31	.39	5.0	trace	83
trace	trace	trace	12	19	.2	trace	.02	.02	.3	trace	84
trace	trace	trace	12	19	.2	trace	.01	.02	.3	trace	85
trace	trace	trace	9	14	.1	trace	.01	.01	.2	trace	86
4	10	2	228	435	3.2	trace	.32	.59	4.1	trace	87
trace	trace	trace	12	22	.2	trace	.02	.03	.2	trace	88
3	6	3	216	449	10.4	trace	1.17	.56	12.9	trace	89
trace	trace	trace	11	23	.5	trace	.06	.03	.7	trace	90
trace	trace	trace	11	22	.5	trace	.05	.03	.6	trace	91
1	2	1	65	107	3.2	trace	.19	.26	3.1	trace	92
—	—	—	7	132	1.2	3750	.14	.29	1.2	135	93
2	5	1	15	12	.5	60	.06	.04	.2	trace	94
—	—	—	8	42	1.4	680	.10	.18	1.1	113	95
101	61	6	1	45	0	7500[5]	—	—	—	0	96
6	4	trace	trace	3	0	460[5]	—	—	—	0	97
3	2	trace	trace	1	0	230[5]	—	—	—	0	98
—	—	—	13	298	.1	10	.09	.44	.2	2	99

[5] Year-round average.

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)		Water	Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
	Cabbage:						
	Raw:						
100	Finely shredded	1 cup	100	92	25	1	trace
101	Coleslaw	1 cup	120	83	120	1	9
	Cooked:						
102	In small amount of water, short time	1 cup	170	94	35	2	trace
103	In large amount of water, long time	1 cup	170	94	30	2	trace
	Cabbage, celery or Chinese:						
104	Raw, leaves and stalk, 1-inch pieces	1 cup	100	95	15	1	trace
105	Cabbage, spoon (or pak-choy), cooked	1 cup	150	95	20	2	trace
	Cakes:[6]						
106	Angelfood cake; sector, 2-inch (1/12 of 8-inch-diameter cake)	1 sector	40	32	110	3	trace
107	Chocolate cake, chocolate icing; sector, 2-inch (1/16 of 10-inch diameter layer cake)	1 sector	120	22	445	5	20
108	Fruitcake, dark (made with enriched flour); piece, 2 by 2 by ½ inch	1 piece	30	18	115	1	5
109	Gingerbread (made with enriched flour); piece 2 by 2 by 2 inches	1 piece	55	31	175	2	6
	Plain cake and cupcakes, without icing:						
110	Piece, 3 by 2 by 1½ inches	1 piece	55	24	200	2	8
111	Cupcake, 2¾-inch diameter	1 cupcake	40	24	145	2	6
	Plain cake and cupcakes with chocolate icing:						
112	Sector, 2-inch (1/16 of 10-inch-layer cake)	1 sector	100	21	370	4	14
113	Cupcake, 2¾-inch diameter	1 cupcake	50	21	185	2	7
114	Poundcake, old-fashioned (equal weights flour, sugar, fat, eggs); slice, 2¾ by 3 by 5/8 inch	1 slice	30	17	140	2	9

[6] Unenriched cake flour and vegetable cooking fat used unless otherwise specified.

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
—	—	—	5	49	0.4	130	0.05	0.05	0.3	47	100
2	2	5	9	52	.5	180	.06	.06	.3	35	101
—	—	—	7	75	.5	220	.07	.07	.5	56	102
—	—	—	7	71	.5	200	.04	.04	.2	40	103
—	—	—	3	43	.6	150	.05	.04	.6	25	104
—	—	—	4	222	.9	4650	.07	.12	1.1	23	105
—	—	—	24	4	.1	0	trace	.06	.1	0	106
8	10	1	67	84	1.2	190[7]	.03	.12	.3	trace	107
1	3	1	18	22	.8	40[7]	.04	.04	.2	trace	108
1	4	trace	29	37	1.3	50	.06	.06	.5	0	109
2	5	1	31	35	.2	90[7]	.01	.05	.1	trace	110
1	3	trace	22	26	.2	70[7]	.01	.03	.1	trace	111
5	7	1	59	63	.6	180[7]	.02	.09	.2	trace	112
2	4	trace	30	32	.3	90[7]	.01	.04	.1	trace	113
2	5	1	14	6	.2	80[7]	.01	.03	.1	0	114

[7] If the fat used in the recipe is butter or fortified margarine, the vitamin-A value for chocolate cake with chocolate icing will be 490 I.U., item 107; 100 I.U. for fruitcake, item 108; for plain cake without icing, 300 I.U., item 110; 220 I.U. per cupcake, item 111; for plain cake with icing, 440 I.U., item 112; 220 I.U. per cupcake, item 113; and 300 I.U. for poundcake, item 114.

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)		Water	Food Energy	Protein	Fat (total lipid)
			gm	*per cent*	*calories*	*gm*	*gm*
115	Sponge cake; sector, 2-inch (1/12 of 8-inch-diameter cake)	1 sector	40	32	120	3	2
	Candy:						
116	Caramels	1 ounce	28	8	115	1	3
117	Chocolate, milk, plain	1 ounce	28	1	150	2	9
118	Fudge, plain	1 ounce	28	8	115	1	3
119	Hard candy	1 ounce	28	1	110	0	trace
120	Marshmallows	1 ounce	28	17	90	1	trace
121	Cantaloupe, raw; medium, 5-inch diameter, about 1⅓ pounds[1]	½ melon	385	91	60	1	trace
	Carrots:						
	Raw:						
122	Whole, 5½ by 1 inch (25 thin strips)	1 carrot	50	88	20	1	trace
123	Grated	1 cup	110	88	45	1	trace
124	Cooked, diced	1 cup	145	91	45	1	trace
125	Cashew nuts, roasted	1 cup	135	5	760	23	62
	Cauliflower:						
126	Raw	1 cup	100	91	27	3	trace
127	Cooked, flower buds	1 cup	120	93	25	3	trace
	Celery:						
	Raw:						
128	Stalk, large outer, 8 by about 1½ inches at root end	1 stalk	40	94	5	trace	trace
129	Pieces, diced	1 cup	100	94	15	1	trace
130	Cooked	1 cup	120	95	17	1	trace
	Cheese:						
131	Blue or Roquefort type	1 ounce	28	40	105	6	9
132	Camembert	1 ounce	28	52	84	5	7
	Cheddar or American:						
133	Ungrated	1 inch cube	17	37	70	4	5
134	Grated	1 cup	112	37	445	28	36
135		1 tablespoon	7	37	30	2	2
136	Cheddar, process	1 ounce	28	40	105	7	9
137	Cheese foods, Cheddar	1 ounce	28	43	90	6	7
	Cottage cheese from skim milk:						
138	Creamed	1 cup	225	78	240	31	9
139		1 ounce	28	78	30	4	1
140	Uncreamed	1 cup	225	79	195	38	1
141		1 ounce	28	79	25	5	trace
142	Cream cheese	1 ounce	28	51	105	2	11
143		1 tablespoon	15	51	55	1	6

Fatty Acids											
Saturated (total gm	Unsaturated Oleic gm	Linoleic gm	Carbohydrate gm	Calcium mg	Iron mg	Vitamin A Value I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Ascorbic Acid mg	Item No.
1	1	trace	22	12	0.5	180	0.02	0.06	0.1	trace	115
2	1	trace	22	42	.4	trace	.01	.05	trace	trace	116
5	3	trace	16	65	.3	80	.02	.09	.1	trace	117
2	1	trace	21	22	.3	trace	.01	.03	.1	trace	118
—	—	—	28	6	.5	0	0	0	0	0	119
—	—	—	23	5	.5	0	0	trace	trace	0	120
—	—	—	14	27	.8	6540[8]	.08	.06	1.2	63	121
—	—	—	5	18	.4	5500	.03	.03	.3	4	122
—	—	—	11	41	.8	12100	.06	.06	.7	9	123
—	—	—	10	48	.9	15220	.08	.07	.7	9	124
10	43	4	40	51	5.1	140	.58	.33	2.4	—	125
—	—	—	5	25	1.1	60	.11	.10	.7	78	126
—	—	—	5	25	.8	70	.11	.10	.7	66	127
—	—	—	2	16	.1	100	.01	.01	.1	4	128
—	—	—	4	39	.3	240	.03	.03	.3	9	129
—	—	—	4	37	.2	275	.02	.03	.3	7	130
5	3	trace	1	89	.1	350	.01	.17	.1	0	131
—	—	—	1	30	.1	285	.01	.21	.3	0	132
3	2	trace	trace	128	.2	220	trace	.08	trace	0	133
20	12	1	2	840	1.1	1470	.03	.51	.1	0	134
1	1	trace	trace	52	.1	90	trace	.03	trace	0	135
5	3	trace	1	219	.3	350	trace	.12	trace	0	136
4	2	trace	2	162	.2	280	.01	.16	trace	0	137
5	3	trace	7	212	.7	380	.07	.56	.2	0	138
1	trace	trace	1	27	.1	50	.01	.07	trace	0	139
trace	trace	trace	6	202	.9	20	.07	.63	.2	0	140
—	—	—	1	26	.1	trace	.01	.08	trace	0	141
6	4	trace	1	18	.1	440	trace	.07	trace	0	142
3	2	trace	trace	9	trace	230	trace	.04	trace	0	143

[8] Value based on varieties with orange-colored flesh; for green-fleshed varieties value is about 540 I.U. per 1/2 melon.



Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)			Water	Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
144	Cheese, Limburger	1 ounce	28	45	97	6	8
145	Parmesan	1 ounce	28	30	110	10	7
146	Swiss (domestic)	1 ounce	28	39	105	8	8
	Cherries:						
147	Raw, sweet, with stems[1]	1 cup	130	80	80	2	trace
148	Canned, red, sour, pitted in heavy syrup	1 cup	260	76	230	2	1
	Chicken, cooked:						
149	Flesh only, broiled	3 ounces	85	71	115	20	3
	Breast, fried, ½ breast:						
150	With bone	3.3 ounces	94	58	155	25	5
151	Flesh and skin only	2.7 ounces	76	58	155	25	5
	Drumstick, fried:						
152	With bone	2.1 ounces	59	55	90	12	4
153	Flesh and skin only	1.3 ounces	38	55	90	12	4
154	Chicken, canned, boneless	3 ounces	85	65	170	18	10
155	Chicken potpie. Individual pie, 4¼-inch diameter, weight before baking 8 ounces	1 pie	227	57	535	23	31
	Chili con carne:						
156	With beans	1 cup	250	72	335	19	15
157	Without beans	1 cup	255	67	510	26	38
158	Chili powder (dried hot red peppers without seeds, added seasonings)	1 tablespoon	15	8	50	2	2
159	Chili sauce (mainly tomatoes)	1 tablespoon	17	68	20	trace	trace
	Chocolate:						
160	Bitter or baking	1 ounce	28	2	145	3	15
161	Sweet	1 ounce	28	1	150	1	10
162	Chocolate syrup, thin	1 tablespoon	20	32	50	trace	trace
	Clams:						
163	Raw, meat only	3 ounces	85	82	65	11	1
164	Canned, solids and liquid	3 ounces	85	86	45	7	1
165	Cocoa, beverage with milk	1 cup	242	79	235	9	11
166	Cocoa, dry powder, breakfast	1 teaspoon	4	3	12	1	1
	Coconut:						
167	Fresh, shredded	1 cup	97	51	335	3	34
168	Dried, shredded, sweetened	1 cup	62	3	340	2	24
169	Collards, cooked	1 cup	190	91	55	5	1
	Cookies:						
170	Plain and assorted, 3-inch diameter	1 cooky	25	3	120	1	5
171	Fig bars, small	1 fig bar	16	14	55	1	1

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
—	—	—	1	167	0.2	323	0.02	0.15	0.1	0	144
—	—	—	1	323	.1	300	.01	.21	.1	0	145
4	3	trace	1	262	.3	320	trace	.11	trace	0	146
—	—	—	20	26	.5	130	.06	.07	.5	12	147
—	—	—	59	36	.8	1680	.07	.06	.4	13	148
1	1	1	0	8	1.4	80	.05	.16	7.4	—	149
1	2	1	1	9	1.3	70	.04	.17	11.2	—	150
1	2	1	1	9	1.3	70	.04	.17	11.2	—	151
1	2	1	trace	6	.9	50	.03	.15	2.7	—	152
1	2	1	trace	6	.9	50	.03	.15	2.7	—	153
3	4	2	0	18	1.3	200	.03	.11	3.7	3	154
10	15	3	42	68	3.0	3020	.25	.26	4.1	5	155
7	7	trace	30	80	4.2	150	.08	.18	3.2	—	156
18	17	1	15	97	3.6	380	.05	.31	5.6	—	157
—	—	—	8	40	2.3	9750	.03	.17	1.3	2	158
—	—	—	4	3	.1	240	.02	.01	.3	3	159
8	6	trace	8	22	1.9	20	.01	.07	.4	0	160
6	4	trace	16	27	.4	trace	.01	.04	.1	trace	161
trace	trace	trace	13	3	.3	—	trace	.01	.1	trace	162
—	—	—	2	59	5.2	90	.08	.15	1.1	8	163
—	—	—	2	47	3.5	—	.01	.09	.9	—	164
6	4	trace	26	286	.9	390	.09	.45	.4	2	165
—	—	—	2	5	.4	trace	.01	.02	.1	0	166
29	2	trace	9	13	1.6	0	.05	.02	.5	3	167
21	2	trace	33	10	1.2	0	.02	.02	.2	0	168
—	—	—	9	289	1.1	10260	.27	.37	2.4	87	169
—	—	—	18	9	.2	20	.01	.01	.1	trace	170
—	—	—	12	12	.2	20	.01	.01	.1	trace	171

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)			Water	Food Energy	Protein	Fat (total lipid
			gm	per cent	calories	gm	gm
	Corn:						
172	Cooked, ear 5 by 1¾ inches[1]	1 ear	140	74	70	3	1
173	Canned, solids and liquid	1 cup	256	81	170	5	2
174	Corn, rice and wheat flakes, mixed, added nutrients	1 ounce	28	3	110	2	trace
	Corn flakes, added nutrients:						
175	Plain	1 ounce	28	4	110	2	trace
176	Sugar-covered	1 ounce	28	2	110	1	trace
	Corn grits, degermed, cooked:						
177	Enriched	1 cup	242	87	120	3	trace
178	Unenriched	1 cup	242	87	120	3	trace
	Cornmeal, white or yellow, dry:						
179	Whole ground, unbolted	1 cup	118	12	420	11	5
180	Degermed, enriched	1 cup	145	12	525	11	2
181	Corn muffins, made with enriched degermed cornmeal and enriched flour; muffin, 2¾-inch diameter	1 muffin	48	33	150	3	5
182	Corn, puffed, presweetened, added nutrients	1 ounce	28	5	110	1	trace
183	Corn, shredded, added nutrients	1 ounce	28	3	110	2	trace
	Cowpeas:						
184	Immature seeds, cooked	1 cup	160	72	175	13	1
185	Dry, cooked	1 cup	248	80	190	13	1
186	Crabmeat, canned	3 ounces	85	77	85	15	2
	Crackers:						
187	Graham, plain	4 small or 2 medium	14	6	55	1	1
188	Saltines, 2 inches square	2 crackers	8	4	35	1	1
	Soda:						
189	Cracker, 2½ inches square	2 crackers	11	4	50	1	1
190	Oyster crackers	10 crackers	10	4	45	1	1
191	Cracker meal	1 tablespoon	10	6	45	1	1
192	Cranberry juice cocktail, canned	1 cup	250	83	160	trace	trace
193	Cranberry sauce, canned, sweetened, strained	1 cup	277	62	405	trace	1

Fatty Acids											
Satu-rated (*total*)	Unsaturated Oleic	Lino-leic	Carbo-hydrate	Cal-cium	Iron	Vitamin A Value	Thia-mine	Ribo-flavin	Niacin	Ascorbic Acid	Item No.
gm	*gm*	*gm*	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*	
—	—	—	16	2	0.5	310[9]	0.09	0.08	1.0	7	172
—	—	—	40	10	1.0	690[9]	.07	.12	2.3	13	173
—	—	—	24	11	.5	0	.11	—	.9	0	174
—	—	—	24	5	.4	0	.12	.02	.6	0	175
—	—	—	26	3	.3	0	.12	.01	.5	0	176
—	—	—	27	2	.7[10]	150[11]	.10[10]	.07[10]	1.0[10]	0	177
—	—	—	27	2	.2	150[11]	.05	.02	.5	0	178
1	2	2	87	24	2.8	600[11]	.45	.13	2.4	0	179
trace	1	1	114	9	4.2[10]	640[11]	.64[10]	.38[10]	5.1[10]	0	180
2	2	trace	23	50	.8	80[12]	.09	.11	.8	trace	181
—	—	—	26	3	.5	0	.12	.05	.6	0	182
—	—	—	25	1	.7	0	.12	.05	.6	0	183
—	—	—	29	38	3.4	560	.49	.18	2.3	28	184
—	—	—	34	42	3.2	20	.41	.11	1.1	trace	185
—	—	—	1	38	.7	—	.07	.07	1.6	—	186
—	—	—	10	6	.2	0	.01	.03	.2	0	187
—	—	—	6	2	.1	0	trace	trace	.1	0	188
trace	1	trace	8	2	.2	0	trace	trace	.1	0	189
trace	1	trace	7	2	.2	0	trace	trace	.1	0	190
trace	1	trace	7	2	.1	0	.01	trace	.1	0	191
—	—	—	41	12	.8	trace	.02	.02	.1	[13]	192
—	—	—	104	17	.6	40	.03	.03	.1	5	193

[9] Based on yellow varieties; white varieties contain only a trace of cryptoxanthin and carotenes, the pigments in corn that have biological activity.

[10] Iron, thiamine, riboflavin, and niacin are based on the minimum levels of enrichment specified in standards of identity promulgated under the Federal Food, Drug, and Cosmetic Act.

[11] Vitamin-A value based on yellow product. White product contains only a trace.

[12] Based on recipe using white cornmeal; if yellow cornmeal is used, the vitamin-A value is 140 I.U. per muffin.

[13] About 5 mg per 8 fluid ounces is from cranberries. Ascorbic acid is usually added to approximately 100 mg per 8 fluid ounces.

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)			Water	Food Energy	Protein	Fat (total) lipid
			gm	per cent	calories	gm	gm
	Cream:						
194	Half-and-half (cream and milk)	1 cup	242	80	325	8	28
195		1 tablespoon	15	80	20	trace	2
196	Light, coffee or table	1 cup	240	72	505	7	49
197		1 tablespoon	15	72	30	trace	3
	Whipping, unwhipped, (volume about double when whipped):						
198	Light	1 cup	239	62	715	6	75
199		1 tablespoon	15	62	45	trace	5
200	Heavy	1 cup	238	57	840	5	89
201		1 tablespoon	15	57	55	trace	6
202	Cucumbers, raw, pared, 7½ by about 2 inches	1 cucumber	207	96	30	1	trace
203	Slices, ⅛-inch thick	6 slices	50	96	5	trace	trace
204	Custard, baked	1 cup	248	77	285	13	14
205	Dandelion greens, cooked	1 cup	180	90	60	4	1
206	Dates, domestic, natural and dry, pitted, cut	1 cup	178	22	490	4	1
207	Doughnuts, cake type	1 doughnut	32	24	125	1	6
	Eggs, large, 24 ounces per dozen:						
	Raw:						
208	Whole, without shell	1 egg	50	74	80	6	6
209	White of egg	1 white	33	88	15	4	trace
210	Yolk of egg	1 yolk	17	51	60	3	5
	Cooked:						
211	Boiled, shell removed	2 eggs	100	74	160	13	12
212	Scrambled, with milk and fat	1 egg	64	72	110	7	8
213	Endive, curly (including escarole)	2 ounces	57	93	10	1	trace
214	Farina, regular, enriched, cooked	1 cup	238	90	100	3	trace
215	Fats, cooking vegetable	1 cup	200	0	1770	0	200
216		1 tablespoon	12.5	0	110	0	12
	Figs:						
217	Raw, small, 1½-inch diameter, about 12 per pound	3 figs	114	78	90	1	trace
218	Dried, large, 2 by 1 inch	1 fig	21	23	60	1	trace
219	Fish sticks, breaded, cooked, frozen; stick 3.8 by 1.0 by 0.5 inches	10 sticks or 8-ounce package	227	66	400	38	20
220	Fruit cocktail, canned in heavy syrup, solids and liquid	1 cup	256	80	195	1	1

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	gm	mg	I.U.	mg	mg	mg	mg	
16	9	1	11	261	0.1	1160	0.08	0.38	0.1	2	194
1	1	trace	1	16	trace	70	trace	.02	trace	trace	195
27	16	1	10	245	.1	2030	.07	.36	.1	2	196
2	1	trace	1	15	trace	130	trace	.02	trace	trace	197
41	25	2	9	203	.1	3070	.06	.30	.1	2	198
3	2	trace	1	13	trace	190	trace	.02	trace	trace	199
49	29	3	7	178	.1	3670	.05	.26	.1	2	200
3	2	trace	trace	11	trace	230	trace	.02	trace	trace	201
—	—	—	7	35	.6	trace	.07	.09	.4	23	202
—	—	—	2	8	.2	trace	.02	.02	.1	6	203
6	5	1	28	278	1.0	870	.10	.47	.2	1	204
—	—	—	12	252	3.2	21060	.24	.29	—	32	205
—	—	—	130	105	5.3	90	.16	.17	3.9	0	206
1	4	trace	16	13	.4[14]	30	.05[14]	.05[14]	.4[14]	trace	207
2	3	trace	trace	27	1.1	590	.05	.15	trace	0	208
—	—	—	trace	3	trace	0	trace	.09	trace	0	209
2	2	trace	trace	24	.9	580	.04	.07	trace	0	210
4	5	1	1	54	2.3	1180	.09	.28	.1	0	211
3	3	trace	1	51	1.1	690	.05	.18	trace	0	212
—	—	—	2	46	1.0	1870	.04	.08	.3	6	213
—	—	—	21	10	.7[10]	0	.11[10]	.07[10]	1.0[10]	0	214
46	130	14	0	0	0	—	0	0	0	0	215
3	8	1	0	0	0	—	0	0	0	0	216
—	—	—	23	40	.7	90	.07	.06	.5	2	217
—	—	—	15	26	.6	20	.02	.02	.1	0	218
5	4	10	15	25	.9	—	.09	.16	3.6	—	219
—	—	—	50	23	1.0	360	.04	.03	1.1	5	220

[14] Based on product made with enriched flour. With unenriched flour, approximate values per doughnu

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)			Water	Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
	Gelatin, dry:						
221	Plain	1 tablespoon	10	13	35	9	trace
222	Dessert powder, 3-ounce package	½ cup	85	2	315	8	0
223	Gelatin dessert, plain, reacy-to-eat	1 cup	239	84	140	4	0
	Grapefruit:						
	Raw, medium, 4¼-inch d ameter, size 64:						
224	White[1]	½ grapefruit	285	89	55	1	trace
225	Pink or red[1]	½ grapefruit	285	89	60	1	trace
226	Raw sections, white	1 cup	194	89	75	1	trace
	Canned, white:						
227	Syrup pack, solids and liquid	1 cup	249	81	175	1	trace
228	Water pack, solids and liquid	1 cup	240	91	70	1	trace
	Grapefruit juice:						
229	Fresh	1 cup	246	90	95	1	trace
230	Canned, unsweetened	1 cup	247	89	100	1	trace
231	Canned, sweetened	1 cup	250	86	130	1	trace
	Frozen concentrate, unsweetened:						
232	Undiluted, can, 6 fluid ounces	1 can	207	62	300	4	1
233	Diluted with 3 parts water, by volume	1 cup	247	89	100	1	trace
234	Frozen concentrate, sweetened:						
	Undiluted, can, 6 fluid ounces	1 can	211	57	350	3	1
235	Diluted with 3 parts water, by volume	1 cup	249	88	115	1	trace
	Dehydrated:						
236	Crystals, can, net weight 4 ounces	1 can	114	1	430	5	1
237	Prepared with water (1 pound yields about 1 gallon)	1 cup	247	90	100	1	trace
	Grapes, raw:						
238	American type (slip skin), such as Concord, Delaware, Niagara, Catawba, and Scuppernong	1 cup	153	82	65	1	1
239	European type (adherent skin), such as Malaga, Muscat, Thompson Seedless, Emperor and Flame Tokay	1 cup	160	81	95	1	trace

Fatty Acids											
Saturated (*total*)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	*gm*	*gm*	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*	
—	—	—	—	—	—	—	—	—	—	—	221
—	—	—	75	—	—	—	—	—	—	—	222
—	—	—	34	—	—	—	—	—	—	—	223
—	—	—	14	22	.6	10	.05	.02	.2	52	224
—	—	—	15	23	.6	640	.05	.02	.3	52	225
—	—	—	20	31	.8	20	.07	.03	.3	72	226
—	—	—	44	32	.7	20	.07	.04	.5	75	227
—	—	—	18	31	.7	20	.07	.04	.5	72	228
—	—	—	23	22	.5	[15]	.09	.04	.4	92	229
—	—	—	24	20	1.0	20	.07	.04	.4	84	230
—	—	—	32	20	1.0	20	.07	.04	.4	78	231
—	—	—	72	70	.8	60	.29	.12	1.4	286	232
—	—	—	24	25	.2	20	.10	.04	.5	96	233
—	—	—	85	59	.6	50	.24	.11	1.2	245	234
—	—	—	28	20	.2	20	.08	.03	.4	82	235
—	—	—	103	99	1.1	90	.41	.18	2.0	399	236
—	—	—	24	22	.2	20	.10	.05	.5	92	237
—	—	—	15	15	.4	100	.05	.03	.2	3	238
—	—	—	25	17	.6	140	.07	.04	.4	6	239

[15] For white-fleshed varieties value is about 20 I.U. per cup; for red-fleshed varieties, 1080 I.U. per cup.

Item No.	Food, approximate measure, and weight (in grams)		Water	Food Energy	Protein	Fat (total lipid)
		gm	per cent	Calories	gm	gm
240	Grape juice, bottle or canned	1 cup 254	83	165	1	trace
241	Gravy, meat, brown	1 tablespoon 18	81	22	trace	2
242	Haddock, fried	3 ounces 85	66	140	17	5
243	Heart, beef, lean, braised	3 ounces 85	61	160	27	5
244	Honey, strained or extracted	1 tablespoon 21	17	65	trace	0
245	Honeydew melon, 7-inch diameter	⅛ melon 150	91	50	1	trace
	Ice cream, plain, factory packed:					
246	Slice or cut brick, ⅛ of quart brick	1 slice or cut brick 71	62	145	3	9
247	Container	3½ fluid ounces 62	62	130	2	8
248	Container	8 fluid ounces 142	62	295	6	18
249	Ice milk	1 cup 187	67	285	9	10
250	Jams and preserves	1 tablespoon 20	29	55	trace	trace
251	Jellies	1 tablespoon 20	29	55	trace	trace
252	Kale, leaves including stems, cooked	1 cup 110	91	30	4	1
	Lamb, trimmed to retail basis,[2] cooked:					
253	Chop, thick, with bone, broiled	1 chop, 4.8 ounces 137	47	400	25	33
254	Lean and fat	4.0 ounces 112	47	400	25	33
255	Lean only	2.6 ounces 74	62	140	21	6
	Leg, roasted:					
256	Lean and fat	3 ounces 85	54	235	22	16
257	Lean only	2.5 ounces 71	62	130	20	5
	Shoulder, roasted:					
258	Lean and fat	3 ounces 85	50	285	18	23
259	Lean only	2.3 ounces 64	61	130	17	6
260	Lard	1 cup 220	0	1985	0	220
261	Lard	1 tablespoon 14	0	125	0	14
262	Lemons, raw, medium, 2 1/5-inch diameter, size 150[1]	1 lemon 106	90	20	1	trace
	Lemon juice:					
263	Fresh	1 cup 246	91	60	1	trace
264		1 tablespoon 15	91	5	trace	trace
265	Canned, unsweetened	1 cup 245	92	55	1	trace
	Lemonade, concentrate, frozen, sweetened:					
266	Undiluted, can, 6 fluid ounces	1 can 220	48	430	trace	trace
267	Diluted with 4⅓ parts water by volume	1 cup 248	88	110	trace	trace

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
—	—	—	42	28	0.8	—	0.10	0.05	0.6	trace	240
—	—	—	1	trace	.1	0	trace	trace	trace	0	241
1	3	trace	5	34	1.0	—	.03	.06	2.7	2	242
—	—	—	1	5	5.0	20	.21	1.04	6.5	1	243
—	—	—	17	1	.1	0	trace	.01	.1	trace	244
—	—	—	13	26	.6	60	.08	.05	.3	34	245
5	3	trace	15	87	.1	370	.03	.13	.1	1	246
4	3	trace	13	76	.1	320	.03	.12	.1	1	247
10	6	1	29	175	.1	740	.06	.27	.1	1	248
6	3	trace	42	292	.2	390	.09	.41	.2	2	249
—	—	—	14	4	.2	trace	trace	.01	trace	—	250
—	—	—	14	4	.3	trace	trace	.01	trace	1	251
—	—	—	4	147	1.3	8140	—	—	—	68	252
18	12	1	0	10	1.5	—	.14	.25	5.6	—	253
18	12	1	0	10	1.5	—	.14	.25	5.6	—	254
3	2	trace	0	9	1.5	—	.11	.20	4.5	—	255
9	6	trace	0	9	1.4	—	.13	.23	4.7	—	256
3	2	trace	0	9	1.4	—	.12	.21	4.4	—	257
13	8	1	0	9	1.0	—	.11	.20	4.0	—	258
3	2	trace	0	8	1.0	—	.10	.18	3.7	—	259
84	101	22	0	0	0	0	0	0	0	0	260
5	6	1	0	0	0	0	0	0	0	0	261
—	—	—	6	18	.4	10	.03	.01	.1	38	262
—	—	—	20	17	.5	40	.08	.03	.2	113	263
—	—	—	1	1	trace	trace	trace	trace	trace	7	264
—	—	—	19	17	.5	40	.07	.03	.2	102	265
—	—	—	112	9	.4	40	.05	.06	.7	66	266
—	—	—	28	2	.1	10	.01	.01	.2	17	267

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)			Water	Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
	Lettuce, raw:						
268	Butterhead, as Boston types; head, 4-inch diameter	1 head	220	95	30	3	trace
269	Crisphead, as Iceberg; head, 4¾-inch diameter	1 head	454	96	60	4	trace
270	Looseleaf, or bunching varieties	2 large leaves	50	94	10	1	trace
	Lime juice:						
271	Fresh	1 cup	246	90	65	1	trace
272	Canned	1 cup	246	90	65	1	trace
	Limeade concentrate, frozen, sweetened:	1 can					
273	Undiluted, can, 6 fluid ounces	1 can	218	50	410	trace	trace
274	Diluted with 4⅓ parts water, by volume	1 cup	248	90	105	trace	trace
	Liver, cooked, fried:						
275	Beef	2 ounces	57	57	130	15	6
276	Calf	2 ounces	57	51	150	17	8
277	Pork	2 ounces	57	54	140	17	7
278	Lobster, canned or cooked,	3 ounces	85	77	81	16	1
	Macaroni, cooked:						
	Enriched:						
279	Cooked, firm stage, (8 to 10 minutes; undergoes additional cooking in a food mixture)	1 cup	130	64	190	6	1
280	Cooked until tender	1 cup	140	72	155	5	1
	Unenriched:						
281	Cooked, firm stage (8 to 10 minutes; undergoes additional cooking in a food mixture)	1 cup	130	64	190	6	1
282	Cooked until tender	1 cup	140	72	155	5	1
283	Macaroni (enriched) and cheese, baked	1 cup	220	58	470	18	24
	Mackerel:						
284	Broiled, Atlantic	3 ounces	85	62	200	19	13
285	Canned, Pacific, solids and liquid[16]	3 ounces	85	66	155	18	9
	Margarine, 4 sticks per pound:						
286	Sticks, 2	1 cup	227	16	1635	1	184

[16] Vitamin values based on drained solids.

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
—	—	—	6	77	4.4	2130	0.14	0.13	0.6	18	268
—	—	—	13	91	2.3	[9]1500	.29	.27	1.3	29	269
—	—	—	2	34	.7	950	.03	.04	.2	9	270
—	—	—	22	22	.5	30	.05	.03	.3	80	271
—	—	—	22	22	.5	30	.05	.03	.3	52	272
—	—	—	108	11	.2	trace	.02	.02	.2	26	273
—	—	—	27	2	trace	trace	trace	trace	trace	6	274
—	—	—	3	6	5.0	30280	.15	2.37	9.4	15	275
—	—	—	2	8	8.1	18640	.15	2.37	9.4	22	276
2	3	1	1	9	16.6	8495	.19	2.48	12.7	12	277
—	—	—	trace	55	.7	—	.09	.06	—	—	278
—	—	—	39	14	1.4[10]	0	.23[10]	.14[10]	1.9[10]	0	279
—	—	—	32	11	1.3[10]	0	.19[10]	11[10]	1.5[10]	0	280
—	—	—	39	14	.6	0	.02	.02	.5	0	281
—	—	—	32	11	.6	0	.02	.02	.4	0	282
11	10	1	44	398	2.0	950	.22	.44	2.0	trace	283
—	—	—	0	5	1.0	450	.13	.23	6.5	—	284
—	—	—	0	221	1.9	20	.02	.28	7.4	—	285
37	105	33	1	45	0	7500[17]	—	—	—	0	286

[17] Based on the average vitamin-A content of fortified margarine. Federal specifications for fortified margarine require a minimum of 15,000 I.U. of vitamin A per pound.

Item No.	Food, approximate measure, and weight (in grams)			Water	Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
	Margarine (Cont.)						
287	Stick, ⅛	1 tablespoon	14	16	100	trace	11
288	Pat or square (64 per pound)	1 pat	7	16	50	trace	6
	Milk, cow's:						
289	Fluid, whole (3.5% fat)	1 cup	244	87	160	9	9
290	Fluid, nonfat (skim)	1 cup	246	90	90	9	trace
291	Buttermilk, cultured, from skim milk	1 cup	246	90	90	9	trace
292	Dry, nonfat, instant	1 cup	70	3	250	25	trace
293	Dry, whole	1 cup	103	2	515	27	28
294	Evaporated, unsweetened, undiluted	1 cup	252	74	345	18	20
295	Condensed, sweetened, undiluted	1 cup	306	27	980	25	27
296	Milk, goat's, fluid, whole	1 cup	244	88	165	8	10
	Milk beverages:						
297	Chocolate-flavored milk drink (made with skim milk)	1 cup	250	83	190	8	6
298	Malted milk	1 cup	270	78	280	13	12
	Molasses, cane:						
299	Light (first extraction)	1 tablespoon	20	24	50	0	0
300	Blackstrap (third extraction)	1 tablespoon	20	24	45	0	0
301	Muffins, with enriched white flour; muffin, 2¾-inch diameter	1 muffin	48	38	140	4	5
302	Mushrooms, canned, solids and liquid	1 cup	244	93	40	5	trace
303	Mustard greens, cooked	1 cup	140	93	35	3	1
304	Nectarine, raw, whole 2-inch diameter, about 4 to the pound[1]	1 nectarine	114	82	64	1	trace
	Noodles (egg noodles) cooked:						
305	Enriched	1 cup	160	70	200	7	2
306	Unenriched	1 cup	160	70	200	7	2
307	Oats (with or without corn) puffed, added nutrients	1 ounce	28	3	115	3	2
308	Oatmeal or rolled oats, regular or quick cooking, cooked	1 cup	236	86	130	5	2
	Oils, salad or cooking:						
309	Corn	1 tablespoon	14	0	125	0	14
310	Cottonseed	1 tablespoon	14	0	125	0	14
311	Olive	1 tablespoon	14	0	125	0	14
312	Soybean	1 tablespoon	14	0	125	0	14
313	Okra, cooked, pod 3 by 5/8 inch	8 pods	85	91	25	2	trace

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
2	6	2	trace	3	0	460[17]	—	—	—	0	287
1	3	1	trace	1	0	230[17]	—	—	—	0	288
5	3	trace	12	288	.1	350	.08	.42	.1	2	289
—	—	—	13	298	.1	10	.10	.44	.2	2	290
—	—	—	13	298	.1	10	.09	.44	.2	2	291
—	—	—	36	905	.4	20	.24	1.25	.6	5	292
16	9	1	39	936	.5	1160	.30	1.50	.7	6	293
11	7	1	24	635	.3	820	.10	.84	.5	3	294
15	9	1	166	802	.3	1090	.23	1.17	.5	3	295
6	2	trace	11	315	.2	390	.10	.27	.7	2	296
3	2	trace	27	270	.4	210	.09	.41	.2	2	297
—	—	—	32	364	.8	670	.17	.56	.2	2	298
—	—	—	13	33	.9	—	.01	.01	trace	—	299
—	—	—	11	137	3.2	—	.02	.04	.4	—	300
1	3	trace	20	50	.8	50	.08	.11	.7	trace	301
—	—	—	6	15	1.2	trace	.04	.60	4.8	4	302
—	—	—	6	193	2.5	8120	.11	.19	.9	68	303
—	—	—	18	4	.5	1725	—	—	—	14	304
1	1	trace	37	16	1.4[10]	110	.23[10]	.14[10]	1.8[10]	0	305
1	1	trace	37	16	1.0	110	.04	.03	.7	0	306
trace	1	1	21	50	1.3	0	.28	.05	.5	0	307
trace	1	1	23	21	1.4	0	.19	.05	.3	0	308
1	4	7	0	0	0	—	0	0	0	0	309
4	3	7	0	0	0	—	0	0	0	0	310
2	11	1	0	0	0	—	0	0	0	0	311
2	3	7	0	0	0	—	0	0	0	0	312
—	—	—	5	78	.4	420	.11	.15	.8	17	313

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)		Water	Food Energy	Protein	Fat (total lipid)
			per cent	*calories*	*gm*	*gm*
	Olives, pickled:					
314	Green	4 medium or 3 extra large or 2 giant	78	15	trace	2
315	Ripe: Mission	3 small or 2 large	73	15	trace	2
	Onions:					
	Mature:					
316	Raw, onion 2½-inch diameter	1 onion	89	40	2	trace
317	Cooked	1 cup	92	60	3	trace
318	Young green, small, without tops	6 onions	88	20	1	trace
	Oranges, raw:					
319	California, Navel (winter), 2 4/5-inch diameter, size 88[1]	1 orange	85	60	2	trace
320	Florida, all varieties, 3-inch diameter[1]	1 orange	86	75	1	trace
321	Sections	½ cup	86	49	1	trace
	Orange juice:					
	Fresh:					
322	California, Valencia (summer)	1 cup	88	115	2	1
	Florida varieties:					
323	Early and midseason	1 cup	90	100	1	trace
324	Late season, Valencia	1 cup	88	110	1	trace
325	Canned, unsweetened	1 cup	87	120	2	trace
	Frozen concentrate:					
326	Undiluted, can, 6 fluid ounces	1 can	58	330	5	trace
327	Diluted with 3 parts water, by volume	1 cup	88	110	2	trace
	Dehydrated:					
328	Crystals, can, net weight 4 ounces	1 can	1	430	6	2
329	Prepared with water, 1 pound yields about 1 gallon	1 cup	88	115	1	trace
	Orange and grapefruit juice:					
	Frozen concentrate:					
330	Undiluted, can, 6 fluid ounces	1 can	59	325	4	1
331	Diluted with 3 parts water, by volume	1 cup	88	110	1	trace
332	Oysters, meat only, raw, 13–19 medium selects	1 cup	85	160	20	4

Fatty Acids											
Saturated (total) gm	Unsaturated Oleic gm	Unsaturated Linoleic gm	Carbohydrate gm	Calcium mg	Iron mg	Vitamin A Value I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Ascorbic Acid mg	Item No.
trace	2	trace	trace	8	0.2	40	—	—	—	—	314
trace	2	trace	trace	9	.1	10	trace	trace	—	—	315
—	—	—	10	30	.6	40	.04	.04	.2	11	316
—	—	—	14	50	.8	80	.06	.06	.4	14	317
—	—	—	5	20	.3	trace	.02	.02	.2	12	318
—	—	—	16	49	.5	240	.12	.05	.5	75	319
—	—	—	19	67	.3	310	.16	.06	.6	70	320
—	—	—	12	41	.4	200	.10	.04	.4	50	321
—	—	—	26	27	.7	500	.22	.06	.9	122	322
—	—	—	23	25	.5	490	.22	.06	.9	127	323
—	—	—	26	25	.5	500	.22	.06	.9	92	324
—	—	—	28	25	1.0	500	.17	.05	.6	100	325
—	—	—	80	69	.8	1490	.63	.10	2.4	332	326
—	—	—	27	22	.2	500	.21	.03	.8	112	327
—	—	—	100	95	1.9	1900	.76	.24	3.3	406	328
—	—	—	27	25	.5	500	.20	.06	.9	108	329
—	—	—	78	61	.8	790	.47	.06	2.3	301	330
—	—	—	26	20	.2	270	.16	.02	.8	102	331
—	—	—	8	226	13.2	740	.33	.43	6.0	—	332

Item No.	Food, approximate measure, and weight (in grams)		Water		Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
333	Oyster stew, 1 part oysters to 3 parts milk by volume, 3–4 oysters	1 cup	230	84	200	11	12
	Pancakes (griddlecakes), 4-inch diameter:						
334	Wheat, enriched flour (home recipe)	1 cake	27	50	60	2	2
335	Buckwheat (buckwheat mix, made with eggs and milk)	1 cake	27	58	55	2	2
336	Papayas, raw, ½ ich cubes	1 cup	182	89	70	1	trace
337	Parsley, raw, chopped	1 tablespoon	3.5	85	1	trace	trace
338	Parsnips, cooked	1 cup	155	82	100	2	1
	Peaches:						
	Raw, yellow:						
339	Whole, medium, 2-inch diameter, about 4 per pound[1]	1 peach	114	89	35	1	trace
340	Sliced	1 cup	168	89	65	1	trace
	Canned, yellow-fleshed, solids and liquid:						
	Syrup pack, heavy:						
341	Halves or slices	1 cup	257	79	200	1	trace
342	Halves (medium) and syrup	2 halves and 2 tablespoons syrup	117	79	90	trace	trace
343	Water pack	1 cup	245	91	75	1	trace
	Dried:						
344	Uncooked	1 cup	160	25	420	5	1
345	Cooked, unsweetened, 10–12 halves and 6 tablespoons liquid	1 cup	270	77	220	3	1
	Frozen:						
346	Carton, 12 ounces, not thawed	1 carton	340	76	300	1	trace
347	Can, 16 ounces, not thawed	1 can	454	76	400	2	trace
348	Peach nectar, canned	1 cup	250	87	120	trace	trace
	Peanuts, roasted:						
349	Halves	1 cup	144	2	840	37	72
350	Chopped	1 tablespoon	9	2	55	2	4
351	Peanut butter	1 tablespoon	16	2	95	4	8
	Pears:						
352	Raw, 3 by 2½-inch diameter[1]	1 pear	182	83	100	1	1

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
—	—	—	11	269	3.3	640	0.13	0.41	1.6	—	333
trace	1	trace	9	27	.4	30	.05	.06	.3	trace	334
1	1	trace	6	59	.4	60	.03	.04	.2	trace	335
—	—	—	18	36	.5	3190	.07	.08	.5	102	336
—	—	—	trace	7	.2	300	trace	.01	trace	6	337
—	—	—	23	70	.9	50	.11	.13	.2	16	338
—	—	—	10	9	.5	1320	.02	.05	1.0	7	339
—	—	—	16	15	.8	2230	.03	.08	1.6	12	340
—	—	—	52	10	.8	1100	.02	.06	1.4	7	341
—	—	—	24	5	.4	500	.01	.03	.7	3	342
—	—	—	20	10	.7	1100	.02	.06	1.4	7	343
—	—	—	109	77	9.6	6240	.02	.31	8.5	28	344
—	—	—	58	41	5.1	3290	.01	.15	4.2	6	345
—	—	—	77	14	1.7	2210	.03	.14	2.4	135[18]	346
—	—	—	103	18	2.3	2950	.05	.18	3.2	181[18]	347
—	—	—	31	10	.5	1080	.02	.05	1.0	1	348
16	31	21	27	107	3.0	—	.46	.19	24.7	0	349
1	2	1	2	7	.2	—	.03	.01	1.5	0	350
2	4	2	3	9	.3	—	.02	.02	2.4	0	351
—	—	—	25	13	.5	30	.04	.07	.2	7	352

[18] Average weighted in accordance with commercial freezing practices. For products without added ascorbic acid, value is about 37 mg per 12-ounce carton and 50 mg per 16-ounce carton; for those with added ascorbic acid, 139 mg per 12 ounces and 186 mg per 16 ounces.

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)		Water		Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
	Pears, Canned, solids and liquid:						
	Syrup pack, heavy:						
353	Halves and slices	1 cup	255	80	195	1	1
354	Halves (medium) and syrup	2 halves and 2 tablespoons syrup	117	80	90	trace	trace
355	Water pack	1 cup	243	91	80	trace	trace
356	Pear nectar, canned	1 cup	250	86	130	.1	trace
	Peas, green:						
357	Fresh, cooked	1 cup	160	82	115	9	1
358	Canned, solids and liquid	1 cup	249	83	165	9	1
359	Dry, split, cooked	1 cup	250	70	290	20	1
	Pecans:						
360	Halves	1 cup	108	3	740	10	77
361	Chopped	1 tablespoon	7.5	3	50	1	5
	Peppers, sweet:						
	Raw, medium, about 6 per pound:						
362	Green pod without stem and seeds	1 pod	62	93	15	1	trace
363	Red pod without stem and seeds	1 pod	60	91	20	1	trace
364	Canned, pimientos, medium	1 pod	38	92	10	trace	trace
365	Perch, ocean, breaded (egg and bread crumbs), fried	3 ounces	85	59	195	16	11
366	Persimmons, Japanese or kaki, raw, seedless, 2½-inch diameter[1]	1 persimmon	125	79	75	1	trace
	Pickles, cucumber:						
367	Dill, large, 4 by 1¾ inches	1 pickle	135	93	15	1	trace
368	Sweet, 2¾ by ¾ inches	1 pickle	20	61	30	trace	trace
	Piecrust, plain, baked:						
	Enriched flour:						
369	Lower crust, 9-inch shell	1 crust	135	15	675	8	45
370	Double crust, 9-inch pie	1 double crust	270	15	1350	16	90
	Unenriched flour:						
371	Lower crust, 9-inch shell	1 crust	135	15	675	8	45
372	Double crust, 9-inch pie	1 double crust	270	15	1350	16	90
	Pies (piecrust made with unenriched flour); sector, 4-inch, 1/7 of 9-inch diameter pie:						
373	Apple	1 sector	135	48	345	3	15
374	Cherry	1 sector	135	47	355	4	15
375	Custard	1 sector	130	58	280	8	14
376	Lemon meringue	1 sector	120	47	305	4	12
377	Mince	1 sector	135	43	365	3	16

Fatty Acids											
Saturated (*total*)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	*gm*	*gm*	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*	
—	—	—	50	13	0.5	trace	0.03	0.05	0.3	4	353
—	—	—	23	6	.2	trace	.01	.02	.2	2	354
—	—	—	20	12	.5	trace	.02	.05	.3	4	355
—	—	—	33	8	.1	trace	.01	.05	trace	1	356
—	—	—	19	37	2.9	860	.44	.17	3.7	33	357
—	—	—	31	50	4.2	1120	.23	.13	2.2	22	358
—	—	—	52	28	4.2	100	.37	.22	2.2	—	359
5	48	15	16	79	2.6	140	.93	.14	1.0	2	360
trace	3	1	1	5	.2	10	.06	.01	.1	trace	361
—	—	—	3	6	.4	260	.05	.05	.3	79	362
—	—	—	4	8	.4	2670	.05	.05	.3	122	363
—	—	—	2	3	.6	870	.01	.02	.1	36	364
—	—	—	6	28	1.1	—	.08	.09	1.5	—	365
—	—	—	20	6	.4	2740	.03	.02	.1	11	366
—	—	—	3	35	1.4	140	trace	.03	trace	8	367
—	—	—	7	2	.2	20	trace	trace	trace	1	368
10	29	3	59	19	2.3	0	.27	.19	2.4	0	369
21	58	7	118	38	4.6	0	.55	.39	4.9	0	370
10	29	3	59	19	.7	0	.04	.04	.6	0	371
21	58	7	118	38	1.4	0	.08	.07	1.3	0	372
4	9	1	51	11	.4	40	.03	.02	.5	1	373
4	10	1	52	19	.4	590	.03	.03	.6	1	374
5	8	1	30	125	.8	300	.07	.21	.4	0	375
4	7	1	45	17	.6	200	.04	.10	.2	4	376
4	10	1	56	38	1.4	trace	.09	.05	.5	1	377

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)		Water		Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
378	Pie, Pumpkin	1 sector	130	59	275	5	15
	Pineapple:						
379	Raw, diced	1 cup	140	85	75	1	trace
	Canned, heavy syrup pack, solids and liquid:						
380	Crushed	1 cup	260	80	195	1	trace
381	Sliced, slices and juice	2 small or 1 large slices and 2 tablespoons juice	122	80	90	trace	trace
382	*Pineapple juice, canned*	1 cup	249	86	135	1	trace
383	Pizza (cheese); 5½-inch sector; ⅛ of 14-inch-diameter pie	1 sector	75	45	185	7	6
	Plums, all except prunes:						
384	Raw, 2-inch diameter, about 2 ounces[1]	1 plum	60	87	25	trace	trace
	Canned, syrup pack (Italian prunes):						
385	Plums (with pits) and juice[1]	1 cup	256	77	205	1	trace
386	Plums (without pits) and juice	3 plums and 2 tablespoons juice	122	77	100	trace	trace
387	Popcorn, popped, with added oil and salt	1 cup	14	3	65	1	3
	Pork, cured, cooked:						
388	*Ham, light cure, lean and fat, roasted*	3 ounces	85	54	245	18	19
	Luncheon meat:						
389	Boiled ham, slices	2 ounces	57	59	135	11	10
390	Canned, spiced or unspiced	2 ounces	57	55	165	8	14
	Pork, fresh, trimmed to retail basis,[2] cooked:						
391	Chop, thick, with bone	1 chop, 3.5 ounces	98	42	260	16	21
392	Lean and fat	2.3 ounces	66	42	260	16	21
393	Lean only	1.7 ounces	48	53	130	15	7
	Roast, oven-cooked, no liquid added:						
394	Lean and fat	3 ounces	85	46	310	21	24
395	Lean only	2.4 ounces	68	55	175	20	10
	Cuts, simmered:						
396	Lean and fat	3 ounces	85	46	320	20	26
397	Lean only	2.2 ounces	63	60	135	18	6
	Potatoes, medium (about 3 per pound raw):						
398	Baked, peeled after baking	1 potato	99	75	90	3	trace
399	Boiled, peeled after boiling	1 potato	136	80	105	3	trace
400	Boiled, peeled before boiling	1 potato	122	83	80	2	trace

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
5	7	1	32	66	0.6	3210	0.04	0.13	0.6	trace	378
—	—	—	19	24	.7	100	.12	.04	.3	24	379
—	—	—	50	29	.8	120	.20	.06	.5	17	380
—	—	—	24	13	.4	50	.09	.03	.2	8	381
—	—	—	34	37	.7	120	.12	.04	.5	22	382
2	3	trace	27	107	.7	290	.04	.12	.7	4	383
—	—	—	7	7	.3	140	.02	.02	.3	3	384
—	—	—	53	22	2.2	2970	.05	.05	.9	4	385
—	—	—	26	11	1.1	1470	.03	.02	.5	2	386
2	trace	trace	8	1	.3	—	—	.01	.2	0	387
7	8	2	0	8	2.2	0	.40	.16	3.1	—	388
4	4	1	0	6	1.6	0	.25	.09	1.5	—	389
5	6	1	1	5	1.2	0	.18	.12	1.6	—	390
8	9	2	0	8	2.2	0	.63	.18	3.8	—	391
8	9	2	0	8	2.2	0	.63	.18	3.8	—	392
2	3	1	0	7	1.9	0	.54	.16	3.3	—	393
9	10	2	0	9	2.7	0	.78	.22	4.7	—	394
3	4	1	0	9	2.6	0	.73	.21	4.4	—	395
9	11	2	0	8	2.5	0	.46	.21	4.1	—	396
2	3	1	0	8	2.3	0	.42	.19	3.7	—	397
—	—	—	21	9	.7	trace	.10	.04	1.7	20	398
—	—	—	23	10	.8	trace	.13	.05	2.0	22	399
—	—	—	18	7	.6	trace	.11	.04	1.4	20	400

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)			Water	Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
	Potatoes, French-fried, piece 2 by ½ by ½ inch:						
401	Cooked in deep fat	10 pieces	57	45	155	2	7
402	Frozen, heated	10 pieces	57	53	125	2	5
	Mashed:						
403	Milk added	1 cup	195	83	125	4	1
404	Milk and butter added	1 cup	195	80	185	4	8
405	Potato chips, medium, 2-inch diameter	10 chips	20	2	115	1	8
406	Pretzels, small stick	5 sticks	5	8	20	trace	trace
	Prunes, dried, "softenized", medium:						
407	Uncooked[1]	4 prunes	32	28	70	1	trace
408	Cooked, unsweetened, 17–18 prunes and ⅓ cup liquid[1]	1 cup	270	66	295	2	1
409	Prune juice, canned	1 cup	256	80	200	1	trace
	Puddings:						
410	Bread, with raisins	1 cup	250	59	468	14	15
411	Chocolate	1 cup	250	66	370	8	12
412	Cornstarch (blancmange)	1 cup	248	76	275	9	10
413	Rennin dessert, made from mix	½ cup	140	80	133	5	5
414	Rice pudding with raisins	1 cup	250	66	365	9	8
415	Tapioca cream	1 cup	250	72	335	13	13
416	Pumpkin, canned	1 cup	228	90	75	2	1
417	Radishes, raw, small, without tops	4 radishes	40	94	5	trace	trace
418	Raisins, dried	1 cup	160	18	460	4	trace
	Raspberries:						
419	Raw	1 cup	123	84	70	1	1
420	Frozen, 10-ounce carton, not thawed	1 carton	284	74	275	2	1
421	Rhubarb, cooked, sugar added	1 cup	272	63	385	1	trace
	Rice, white (fully milled or polished), enriched, cooked:						
422	Common commercial varieties, all types	1 cup	168	73	185	3	trace
423	Long grain, parboiled	1 cup	176	73	185	4	trace
424	Rice puffed, added nutrients	1 cup	14	4	55	1	trace
425	Rice flakes, added nutrients	1 cup	30	3	115	2	trace
	Rolls:						
	Plain, pan; 12 per 16 ounces:						
426	Enriched	1 roll	38	31	115	3	2

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
2	2	4	20	9	0.7	trace	0.07	0.04	1.8	12	401
1	1	2	19	5	1.0	trace	.08	.01	1.5	12	402
—	—	—	25	47	.8	50	.16	.10	2.0	19	403
4	3	trace	24	47	.8	330	.16	.10	1.9	18	404
2	2	4	10	8	.4	trace	.04	.01	1.0	3	405
—	—	—	4	1	0	0	trace	trace	trace	0	406
—	—	—	18	14	1.1	440	.02	.04	.4	1	407
—	—	—	78	60	4.5	1860	.08	.18	1.7	2	408
—	—	—	49	36	10.5	—	.02	.03	1.1	4	409
8	5	trace	71	272	2.7	750	.15	.48	.3	2	410
7	5	trace	64	240	1.3	375	.05	.35	.3	trace	411
5	3	trace	39	290	.1	390	.07	.40	.1	2	412
3	1	trace	18	163	trace	210	.04	.22	.1	1	413
5	3	trace	67	245	1.0	275	.07	.35	.5	trace	414
5	5	trace	43	263	1.0	725	.10	.45	.3	2	415
—	—	—	18	57	.9	14590	.07	.12	1.3	12	416
—	—	—	1	12	.4	trace	.01	.01	.1	10	417
—	—	—	124	99	5.6	30	.18	.13	.9	2	418
—	—	—	17	27	1.1	160	.04	.11	1.1	31	419
—	—	—	70	37	1.7	200	.06	.17	1.7	59	420
—	—	—	98	212	1.6	220	.06	.15	.7	17	421
—	—	—	41	17	1.5[19]	0	.19[19]	.01[19]	1.6[19]	0	422
—	—	—	41	33	1.4[19]	0	.19[19]	.02[19]	2.0[19]	0	423
—	—	—	13	3	.3	0	.06	.01	.6	0	424
—	—	—	26	9	.5	0	.10	.02	1.6	0	425
trace	1	trace	20	28	.7	trace	.11	.07	.8	trace	426

[19] Iron, thiamine, and niacin are based on the minimum levels of enrichment specified in standards of identity promulgated under the Federal Food, Drug, and Cosmetic Act. Riboflavin is based on unenriched rice. When the minimum level of enrichment for riboflavin specified in the standards of identity becomes effective, the value will be 0.12 mg per cup of parboiled rice and of white rice.

Item No.	Food, approximate measure, and weight (in grams)			Water	Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
427	Rolls, plain, unenriched	1 roll	38	31	115	3	2
428	Hard, round; 12 per 22 ounces	1 roll	52	25	160	5	2
429	Sweet, pan; 12 per 18 ounces	1 roll	43	32	135	4	4
430	Rutabagas, cooked	1 cup	200	90	70	2	trace
431	Rye flour, medium	1 cup	80	11	280	9	2
432	Rye wafers, whole-grain, 1⅞ by 3½ inches	2 wafers	13	6	45	2	trace
	Salad dressings:						
433	Blue cheese	1 tablespoon	16	32	80	1	8
434	Commercial, mayonnaise type	1 tablespoon	15	41	65	trace	6
435	French	1 tablespoon	15	39	60	trace	6
436	Home cooked, boiled	1 tablespoon	17	68	30	1	2
437	Mayonnaise	1 tablespoon	15	15	110	trace	12
438	Thousand island	1 tablespoon	15	32	75	trace	8
439	Salmon, pink, canned	3 ounces	85	71	120	17	5
440	Sardines, Atlantic, canned in oil, drained solids	3 ounces	85	62	175	20	9
441	Sauerkraut, canned, solids and liquid	1 cup	235	93	45	2	trace
	Sausage:						
442	Bologna, slice, 4.1 by 0.1 inch	8 slices	227	56	690	27	62
443	Frankfurter, cooked	1 frankfurter	51	58	155	6	14
444	Pork, links or patty, cooked	4 ounces	113	35	540	21	50
445	Shad, baked	3 ounces	85	64	170	20	10
446	Sherbet, orange	1 cup	193	67	260	2	2
447	Shrimp, canned, meat only	3 ounces	85	70	100	21	1
448	Syrup, table blends (chiefly corn, light and dark)	1 tablespoon	20	24	60	0	0
	Soups, canned; ready-to-serve (prepared with equal volume of water):						
449	Bean with pork	1 cup	250	84	170	8	6
450	Beef noodle	1 cup	250	93	70	4	3
451	Beef bouillon, broth, consomme	1 cup	240	96	30	5	0
452	Chicken noodle	1 cup	250	93	65	4	2
453	Clam chowder	1 cup	255	92	85	2	3
454	Cream soup (mushroom)	1 cup	240	90	135	2	10
455	Minestrone	1 cup	245	90	105	5	3
456	Pea, green	1 cup	245	86	130	6	2
457	Tomato	1 cup	245	90	90	2	2
458	Vegetable with beef	1 cup	250	92	80	3	2

Fatty Acids											
Saturated (*total*)	Unsaturated Oleic	Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	*gm*	*gm*	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*	
trace	1	trace	20	28	0.3	trace	0.02	0.03	0.3	trace	427
trace	1	trace	31	24	.4	trace	.03	.05	.4	trace	428
1	2	trace	21	37	.3	30	.03	.06	.4	trace	429
—	—	—	16	118	.6	1100	.12	.12	1.6	52	430
—	—	—	60	22	2.1	0	.24	.10	2.0	0	431
—	—	—	10	7	.5	0	.04	.03	.2	0	432
2	2	4	1	13	trace	30	trace	.02	trace	trace	433
1	1	3	2	2	trace	30	trace	trace	trace	—	434
1	1	3	3	2	.1	—	—	—	—	—	435
1	1	trace	3	15	.1	80	.01	.03	trace	trace	436
2	3	6	trace	3	.1	40	trace	.01	trace	—	437
1	2	4	2	2	.1	50	trace	trace	trace	trace	438
1	1	trace	0	167[20]	.7	60	.03	.16	6.8	—	439
—	—	—	0	372	2.5	190	.02	.17	4.6	—	440
—	—	—	9	85	1.2	120	.07	.09	.4	33	441
—	—	—	2	16	4.1	—	.36	.49	6.0	—	442
—	—	—	1	3	.8	—	.08	.10	1.3	—	443
18	21	5	trace	8	2.7	0	.89	.39	4.2	—	444
—	—	—	0	20	.5	20	.11	.22	7.3	—	445
—	—	—	59	31	trace	110	.02	.06	trace	4	446
—	—	—	1	98	2.6	50	.01	.03	1.5	—	447
—	—	—	15	9	.8	0	0	0	0	0	448
1	2	2	22	62	2.2	650	.14	.07	1.0	2	449
1	1	1	7	8	1.0	50	.05	.06	1.1	trace	450
0	0	0	3	trace	.5	trace	trace	.02	1.2	—	451
trace	1	1	8	10	.5	50	.02	.02	.8	trace	452
—	—	—	13	36	1.0	920	.03	.03	1.0	—	453
1	3	5	10	41	.5	70	.02	.12	.7	trace	454
—	—	—	14	37	1.0	2350	.07	.05	1.0	—	455
1	1	trace	23	44	1.0	340	.05	.05	1.0	7	456
trace	1	1	16	15	.7	1000	.06	.05	1.1	12	457
—	—	—	14	20	.8	3250	.05	.02	1.2	—	458

[20] Based on total contents of can. If bones are discarded, value will be greatly reduced.

SHILINGAM HOME SCI

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)		Water	Food Energy	Protein	Fat (total lipid)
		gm	per cent	calories	gm	gm
	Spaghetti:					
	Cooked, tender stage (14 to 20 minutes):					
459	Enriched	1 cup	140	72	155	5	1
460	Unenriched	1 cup	140	72	155	5	1
461	Spaghetti with meat balls in tomato sauce (home recipe)	1 cup	250	70	335	19	12
462	Spaghetti in tomato sauce with cheese (home recipe)	1 cup	250	77	260	9	9
	Spinach:					
463	Cooked	1 cup	180	92	40	5	1
464	Canned, drained solids	1 cup	180	91	45	5	1
	Squash:					
	Cooked:					
465	Summer, diced	1 cup	210	96	30	2	trace
466	Winter, baked, mashed	1 cup	205	81	130	4	1
467	Starch (cornstarch)	1 cup	128	12	465	trace	trace
468		1 tablespoon	8	12	30	trace	trace
	Strawberries:					
469	Raw, capped	1 cup	149	90	55	1	1
470	Frozen, 10-ounce carton, not thawed	1 carton	284	71	310	1	1
471	Frozen, 16-ounce can, not thawed	1 can	454	71	495	2	1
	Sugars (cane or beet):					
472	Granulated	1 cup	200	trace	770	0	0
473		1 tablespoon	12	trace	45	0	0
474	Lump, 1⅛ by ¾ by ⅜ inch	1 lump	6	trace	25	0	0
475	Powdered, stirred before measuring	1 cup	128	trace	495	0	0
476		1 tablespoon	8	trace	30	0	0
477	Brown, firm-packed	1 cup	220	2	820	0	0
478		1 tablespoon	14	2	50	0	0
	Sweetpotatoes:					
	Cooked, medium, 5 by 2 inches, weight raw about 6 ounces:					
479	Baked, peeled after baking	1 sweetpotato	110	64	155	2	1
480	Boiled, peeled after boiling	1 sweetpotato	147	71	170	2	1
481	Candied, 3½ by 2¼ inches	1 sweetpotato	175	60	295	2	6
482	Canned, vacuum or solid pack	1 cup	218	72	235	4	trace
483	Swordfish, broiled with butter or margarine	3 ounces	85	65	150	24	5

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	mg	mg	mg	mg	
—	—	—	32	11	1.3[10]	0	0.19[10]	0.11[10]	1.5[10]	0	459
—	—	—	32	11	.6	0	.02	.02	.4	0	460
4	6	1	39	125	3.8	1600	.26	.30	4.0	22	461
2	5	1	37	80	2.2	1080	.24	.18	2.4	14	462
—	—	—	6	167[3]	4.0	14580	.13	.25	1.0	50	463
—	—	—	6	212[3]	4.7	14400	.03	.21	.6	24	464
—	—	—	7	52	.8	820	.10	.16	1.6	21	465
—	—	—	32	57	1.6	8610	.10	.27	1.4	27	466
—	—	—	112	0	0	0	0	0	0	0	467
—	—	—	7	0	0	0	0	0	0	0	468
—	—	—	13	31	1.5	90	.04	.10	1.0	88	469
—	—	—	79	40	2.0	90	.06	.17	1.5	150	470
—	—	—	126	64	3.2	150	.09	.27	2.4	240	471
—	—	—	199	0	.2	0	0	0	0	0	472
—	—	—	12	0	trace	0	0	0	0	0	473
—	—	—	6	0	trace	0	0	0	0	0	474
—	—	—	127	0	.1	0	0	0	0	0	475
—	—	—	8	0	trace	0	0	0	0	0	476
—	—	—	212	187	7.5	0	.02	.07	.4	0	477
—	—	—	13	12	.5	0	trace	trace	trace	0	478
—	—	—	36	44	1.0	8910	.10	.07	.7	24	479
—	—	—	39	47	1.0	11610	.13	.09	.9	25	480
2	3	1	60	65	1.6	11030	.10	.08	.8	17	481
—	—	—	54	54	1.7	17000	.10	.10	1.4	30	482
—	—	—	0	23	1.1	1750	.03	.04	9.3	—	483

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)		Water		Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
484	Tangerines, raw, medium 2½-inch diameter, about 4 per pound[1]	1 tangerine	114	87	40	1	trace
	Tangerine juice:						
485	Canned, unsweetened	1 cup	248	89	105	1	trace
	Frozen concentrate:						
486	Undiluted, can, 6 fluid ounces	1 can	210	58	340	4	1
487	Diluted with 3 parts water, by volume	1 cup	248	88	115	1	trace
488	Tapioca, quick-cooking granulated, dry, stirred before measuring	1 cup	152	13	535	1	trace
489		1 tablespoon	10	13	35	trace	trace
	Tomatoes:						
490	Raw, medium, 2 by 2½ inches, about 3 per pound	1 tomato	150	94	35	2	trace
491	Canned	1 cup	242	94	50	2	trace
492	Tomato juice, canned	1 cup	242	94	45	2	trace
493	Tomato catsup	1 tablespoon	17	69	15	trace	trace
494	Tongue, beef, braised	3 ounces	85	61	210	18	14
495	Tuna, canned in oil, drained solids	3 ounces	85	61	170	24	7
	Turkey, roasted, meat only:						
496	Light meat	3 ounces	85	62	150	28	3
497	Dark meat	3 ounces	85	61	172	26	7
498	Turnips, cooked, diced	1 cup	155	94	35	1	trace
	Turnip greens:						
	Cooked:						
499	In small amount of water, short time	1 cup	145	93	30	3	trace
500	In large amount of water, long time	1 cup	145	94	25	3	trace
501	Canned, solids and liquid	1 cup	232	94	40	3	1
	Veal, cooked:						
502	Cutlet, without bone, broiled	3 ounces	85	60	185	23	9
503	Roast, medium fat, medium done; lean and fat	3 ounces	85	55	230	23	14
504	Vinegar	1 tablespoon	15	—	2	0	—
505	Waffles, with enriched flour, ½ by 4½ by 5½ inches	1 waffle	75	41	210	7	7

Fatty Acids											
Saturated (*total*)	Unsaturated Oleic	Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	*gm*	*gm*	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*	
—	—	—	10	34	0.3	350	0.05	0.02	0.1	26	484
—	—	—	25	45	.5	1040	.14	.04	.3	56	485
—	—	—	80	130	1.5	3070	.43	.12	.9	202	486
—	—	—	27	45	.5	1020	.14	.04	.3	67	487
—	—	—	131	15	.6	0	0	0	0	0	488
—	—	—	9	1	trace	0	0	0	0	0	489
—	—	—	7	20	.8	1350	.10	.06	1.0	34[21]	490
—	—	—	10	15	1.2	2180	.13	.07	1.7	40	491
—	—	—	10	17	2.2	1940	.13	.07	1.8	39	492
—	—	—	4	4	.1	240	.02	.01	.3	3	493
—	—	—	trace	6	1.9	—	.04	.25	3.0	—	494
—	—	—	0	7	1.6	70	.04	.10	10.1	—	495
1	2	trace	0	—	1.0	—	.04	.12	9.4	—	496
2	3	1	0	—	2.0	—	.03	.19	3.6	—	497
—	—	—	8	54	.6	trace	.06	.08	.5	33	498
—	—	—	5	267	1.6	9140	.21	.36	.8	100	499
—	—	—	5	252	1.4	8260	.14	.33	.8	68	500
—	—	—	7	232	3.7	10900	.04	.21	1.4	44	501
5	4	trace	—	9	2.7	—	.06	.21	4.6	—	502
7	6	trace	0	10	2.9	—	.11	.26	6.6	—	503
—	—	—	1	1	.1	—	—	—	—	—	504
2	4	1	28	85	1.3	250	.13	.19	1.0	trace	505

[21] Year-round average. Samples marketed from November through May average around 15 mg per 150-gram tomato; from June through October, around 39 mg.

Table A–1. Nutritive Values of the Edible Part of Food (Continued)

Item No.	Food, approximate measure, and weight (in grams)			Water	Food Energy	Protein	Fat (total lipid)
			gm	per cent	calories	gm	gm
	Walnuts, shelled:						
506	Black or native, chopped	1 cup	126	3	790	26	75
	English or Persian:						
507	Halves	1 cup	100	4	650	15	64
508	Chopped	1 tablespoon	8	4	50	1	5
509	Watermelon, raw, wedge 4 by 8 inches (1/16 of 10 by 16-inch melon, about 2 pounds with rind)[1]	1 wedge	925	93	115	2	1
	Wheat puffed:						
510	With added nutrients	1 ounce	28	3	105	4	trace
511	With added nutrients, with sugar and honey	1 ounce	28	3	105	2	1
512	Wheat, rolled; cooked	1 cup	236	80	175	5	1
513	Wheat, shredded, plain (long, round, or bite size)	1 ounce	28	7	100	3	1
514	Wheat and malted barley flakes, with added nutrients	1 ounce	28	3	110	2	trace
515	Wheat flakes with added nutrients	1 ounce	28	4	100	3	trace
	Wheat flours:						
516	Whole-wheat, from hard wheats, stirred	1 cup	120	12	400	16	2
	All-purpose or family flour:						
517	Enriched, sifted	1 cup	110	12	400	12	1
518	Unenriched, sifted	1 cup	110	12	400	12	1
519	Self-rising, enriched	1 cup	110	11	385	10	1
520	Cake or pastry flour, sifted	1 cup	100	12	365	8	1
521	Wheat germ, crude, commercially milled	1 cup	68	11	245	18	7
522	White sauce, medium	1 cup	265	73	430	10	33
	Yeast:						
	Baker's:						
523	Compressed	1 ounce	28	71	25	3	trace
524	Dry active	1 ounce	28	5	80	10	trace
525	Brewer's, dry, debittered	1 tablespoon	8	5	25	3	trace
526	Yogurt, from partially skimmed milk	1 cup	246	89	120	8	4

Fatty Acids											
Saturated (total)	Unsaturated Oleic	Unsaturated Linoleic	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Item No.
gm	gm	gm	gm	mg	mg	I.U.	gm	mg	mg	mg	
4	26	36	19	trace	7.6	380	0.28	0.14	0.9	—	506
4	10	40	16	99	3.1	30	.33	.13	.9	3	507
trace	1	3	1	8	.2	trace	.03	.01	.1	trace	508
—	—	—	27	30	2.1	2510	.13	.13	.7	30	509
—	—	—	22	8	1.2	0	.15	.07	2.2	0	510
—	—	—	25	7	.9	0	.14	.05	1.8	0	511
—	—	—	40	19	1.7	0	.17	.06	2.1	0	512
—	—	—	23	12	1.0	0	.06	.03	1.2	0	513
—	—	—	24	14	.7	0	.13	.03	1.1	0	514
—	—	—	23	12	1.2	0	.18	.04	1.4	0	515
trace	1	1	85	49	4.0	0	.66	.14	5.2	0	516
trace	trace	trace	84	18	3.2[10]	0	.48[10]	.29[10]	3.8[10]	0	517
trace	trace	trace	84	18	.9	0	.07	.05	1.0	0	518
trace	trace	trace	82	292	3.2[10]	0	.49[10]	.29[10]	3.9[10]	0	519
trace	trace	trace	79	17	.5	0	.03	.03	.7	0	520
1	2	4	32	49	6.4	0	1.36	.46	2.9	0	521
18	11	1	23	305	.5	1220	.12	.44	.6	trace	522
—	—	—	3	4	1.4	trace	.20	.47	3.2	trace	523
—	—	—	11	12	4.6	trace	.66	1.53	10.4	trace	524
—	—	—	3	17	1.4	trace	1.25	.34	3.0	trace	525
2	1	trace	13	295	.1	170	.09	.43	.2	2	526

Table A–2. Nutritive Value of Baby Foods*

(Per 100 Grams Edible Portion—About 7 Tablespoons)

Food	Energy *calories*	Protein *gm*	Fat *gm*	Carbohydrate *gm*	Calcium *mg*	Iron *mg*	Vitamin A Value *I.U.*	Thiamine *mg*	Riboflavin *mg*	Niacin *mg*	Ascorbic Acid *mg*
Cereals, precooked, dry and other cereal products											
Barley, added nutrients	348	13.4	1.2	73.6	736	53.2	(0)	3.71	1.20	32.2	(0)
High protein, added nutrients	357	35.2	3.7	48.1	815	63.1	–	3.67	1.15	24.0	(0)
Mixed, added nutrients	368	15.2	2.9	70.6	820	56.4	–	3.15	1.35	22.3	(0)
Oatmeal, added nutrients	375	16.5	5.5	66.0	757	48.2	(0)	2.58	1.05	21.3	(0)
Rice, added nutrients	371	6.6	1.6	80.0	858	50.2	(0)	2.56	1.24	19.7	(0)
Dinners, canned											
Cereal, vegetable, meat mixtures (approx. 2%–4% protein):											
Beef noodle dinner	48	2.8	1.1	6.8	12	.5	620	.02	.05	.5	2
Cereal, egg yolk, and bacon	82	2.9	4.9	6.6	29	.8	520	.05	.06	.4	–
Chicken noodle dinner	49	2.1	1.3	7.2	27	.3	800	.03	.06	.4	1
Macaroni, tomatoes, meat and cereal	67	2.6	2.0	9.6	21	.5	500	.14	.12	1.0	1
Split peas, vegetables and ham or bacon	80	4.0	2.1	11.2	29	.7	600	.08	.05	.5	1
Vegetables and bacon with cereal	68	1.7	2.9	8.7	17	.6	2200	.07	.05	.6	1
Vegetables and beef with cereal	56	2.7	1.6	7.6	17	.8	2800	.03	.04	.9	1
Vegetables and chicken with cereal	52	2.1	1.4	7.7	33	.4	1000	.03	.04	.5	Trace
Vegetables and ham, with cereal	64	2.8	2.2	8.3	25	.3	1000	.08	.05	.5	3
Vegetables and lamb, with cereal	58	2.2	2.0	7.7	23	.7	2200	.03	.05	.7	1
Vegetables and liver, with cereal	47	3.1	.4	7.8	17	2.7	4700	.04	.37	1.6	3
Vegetables and liver, with bacon and cereal	57	2.4	1.9	7.5	11	2.6	4600	.03	.33	1.3	2

* Items selected from Table 1 in *Composition of Foods—Raw, Processed, Prepared*, by B. K. Watt and A. L. Merrill, Handbook No. 8, Consumer and Food Economics Research Division, U.S. Department of Agriculture, Washington, D.C., 1963.

Food	Energy *calories*	Protein *gm*	Fat *gm*	Carbohydrate *gm*	Calcium *mg*	Iron *mg*	Vitamin A Value *I.U.*	Thiamine *mg*	Riboflavin *mg*	Niacin *mg*	Ascorbic Acid *mg*
Vegetables and turkey, with cereal	44	2.1	0.8	7.2	22	0.3	400	0.01	0.03	0.4	1
Meat or poultry (approx. 6%–8% protein)											
Beef with vegetables	87	7.4	3.7	6.0	13	1.2	1100	.07	.17	1.6	2
Chicken with vegetables	100	7.4	4.6	7.2	22	.9	1000	.09	.15	1.6	2
Turkey with vegetables	86	6.7	3.2	7.6	38	.6	1000	.13	.13	1.8	2
Veal with vegetables	63	7.1	1.6	5.1	11	.8	800	.08	.15	2.0	2
Fruits and fruit products with or without thickening, canned											
Applesauce	72	.2	.2	18.6	4	.4	40	.01	.02	.1	Trace
Applesauce and apricots	86	.3	.1	22.6	4	.3	600	.01	.02	.1	2
Bananas (with tapioca or cornstarch, added ascorbic acid) strained	84	.4	.2	21.6	13	.2	70	.02	.02	.2	35
Bananas and pineapple (with tapioca or cornstarch)	80	.4	.1	20.7	20	.2	30	.01	.01	.1	2
Fruit dessert with tapioca (apricot, pineapple and/or orange)	84	.3	.3	21.5	15	.4	450	.02	.01	.2	4
Peaches	81	.6	.2	20.7	6	.3	500	.01	.02	.7	3
Pears	66	.3	.1	17.1	7	.2	30	.02	.02	.2	2
Pears and pineapple	69	.4	.2	17.6	7	.2	20	.03	.02	.2	2
Plums with tapioca, strained	94	.4	.2	24.3	5	.4	250	.01	.02	.2	2
Prunes with tapioca	86	.3	.2	22.4	7	.9	400	.02	.06	.4	4
Meats, poultry, and eggs; canned											
Beef:											
Strained	99	14.7	4.0	(0)	8	2.0	–	.01	.16	3.5	0
Junior	118	19.3	3.9	(0)	8	2.5	–	.02	.20	4.3	0

Table A–2. Nutritive Value of Baby Foods (Continued)

(Per 100 Grams Edible Portion—About 7 Tablespoons)

Food	Energy	Protein	Fat	Carbohydrate	Calcium	Iron	Vitamin A Value	Thiamine	Riboflavin	Niacin	Ascorbic Acid
	calories	*gm*	*gm*	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*
Chicken	127	13.7	7.6	(0)	–	1.9	–	0.02	0.16	3.5	0
Egg yolks, strained	210	10.0	18.4	.2	81	3.0	1900	.12	.12	Trace	Trace
Lamb:											
Strained	107	14.6	4.9	(0)	9	2.1	–	.02	.17	3.3	–
Junior	121	17.5	5.1	(0)	13	2.7	–	.02	.21	4.1	–
Liver, strained	97	14.1	3.4	1.5	6	5.6	24,000	.05	2.00	7.6	10
Liver and bacon, strained	123	13.7	6.6	1.3	6	4.2	22,000	.05	1.99	7.8	7
Pork:											
Strained	118	15.4	5.8	(0)	8	1.5	–	.19	.20	2.7	–
Junior	134	18.6	6.0	(0)	8	1.2	–	.23	.23	2.8	–
Veal:											
Strained	91	15.5	2.7	(0)	10	1.7	–	.03	.20	4.3	–
Junior	107	18.8	3.0	(0)	8	1.6	–	.03	.22	6.0	–
Vegetables, canned											
Beans, green	22	1.4	.1	5.1	33	1.1	400	.02	.06	.3	3
Beets, strained	37	1.4	.1	8.3	18	.7	20	.02	.03	.1	3
Carrots	29	.7	.1	6.8	23	.5	13,000	.02	.03	.4	3
Mixed vegetables, including vegetable soup	37	1.6	.3	8.5	22	.9	4700	.05	.04	.6	2
Peas, strained	54	4.2	.2	9.3	11	1.2	500	.08	.09	1.2	10
Spinach, creamed	43	2.3	.7	7.5	64	.6	5000	.02	.13	.3	6
Squash	25	.7	.1	6.2	24	.4	2400	.02	.04	.3	8
Sweetpotatoes	67	1.0	.2	15.5	16	.4	4900	.04	.03	.4	8
Tomato soup, strained	54	1.9	.1	13.5	24	.4	1000	.05	.12	.7	3

Table A–3. Food Composition Table for Short Method of Dietary Analysis (3rd revision)*

Food and Approximate Measure	Weight gm	Food Energy calories	Protein gm	Fat gm	Carbohydrate gm	Calcium mg	Iron mg	Vitamin A Value I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Ascorbic Acid mg
Milk, cheese, cream; related products												
Cheese: blue, Cheddar (1 cu in., 17 gm),												
Cheddar process (1 oz), Swiss (1 oz)	30	105	6	9	1	165	0.2	345	0.01	0.12	trace	0
cottage (from skim) creamed (½ c)	115	120	16	5	3	105	0.4	190	0.04	0.28	0.1	0
Cream: half-and-half (cream and milk) (2 tbsp)												
For light whipping add 1 pat butter	30	40	1	4	2	30	trace	145	0.01	0.04	trace	trace
Milk: whole (3.5% fat) (1 c)	245	160	9	9	12	285	0.1	350	0.08	0.42	0.1	2
fluid, nonfat (skim) and buttermilk (from skim)	245	90	9	trace	13	300	trace	—	0.10	0.44	0.2	2
milk beverages, (1 c) cocoa, chocolate drink made with skim milk. For malted milk add 4 tbsp half-and-half (270 gm)	245	210	8	8	26	280	0.6	300	0.09	0.43	0.3	trace
milk desserts, custard (1 c) 248 gm, ice cream (8fl oz) 142 gm		290	8	17	29	210	0.4	785	0.07	0.34	0.1	1
cornstarch pudding (248 gm), ice milk (1 c) 187 gm		280	9	10	40	290	0.1	390	0.08	0.41	0.3	2
White sauce, med (½ c)	130	215	5	16	12	150	0.2	610	0.06	0.22	0.3	trace
Egg: 1 large	50	80	6	6	trace	25	1.2	590	0.06	0.15	trace	0
Meat, poultry, fish, shellfish, related products												
Beef, lamb, veal: lean and fat, cooked, inc. corned beef (3 oz) (all cuts)	85	245	22	16	0	10	2.9	25	0.06	0.19	4.2	0
lean only, cooked; dried beef (2 + oz) (all cuts)	65	140	20	5	0	10	2.4	10	0.05	0.16	3.4	0

* Leichsenring, J. M., and Wilson, E. D., in *Principles of Nutrition*, 2nd ed., by Wilson, E. D., Fisher, K. H., and Fuqua, M. E. John Wiley & Sons, New York, 1965 pp. 528-533.

Table A–3. Food Composition Table for Short Method of Dietary Analysis (3rd revision) (Continued)

Food and Approximate Measure	Weight gm	Food Energy calories	Protein gm	Fat gm	Carbohydrate gm	Calcium mg	Iron mg	Vitamin A Value I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Ascorbic Acid mg
Beef, relatively fat, such as steak and rib, cooked (3 oz)	85	350	18	30	0	10	2.4	60	0.05	0.14	3.5	0
Liver: beef, fried (2 oz)	55	130	15	6	3	5	5.0	30,280	0.15	2.37	9.4	15
Pork, lean & fat, cooked (3 oz) (all cuts)	85	325	20	24	0	10	2.6	0	0.62	0.20	4.2	0
lean only, cooked (2 + oz) (all cuts)	60	150	18	8	0	5	2.2	0	0.57	0.19	3.2	0
ham, light cure, lean & fat, roasted (3 oz)	85	245	18	19	0	10	2.2	0	0.40	0.16	3.1	0
Luncheon meats: bologna (2 sl), pork sausage, cooked (2 oz), frankfurter (1), bacon, broiled or fried crisp (3 sl)		185	9	16	—	5	1.3	—	0.21	0.12	1.7	0
Poultry												
chicken: flesh only, broiled (3 oz)	85	115	20	3	0	10	1.4	80	0.05	0.16	7.4	0
fried (2 + oz)	75	170	24	6	1	10	1.6	85	0.05	0.23	8.3	0
turkey, light & dark, roasted (3 oz)	85	160	27	5	0	—	1.5	—	0.03	0.15	6.5	0
Fish and shellfish												
salmon (3 oz) (canned)	85	130	17	5	0	165	0.7	60	0.03	0.16	6.8	0
fish sticks, breaded, cooked (3–4)	75	130	13	7	5	10	0.3	—	0.03	0.05	1.2	0
mackerel, halibut, cooked	85	175	19	10	0	10	0.8	515	0.08	0.15	6.8	0
blue fish, haddock, herring, perch, shad, cooked (tuna canned in oil, 20 gm)	85	160	19	8	2	20	1.0	60	0.06	0.11	4.4	0
clams, canned; crab meat, canned; lobster; oyster, raw; scallop; shrimp, canned	85	75	14	1	2	65	2.5	65	0.10	0.08	1.5	0

Mature dry beans and peas, nuts, peanuts, related products												
Beans: white with pork & tomato, canned (1 c)	260	320	16	7	50	140	4.7	340	0.20	0.08	1.5	5
red (128 gm), Lima (96 gm), cowpeas (125 gm), cooked (½ c)		125	8	—	25	35	2.5	5	0.13	0.06	0.7	—
Nuts: almonds (12), cashews (8), peanuts (1 tbsp), peanut butter (1 tbsp), pecans (12), English walnuts (2 tbsp), coconut (¼ c)	15	95	3	8	4	15	0.5	5	0.05	0.04	0.9	—
Vegetables and vegetable products												
Asparagus, cooked, cut spears (⅔ c)	115	25	3	trace	4	25	0.7	1055	0.19	0.20	1.6	30
Beans: green (½ c) cooked 60 gm; canned 120 gm		15	1	trace	3	30	0.4	340	0.04	0.06	0.3	8
Lima, immature, cooked (½ c)	80	90	6	1	16	40	2.0	225	0.14	0.08	1.0	14
Broccoli spears, cooked (⅔ c)	100	25	3	trace	4	90	0.8	2500	0.09	0.20	0.8	90
Brussels sprouts, cooked (⅔ c)	85	30	3	trace	5	30	1.0	450	0.07	0.12	0.7	75
Cabbage (110 gm); cauliflower, cooked (80 gm); and sauerkraut, canned (150 gm) (reduce ascorbic acid value by one-third for kraut) (⅔ c)		20	1	trace	4	35	0.5	80	0.05	0.05	0.3	37
Carrots, cooked (⅔ c)	95	30	1	trace	7	30	0.6	10,145	0.05	0.05	0.5	6
Corn, 1 ear, cooked (140 gm); canned (130 gm) (½ c)		75	2	trace	18	5	0.4	315	0.06	0.06	1.1	6
Leafy greens: collards (125 gm), dandelions (120 gm), kale (75 gm), mustard (95 gm), spinach (120 gm), turnip (100 gm cooked, 150 gm canned) (⅔ cooked and canned) (reduce ascorbic acid one-half for canned)		30	3	trace	5	175	1.8	8570	0.11	0.18	0.8	45
green (½ c)	80	60	4	1	10	20	1.4	430	0.22	0.09	1.8	16

Table A–3. Food Composition Table for Short Method of Dietary Analysis (3rd revision) (Continued)

Food and Approximate Measure	Weight gm	Food Energy calories	Protein gm	Fat gm	Carbohydrate gm	Calcium mg	Iron mg	Vitamin A Value I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Ascorbic Acid mg
Potatoes-baked, boiled (100 gm), 10 pc French fried (55 gm) (for fried, add 1 tbsp cooking oil)		85	3	trace	30	10	0.7	trace	0.08	0.04	1.5	16
Pumpkin, canned (½ c)	115	40	1	1	9	30	0.5	7295	0.03	0.06	0.6	6
Squash, winter, canned (½ c)	100	65	2	1	16	30	0.8	4305	0.05	0.14	0.7	14
Sweetpotato, canned (½ c)	110	120	2	—	27	25	0.8	8500	0.05	0.05	0.7	15
Tomato, 1 raw, ⅔ c canned, ⅔ c juice	150	35	2	trace	7	14	0.8	1350	0.10	0.06	1.0	29
Tomato catsup (2 tbsp)	35	30	1	trace	8	10	0.2	480	0.04	0.02	0.6	6
Other, cooked (beets, mushrooms, onions, turnips) (½ c)	95	25	1	—	5	20	0.5	15	0.02	0.10	0.7	7
Others commonly served raw, cabbage (½ c, 50 gm), celery (3 sm stalks, 40 gm), cucumber (¼ med, 50 gm), green pepper (½, 30 gm), radishes (5, 40 gm)		10	trace	trace	2	15	0.3	100	0.03	0.03	0.2	20
carrots, raw (½ carrot)	25	10	trace	trace	2	10	0.2	2750	0.02	0.02	0.2	2
lettuce leaves (2 lg)	50	10	1	trace	2	34	0.7	950	0.03	0.04	0.2	9
Fruits and fruit products												
Cantaloupe (½ med)	385	60	1	trace	14	25	0.8	6540	0.08	0.06	1.2	63
Citrus and strawberries: orange (1), grapefruit (½), juice (½ c), strawberries (½ c), lemon (1), tangerine (1)		50	1	—	13	25	0.4	165	0.08	0.03	0.3	55
Yellow, fresh: apricots (3), peach (2 med); canned fruit and juice (½ c) or dried, cooked, unsweetened: apricot, peaches (½ c)		85	—	—	22	10	1.1	1005	0.01	0.05	1.0	5

Other, dried: dates, pitted (4), figs (2), raisins (¼ c)	40	120	1	—	31	35	1.4	20	0.04	0.04	0.5	—
Other, fresh: apple (1), banana (1), figs (3), pear (1)		80	—	—	21	15	0.5	140	0.04	0.03	0.2	6
Fruit pie: to 1 serving fruit add 1 tbsp flour, 2 tbsp sugar, 1 tbsp fat												
Grain products												
Enriched and whole grain: bread (1 sl, 23 gm), biscuit (½), cooked cereals (½ c), prepared cereals (1 oz), Graham crackers (2 lg), macaroni, noodles, spaghetti (½ c, cooked), pancake (1,27 gm), roll (½), waffle (½, 38 gm)		65	2	1	16	20	0.6	10	0.09	0.05	0.7	—
Unenriched: bread (1 sl, 23 gm), cooked cereal (½ c), macaroni, noodles, spaghetti (½ c), popcorn (½ c), pretzel sticks, small (15), roll (½)		65	2	1	16	10	0.3	5	0.02	0.02	0.3	—
Desserts												
Cake, plain (1 pc), doughnut (1). For iced cake or doughnut add value for sugar (1 tbsp). For chocolate cake add chocolate (30 gm)	45	145	2	5	24	30	0.4	65	0.02	0.05	0.2	—
Cookies, plain (1)	25	120	1	5	18	10	0.2	20	0.01	0.01	0.1	—
Pie crust, single crust (1/7 shell)	20	95	1	6	8	3	0.3	0	0.04	0.03	0.3	—
Flour, white, enriched (1 tbsp)	7	25	1	trace	5	1	0.2	0	0.03	0.02	0.2	0
Fats and Oils												
Butter, margarine (1 pat, ½ tbsp)	7	50	trace	6	trace	1	0	230	—	—	—	—
Fats and oils, cooking (1 tbsp), French dressing (2 tbsp)	14	125	0	14	0	0	0	0	0	0	0	0
Salad dressing, mayonnaise type (1 tbsp)	15	80	trace	9	1	2	0.1	45	trace	trace	trace	0

Table A–3. Food Composition Table for Short Method of Dietary Analysis (3rd revision) (Continued)

Food and Approximate Measure	Weight *gm*	Food Energy *calories*	Protein *gm*	Fat *gm*	Carbohydrate *gm*	Calcium *mg*	Iron *mg*	Vitamin A Value *I.U.*	Thiamine *mg*	Riboflavin *mg*	Niacin *mg*	Ascorbic Acid *mg*
Sugars, sweets												
Candy, plain (½ oz), jam and jelly (1 tbsp), syrup (1 tbsp), gelatin dessert, plain (½ c), beverages, carbonated (1 c)		60	0	0	14	3	0.1	trace	trace	trace	trace	trace
Chocolate fudge (1 oz), chocolate syrup (3 tbsp)		125	1	2	30	15	0.6	10	trace	0.02	0.1	trace
Molasses (1 tbsp), caramel (⅓ oz)		40	trace	trace	8	20	0.3	trace	trace	trace	trace	trace
Sugar (1 tbsp)	12	45	0	0	12	0	trace	0	0	0	0	0
Miscellaneous												
Chocolate, bitter (1 oz)	30	145	3	15	8	20	1.9	20	0.01	0.07	0.4	0
Sherbet (½ c)	96	130	1	1	30	15	trace	55	0.01	0.03	trace	2
Soups: bean, pea (green) (1 c)		150	7	4	22	50	1.6	495	0.09	0.06	1.0	4
noodle, beef, chicken (1 c)		65	4	2	7	10	0.7	50	0.03	0.04	0.9	trace
clam chowder, minestrone, tomato, vegetable (1 c)		90	3	2	14	25	0.9	1880	0.05	0.04	1.1	3

Table A–4 Food Exchange Lists for Calculating Diets*

(Foods are divided into six groups, according to their composition)

Food Exchange	Quantity for One Exchange: Measure	Weight gm	Carbohydrate gm	Protein gm	Fat gm	Calories
Milk	8 ounces	240	12	8	10	170
Vegetables—A	as desired	—	—	—	—	—
Vegetables—B	½ cup	100	7	2	—	36
Fruit	varies	—	10	—	—	40
Bread	varies	—	15	2	—	68
Meat	1 ounce	30	—	7	5	73
Fat	1 teaspoon	5	—	—	—	45

* Caso, E. K.: "Calculation of Diabetic Diets," *J. Am. Dietet. A.*, **26**: 575, 1950.

List 1—Milk Exchanges

Per exchange: carbohydrate, 12 gm; protein, 8 gm; fat, 10 gm

	Measure	Weight
Milk, whole (plain or homogenized)	1 cup (8 ounces)	240
Milk, skim, liquid*	1 cup	240
Milk, evaporated	½ cup	120
Milk, powdered whole	3–5 tablespoons†	35
Milk, nonfat dry*	3–5 tablespoons†	35
Buttermilk (from whole milk)	1 cup	240
Buttermilk (from skim milk)*	1 cup	240

* Since these forms of milk contain no fat, two fat exchanges may be added to the diet when they are used; or one exchange of these forms of milk may be calculated as carbohydrate, 12; protein, 8; and fat, 0.

† The amount of milk powder to use depends upon the brand used; read package directions for the equivalent for 1 cup liquid milk.

List 2—Vegetable Exchanges

Group A Vegetables—negligible carbohydrate, protein, and fat if 1 cup (200 gm) or less is used. Count each additional cup as one exchange of Group B vegetable.

Asparagus	Eggplant	Lettuce
Beans, string, young	Greens*	Mushrooms
Broccoli*	beet greens	Okra
Brussels sprouts	chard, Swiss	Pepper*
Cabbage	collard	Radish
Cauliflower	dandelion	Sauerkraut
Celery	kale	Squash, summer
Chicory*	mustard	Tomatoes*
Cucumbers	spinach	Watercress*
Escarole*	turnip greens	

Group B Vegetables—per exchange: carbohydrate, 7 gm; protein 2 gm; fat, negligible. One exchange = ½ cup = 100 gm.

Beets	Peas, green	Squash, winter*
Carrots*	Pumpkin*	Turnip
Onion	Rutabaga	

* These vegetables have high vitamin-A value. At least one serving should be included in the diet each day.

Table A–4. Food Exchange Lists for Calculating Diets (Continued)

List 3—Fruit Exchanges

Per exchange: carbohydrate, 10 gm; protein, and fat, negligible
Fruits may be used fresh, cooked, canned or frozen, unsweetened

	Measure	Weight
		gm
Apple	1 small, 2-in. diameter	80
Applesauce	½ cup	100
Apricots, dried	4 halves	20
Apricots, fresh	2 medium	100
Banana	½ small	50
Blackberries	1 cup	150
Blueberries	⅔ cup	100
Cantaloupe*	¼, 6-inch diameter	200
Cherries	10 large	75
Dates	2	15
Figs, dried	1 small	15
Figs, fresh	2 large	50
Grapefruit*	½ small	125
Grapefruit juice*	½ cup	100
Grape juice	¼ cup	60
Grapes	12	75
Honeydew melon*	⅛, 7-inch diameter	150
Mango	½ small	70
Nectarines	1 medium	80
Orange*	1 small	100
Orange juice*	½ cup	100
Papaya	⅓ medium	100
Peach	1 medium	100
Pear	1 small	100
Pineapple	½ cup cubed	80
Pineapple juice	⅓ cup	80
Plums	2 medium	100
Prunes, dried	2 medium	25
Raisins	2 tablespoons	15
Raspberries	1 cup	150
Strawberries*	1 cup	150
Tangerine	1 large	100
Watermelon	1 cup diced	175

* These fruits are rich sources of ascorbic acid. At least one exchange should be included in the diet each day.

List 4—Bread Exchanges

Per exchange: carbohydrate, 15 gm; protein, 2 gm; fat, negligible

	Measure	Weight
		gm
Bread	1 slice	25
biscuit, roll (2 inch diameter)	1	30
muffin	1 medium	35
cornbread	1½-inch cube	35

List 4—Bread Exchanges (Continued)

Cereal, cooked	½ cup	100
Cereal, dry	¾ cup	20
Crackers, graham	2	20
oyster	20 (½ cup)	20
saltines (2 inches square)	5	20
soda (2½ inches square)	3	20
round, thin (1½ inch diameter)	6–8	20
Flour	2½ tablespoons	30
Grits	½ cup cooked	100
Ice cream, vanilla (omit two fat exchanges)	⅛ quart	70
Macaroni	½ cup cooked	100
Matzoth	½ (6½ inch square)	20
Noodles	½ cup cooked	100
Rice	½ cup cooked	100
Spaghetti	½ cup cooked	100
Sponge cake, no icing	1½-inch cube	25
Vegetables		
beans, baked; no pork	¼ cup	50
beans and peas, dried (includes kidney, Lima, navy beans, blackeyed, split, and cowpeas, etc.)	½ cup cooked	100
beans, Lima, fresh	½ cup	100
corn, popped	1 cup	20
corn, fresh	⅓ cup or ½ small ear	80
parsnips	⅔ cup	125
potatoes, white	1 small (2-inch diameter)	100
potatoes, white, mashed	½ cup	100
potatoes, sweet or yam	¼ cup	50

List 5—Meat Exchanges

Per exchange: carbohydrate, negligible; protein, 7 gm; fat, 5 gm
Measures and weights are for cooked meat

	Measure	Weight
		gm
Meat, fish, and poultry (medium fat) (beef, lamb, pork, veal, liver, chicken, turkey, etc.)	1 ounce	30
cold cuts (bologna, liver sausage, luncheon loaf, boiled ham, salami, etc.)	1 slice, 4½ inches square, ⅛ inch thick	45
frankfurt (9 per pound)	1	50
cod, haddock, halibut, herring, etc.	1 ounce	30
crab, lobster, salmon, tuna	¼ cup	30
clams, oysters, shrimp	5 small	45
sardines	3 medium	30
Cheese, Cheddar	1 ounce	30
cottage	¼ cup	45
Egg	1	50
Peanut butter*	2 tablespoons	30

* Limit to one exchange daily or adjust for carbohydrate. Deduct 5 gm carbohydrate for each additional exchange.

Table A–4. Food Exchange Lists for Calculating Diets (Continued)

List 6—Fat Exchanges

Per exchange: fat, 5 gm; protein and carbohydrate, negligible

	Measure	Weight gm
Butter or margarine	1 teaspoon	5
Bacon, crisp	1 slice	10
Cream, light, 20 per cent	2 tablespoons	30
Cream, heavy, 35–40 per cent	1 tablespoon	15
Cream cheese	1 tablespoon	15
French dressing	1 tablespoon	15
Mayonnaise	1 teaspoon	5
Nuts	6 small	10
Oil or cooking fat	1 teaspoon	5
Olives	5 small	50
Avocado	⅛, 4-inch diameter	25

Foods Allowed As Desired

Protein, fat, and carbohydrate negligible

Coffee	Gelatin, unsweetened	Vinegar
Tea	Rennet tablets	Cranberries, unsweetened
Clear broth	Cyclamate, sodium or calcium	Lemon
Bouillon	Saccharin	Mustard, dry
(fat free)	Spices (see list p. 759)	Pickle, dill, unsweetened
Herbs (see list p. 759)		Rhubarb, unsweetened

Table A–5. Amino Acid Content of Selected Foods*

(per 100 grams food, edible portion)

Food	Protein	Trypto-phan	Threo-nine	Iso-leucine	Leucine	Lysine	Sulfur Containing Methionine	Sulfur Containing Cystine	Phenyl-alanine	Tyrosine	Valine	Arginine	Histidine
	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm
Milk													
Cow:													
Fluid, whole and nonfat	3.5	0.049	0.161	0.223	0.344	0.272	0.086	0.031	0.170	0.178	0.240	0.128	0.092
Canned:													
Evaporated, unsweetened	7.0	.099	.323	.447	.688	.545	.171	.063	.340	.357	.481	.256	.185
Condensed, sweetened	8.1	.114	.374	.518	.796	.631	.198	.072	.393	.413	.557	.296	.214
Dried													
Whole	25.8	.364	1.191	1.648	2.535	2.009	.632	.231	1.251	1.316	1.774	.944	.680
Nonfat	35.6	.502	1.641	2.271	3.493	2.768	.870	.318	1.724	1.814	2.444	1.300	.937
Goat	3.3	.039	.217	.087	.278	.312	.065	—	.121	—	.139	.174	.068
Human	1.4	.023	.062	.075	.124	.090	.028	.027	.060	.071	.086	.055	.030
Milk Products													
Buttermilk	3.5	.038	.165	.219	.348	.291	.082	.032	.186	.137	.262	.168	.099
Casein	100.0	1.335	4.227	6.550	10.048	8.013	3.084	.382	5.389	5.819	7.393	4.070	3.021
Cheese													
Blue mold	21.5	.293	.799	1.449	2.096	1.577	.559	.121	1.153	1.028	1.543	.785	.701
Camembert	17.5	.239	.650	1.179	1.706	1.284	.455	.099	.938	.837	1.256	.639	.571
Cheddar	25.0	.341	.929	1.685	2.437	1.834	.650	.141	1.340	1.195	1.794	.913	.815
Cheddar processed	23.2	.316	.862	1.563	2.262	1.702	.604	.131	1.244	1.109	1.665	.847	.756
Cottage	17.0	.179	.794	.989	1.826	1.428	.469	.147	.917	.917	.978	.802	.549
Cream cheese	9.0	.080	.408	.519	.923	.721	.229	.085	.547	.408	.538	.313	.278

* Items selected from *Amino Acid Content of Foods*, by M. L. Orr and B. K. Watt, Home Economics Research Rep. No. 4, Agricultural Research Service, U.S. Department of Agriculture, Washington, 1957.

Table A–5. Amino Acid Content of Selected Foods (Continued)

(per 100 grams food, edible portion)

Food	Protein	Trypto-phan	Threo nine	Iso-leucine	Leucine	Lysine	Sulfur Containing Methionine	Sulfur Containing Cystine	Phenyl-alanine	Tyrosine	Valine	Arginine	Histidine
	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm
Swiss	27.5	0.375	1.021	1.853	2.681	2.017	0.715	0.155	1.474	1.315	1.974	1.004	0.896
Swiss processed	26.4	.360	.981	1.779	2.574	1.937	.687	.149	1.415	1.262	1.895	.964	.861
Eggs													
Whole	12.8	.211	.637	.850	1.126	.819	.401	.299	.739	.551	.950	.840	.307
Whites	10.8	.164	.477	.698	.950	.648	.420	.263	.689	.449	.842	.634	.233
Yolks	16.3	.235	.827	.996	1.372	1.074	.417	.274	.717	.756	1.121	1.132	.368
Meat and poultry													
Beef cuts, medium fat													
Chuck	18.6	.217	.821	.973	1.524	1.625	.461	.235	.765	.631	1.033	1.199	.646
Hamburger	16.0	.187	.707	.837	1.311	1.398	.397	.202	.658	.543	.888	1.032	.556
Porterhouse	16.4	.192	.724	.858	1.343	1.433	.407	.207	.674	.556	.911	1.057	.569
Rib roast	17.4	.203	.768	.910	1.425	1.520	.432	.220	.715	.590	.966	1.122	.604
Round	19.5	.228	.861	1.020	1.597	1.704	.484	.246	.802	.661	1.083	1.257	.677
Rump	16.2	.189	.715	.848	1.327	1.415	.402	.205	.666	.550	.899	1.045	.562
Sirloin	17.3	.202	.764	.905	1.417	1.511	.429	.219	.711	.587	.960	1.116	.601
Beef, dried or chipped	34.3	.401	1.515	1.795	2.810	2.996	.851	.434	1.410	1.163	1.904	2.212	1.191
Lamb cuts, medium fat													
Leg	18.0	.233	.824	.933	1.394	1.457	.432	.236	.732	.625	.887	1.172	.501
Rib	14.9	.193	.682	.772	1.154	1.206	.358	.195	.606	.517	.734	.970	.415
Shoulder	15.6	.202	.714	.809	1.208	1.263	.374	.205	.634	.542	.769	1.016	.434
Pork cuts, medium fat, fresh													
Ham	15.2	.197	.705	.781	1.119	1.248	.379	.178	.598	.542	.790	.931	.525
Loin	16.4	.213	.761	.842	1.207	1.346	.409	.192	.646	.585	.853	1.005	.567
Miscellaneous lean cuts	14.5	.188	.673	.745	1.067	1.190	.362	.169	.571	.517	.754	.889	.501

Pork, cured													
Bacon, medium fat	9.1	0.095	0.306	0.399	0.728	0.587	0.141	0.106	0.434	0.234	0.434	0.622	0.246
Fat back or salt pork	3.9	.006	.141	.110	.367	.317	.055	.043	.157	.052	.168	.379	.035
Ham	16.9	.162	.692	.841	1.306	1.420	.411	.273	.646	.652	.879	1.068	.544
Luncheon meat													
Boiled ham	22.8	.219	.934	1.135	1.762	1.915	.554	.368	.872	.879	1.186	1.441	.733
Canned, spiced	14.9	.143	.610	.741	1.151	1.252	.362	.241	.570	.575	.775	.942	.479
Veal cuts, medium fat													
Round	19.5	.256	.846	1.030	1.429	1.629	.446	.231	.792	.702	1.008	1.270	.627
Shoulder	19.4	.255	.841	1.024	1.422	1.620	.444	.230	.788	.698	1.003	1.263	.624
Stew meat	18.3	.240	.793	.966	1.341	1.528	.419	.217	.744	.659	.946	1.192	.589
Chicken, flesh only													
Broilers or fryers	20.6	.250	.877	1.088	1.490	1.810	.537	.277	.811	.725	1.012	1.302	.593
Hens	21.3	259	.907	1.125	1.540	1.871	.556	.286	.838	.750	1.046	1.346	.613
Fish and shellfish													
Blue fish	20.5	.203	.889	1.040	1.548	1,797	.597	.276	.761	.554	1.092	1.155	—
Cod, fresh	16.5	.164	.715	.837	1.246	1.447	.480	.222	.612	.446	.879	.929	—
dried	81.8	.811	3.547	4.149	6.178	7.172	2.382	1.099	3.036	2.212	4.358	4.607	—
Flounder	14.9	.148	.646	.756	1.125	1.306	.434	.200	.553	.403	.794	.839	—
Haddock	18.2	.181	.789	.923	1.374	1.596	.530	.245	.676	.492	.970	1.025	—
Halibut	18.6	.185	.806	.943	1.405	1.631	.542	.250	.690	.503	.991	1.048	—
Herring, Atlantic	18.3	.182	.793	.928	1.382	1.605	.533	.246	.679	.495	.975	1.031	—
Mackeral, raw, common Atlantic	18.7	.186	.811	.948	1.412	1.640	.545	.251	.694	.506	.996	1.053	—
Salmon, raw, Pacific	17.4	.173	.754	.883	1.314	1.526	.507	.234	.646	.470	.927	.980	—
canned, red, solids and liquid	20.2	.200	.876	1.025	1.526	1.771	.588	.271	.750	.546	1.076	1.138	—
Sardines, canned, solids and liquid, Atlantic	21.1	.209	.915	1.070	1.593	1.850	.614	.284	.783	.571	1.124	1.188	—
Shrimp, canned, solids and liquid	18.7	.186	.811	.948	1.412	1.640	.545	.251	.694	.506	.996	1.053	—

Table A–5. Amino Acid Content of Selected Foods (Continued)

(per 100 grams food, edible portion)

Food	Protein gm	Trypto-phan gm	Threo-nine gm	Iso-leucine gm	Leucine gm	Lysine gm	Sulfur Containing Methionine gm	Sulfur Containing Cystine gm	Phenyl-alanine gm	Tyrosine gm	Valine gm	Arginine gm	Histidine gm
Products from meat, poultry and fish													
Fish flour	76.0	0.754	4.378	4.232	6.189	7.381	2.019	—	2.845	—	3.916	5.204	1.289
Gelatin	85.6	.006	1.912	1.357	2.930	4.226	.787	.077	2.036	.401	2.421	7.866	.771
Liver, beef or pork	19.7	.296	.936	1.031	1.819	1.475	.463	.243	.993	.738	1.239	1.201	.523
Sausage													
Bologna	14.8	.126	.606	.718	1.061	1.191	.313	.185	.540	.481	.744	1.028	.398
Frankfurters	14.2	.120	.582	.688	1.018	1.143	.300	.177	.518	.461	.713	.986	.382
Liverwurst	16.7	.187	.724	.818	1.400	1.301	.347	.203	.759	.510	1.037	1.034	.497
Pork, links or bulk, raw	10.8	.092	.442	.524	.774	.869	.228	.135	.394	.351	.543	.750	.290
Pork, bulk, canned	15.4	.131	.631	.747	1.104	1.239	.325	.192	.562	.500	.774	1.069	.414
Salami	23.9	.203	.979	1.159	1.713	1.923	.505	.298	.872	.776	1.201	1.660	.642
Tongue, beef	16.4	.197	.708	.792	1.286	1.364	.357	.207	.661	.548	.840	1.065	.412
Legumes													
Beans													
Red kidney													
raw	23.1	.214	1.002	1.312	1.985	1.715	.233	.229	1.275	.891	1.401	1.390	.658
canned, solids and liquid	5.7	.053	.247	.324	.490	.423	.057	.057	.315	.220	.346	.343	.162
Other common beans including navy, pea-bean, white marrow:													
raw	21.4	.199	.928	1.216	1.839	1.589	.216	.212	1.181	.825	1.298	1.287	.609
baked with pork, canned	5.8	.057	.274	.291	.486	.354	.059	.018	.333	.165	.312	.251	.186

Chickpeas	20.8	0.170	0.739	1.195	1.538	1.434	0.276	0.296	1.012	0.692	1.025	1.551	0.559
Cowpeas	22.9	.220	.901	1.110	1.715	1.491	.352	..297	1.198	.678	1.293	1.473	.692
Lentils, whole	25.0	.216	.896	1.316	1.760	1.528	.180	.204	1.104	.664	1.360	1.908	.548
Lima beans	20.7	.195	.980	1.199	1.722	1.378	.331	.311	1.222	.543	1.298	1.315	.669
Peanuts	26.9	.340	.828	1.266	1.872	1.099	.271	.463	1.557	1.104	1.532	3.296	.749
Peanut flour	51.2	.647	1.575	2.410	3.563	2.091	.516	.881	2.963	2.100	2.916	6.273	1.425
Peanut butter	26.1	.330	.803	1.228	1.816	1.066	.263	.449	1.510	1.071	1.487	3.198	.727
Peas, split	24.5	.259	.945	1.380	2.027	1.795	.294	.318	1.235	.988	1.372	2.164	.670
Soybeans, whole	34.9	.526	1.504	2.504	2.946	2.414	.513	.678	1.889	1.216	2.005	2.763	.911
Soybean flour, flakes and grits													
Low fat	44.7	.673	1.926	2.630	3.773	3.092	.658	.869	2.419	1.558	2.568	3.538	1.166
Full fat	35.9	.541	1.547	2.112	3.030	2.483	.528	.698	1.943	1.251	2.062	2.842	.937
Soybean milk	3.4	.051	.176	.175	.305	.269	.054	.071	.195	.193	.186	.302	.121
Nuts													
Almonds	18.6	.176	.610	.873	1.454	.582	.259	.377	1.146	.618	1.124	2.729	.517
Brazil nuts	14.4	.187	.422	.593	1.129	.443	.941	.504	.617	.483	.823	2.247	.367
Cashews	18.5	.471	.737	1.222	1.522	.792	.353	.527	.946	.712	1.592	2.098	.415
Coconut	3.4	.033	.129	.180	.269	.152	.071	.062	.174	.101	.212	.486	.069
Pecans	9.4	.138	.389	.553	.773	.435	.153	.216	.564	.316	.525	1.185	.273
Walnuts (English or Persian)	15.0	.175	.589	.767	1.228	.441	.306	.320	.767	.583	.974	2.287	.405
Other Seeds													
Cottonseed flour and meal	42.3	.591	1.764	1.884	2.945	2.139	.686	.814	2.610	1.365	2.458	5.603	1.325
Safflower seed meal	42.1	.675	1.462	1.914	2.740	1.525	.731	—	2.605	—	2.446	4.623	.985
Sesame seed	19.3	.331	.707	.951	1.679	.583	.637	.495	1.457	.951	.885	1.992	.441
Meal	33.4	.573	1.223	1.645	2.905	1.008	1.103	.857	2.521	1.645	1.531	3.447	.763
Sunflower meal	39.5	.589	1.565	2.191	2.981	1.491	.760	.797	2.094	1.110	2.325	4.069	1.006
Grains and their products													
Barley	12.8	.160	.433	.545	.889	.433	.184	.257	.661	.466	.643	.659	.239
Bread, white (4% nonfat dry milk, flour basis)	8.5	.091	.282	.429	.668	.225	.142	.200	.465	.243	.435	.340	.192

Table A–5. Amino Acid Content of Selected Foods (Continued)

(per 100 grams food, edible portion)

Food	Protein	Trypto-phan	Threo-nine	Iso-leucine	Leucine	Lysine	Sulfur Containing Methionine	Sulfur Containing Cystine	Phenyl-alanine	Tyrosine	Valine	Arginine	Histidine
	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm
Cereal combinations													
Corn and soy grits	18.0	0.161	0.792	0.841	1.656	0.772	0.271	0.311	0.832	0.562	1.054	0.982	0.472
Infant food, precooked, mixed cereals with nonfat dry milk and yeast	19.4	.118	—	—	—	.273	.310	.137	.543	.447	—	.447	.233
Oat-corn-rye mixture, puffed	14.5	.172	.545	.841	1.368	.343	.388	.234	.933	.622	.900	.776	.326
Corn grits	8.7	.053	.347	.402	1.128	.251	.161	.113	.395	.532	.444	.306	.180
Cornmeal, degermed	7.9	.048	.315	.365	1.024	.228	.147	.102	.359	.483	.403	.278	.163
Corn flakes	8.1	.052	.275	.306	1.057	.154	.135	.152	.354	.283	.386	.231	.226
Oatmeal	14.2	.183	.470	.733	1.065	.521	.209	.309	.758	.524	.845	.935	.261
Rice flakes or puffed	5.9	.046	—	—	—	.056	—	.044	.286	.124	—	.137	.137
Rice, white and converted	7.6	.082	.298	.356	.655	.300	.137	.103	.382	.347	.531	.438	.128
Rye flour, medium	11.4	.129	.422	.485	.766	.465	.180	.227	.538	.368	.594	.557	.260
Wheat flour													
Whole grain	13.3	.164	.383	.577	.892	.365	.203	.292	.657	.497	.616	.636	.271
White	10.5	.129	.302	.483	.809	.239	.138	.210	.577	.359	.453	.466	.210
Wheat products													
Bran	12.0	.196	.342	.485	.717	.491	.145	.270	.434	.259	.552	.742	.280
Burghul	12.4	.070	—	—	—	.430	.300	.319	—	—	—	—	—
Farina	10.9	.124	—	—	—	.199	.143	.184	.579	.447	—	.424	.268
Flakes	10.8	.121	.356	.496	.891	.360	.127	.191	.478	.311	.572	.559	.231
Germ	25.2	.265	1.343	1.177	1.708	1.534	.404	.287	.908	.882	1.364	1.825	.687
Macaroni or spaghetti	12.8	.150	.499	.642	.849	.413	.193	.243	.669	.422	.728	.582	.303
Noodles, containing egg solids	12.6	.133	.533	.621	.834	.411	.212	.245	.610	.312	.745	.621	.301
Shredded wheat	10.1	.085	.405	.449	.684	.331	.139	.204	.481	.236	.577	.523	.236

Whole wheat with added germ	12.8	0.136	—	—		0.466	—	0.246	0.755	0.481	—	0.742	0.371
Fruit													
Bananas, ripe	1.2	.018	—	—	—	.055	.011	—	—	.031	—	—	—
Dates	2.2	.061	.061	.074	.077	.065	.027	—	.063	—	.094	.049	.049
Grapefruit	0.5	.001	—	—	—	.006	.000	—	—	—	—	—	—
Guavas, common	1.0	.010	—	—	—	.030	.010	—	—	—	—	—	—
Limes	0.8	.003	—	—	—	.015	.002	—	—	—	—	—	—
Mangos	0.7	.014	—	—	—	.093	.008	—	—	—	—	—	—
Muskmelons	0.6	.001	—	—	—	.015	.002	—	—	—	—	—	—
Oranges	0.9	.003	—	—	—	.024	.003	—	—	—	—	—	—
Papayas	0.6	.012	—	—	—	.038	.002	—	—	—	—	—	—
Pineapple	0.4	.005	—	—	—	.009	.001	—	—	—	—	—	—
Vegetables													
Asparagus, raw	2.2	.027	.066	.080	.096	.103	.032	—	.069	—	.106	.123	.036
Beans, snap	2.4	.033	.091	.109	.139	126	.035	.024	.057	.050	.115	.101	.045
Beet greens	2.0	.024	.076	.084	.129	.108	.034	—	.116	—	.101	.083	.026
Beets	1.6	.014	.034	.051	.055	.086	.006	—	.027	—	.049	.028	.022
Broccoli	3.3	.037	.122	.126	.163	.147	.050	—	.119	—	.170	.192	.063
Brussels sprouts	4.4	.044	.153	.186	.194	.197	.046	—	.148	—	.193	.279	.106
Cabbage	1.4	.011	.039	.040	.057	.066	.013	.028	.030	.030	.043	.105	.025
Carrots	1.2	.010	.043	.046	.065	.052	.010	.029	.042	.020	.056	.041	.017
Cauliflower	2.4	.033	.102	.104	.162	.134	.047	—	.075	.034	.144	.110	.048
Celery	1.3	.012	—	—	—	.021	.015	.006	—	.016	—	—	—
Chard	1.4	.014	.058	.060	.076	.055	.004	—	.046	—	.055	.035	.018
Chicory	1.6	.024	—	—	—	.052	.016	.006	—	.040	—	—	.024
Corn, sweet	3.7	.023	.151	.137	.407	.137	.072	.062	.207	.124	.231	.174	.095
Cowpeas	9.4	.099	.353	.465	.653	.617	.131	—	.523	—	.513	.615	.310
Cucumbers	0.7	.005	.019	.022	.030	.031	.007	—	.016	—	.024	.053	.001
Eggplant	1.1	.010	.038	.056	.068	.030	.006	—	.048	—	.065	.037	.015
Kale	3.9	.042	.139	.133	.252	.121	.035	.036	.158	—	.184	.202	.062
Lettuce	1.2	.012	—	—	—	.070	.004	—	—	—	—	—	—

Table A–5. Amino Acid Content of Selected Foods (Continued)

(per 100 grams food, edible portion)

Food	Protein	Trypto-phan	Threo-nine	Iso-leucine	Leucine	Lysine	Sulfur Containing Methionine	Sulfur Containing Cystine	Phenyl-alanine	Tyrosine	Valine	Arginine	Histidine
	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm	gm
Lima beans	7.5	0.097	0.338	0.460	0.605	0.474	0.080	0.083	0.389	0.259	0.485	0.454	0.247
Mustard greens	2.3	.037	.060	.075	.062	.111	.024	.035	.074	.121	.108	.167	.041
Onions, mature	1.4	.021	.022	.021	.037	.064	.013	—	.039	.046	.031	.180	.014
Peas	6.7	.056	.245	.308	.418	.316	.054	.073	.257	.163	.274	.595	.109
Peppers	1.2	.009	.050	.046	.046	.051	.016	—	.055	—	.033	.024	.014
Potatoes, raw	2.0	.021	.079	.088	.100	.107	.025	.019	.088	.036	.107	.099	.029
Spinach	2.3	.037	.102	.107	.176	.142	.039	.046	.099	.073	.126	.116	.049
Squash, summer	0.6	.005	.014	.019	.027	.023	.008	—	.016	—	.022	.027	.009
Sweetpotatoes, raw	1.8	.031	.085	.087	.103	.085	.033	.029	.100	.081	.135	.094	.036
Tomatoes	1.0	.009	.033	.029	.041	.042	.007	—	.028	.014	.028	.029	.015
Turnips	1.1	—	—	.020	—	.057	.012	—	.020	.029	—	—	—
Turnip greens	2.9	.045	.125	.107	.207	.129	.052	.045	.146	.105	.149	.167	.051
Miscellaneous food items													
Yeast													
Baker's, compressed	10.6*	.122	.655	.655	1.151	.914	.248	.120	.607	.580	.840	.536	.353
Brewer's, dried	36.9*	.710	2.353	2.398	3.226	3.300	.836	.548	1.902	1.902	2.723	2.250	1.251
Primary, dried													
Saccharomyces cerevisiae	36.9*	.636	2.353	2.708	3.300	3.337	.851	.444	1.813	2.472	2.553	1.931	1.103
Torulopsis utilis	36.9*	.636	2.331	3.323	3.707	3.648	.710	.422	2.361	2.464	2.901	3.337	1.251

* Assumes 4/5 of total nitrogen is protein.

EXPLANATORY NOTES FOR TABLE A–6

The data for this table are taken from *Composition of Foods—Raw, Processed, Prepared,* Handbook No. 8, U.S. Department of Agriculture, 1963. Numbers in parentheses denote values imputed—usually from another form of the food or from a similar food. Dashes denote lack of reliable data for a constituent believed to be present in measurable amounts.

Data for canned fruits are based on heavy syrup, and include solids and liquid. Data for canned vegetables are based on drained solids.

Sodium. The values for sodium apply to foods as they are purchased in the retail market. Further additions of salt and leavening agents are accounted for in home prepared products for which recipes state an exact measure.

Foods to which salt and other sodium compounds have ordinarily been added include canned vegetables, regular pack, assuming 0.6 per cent salt concentration; canned meats, fish, poultry, soups; cured meats; cheeses; baked products including bread, quick breads, rolls, cakes, cookies, pies; ready-to-eat and cooked breakfast cereals; salad dressings; butter, margarine.

The amount of salt added to some foods is so highly variable that the values listed in this table pertain to the unsalted product. Included are cooked fresh and frozen vegetables; cooked fresh meats, fish, and poultry; cooked legumes; cooked macaroni, spaghetti, noodles.

Magnesium. The magnesium values listed in this table should be regarded as tentative since only a few determinations have been made on most foods. Few values for cooked vegetables are available. Some cooking losses undoubtedly occur because of the solubility of some salts in water. The values for cooked vegetables are probably similar to those for canned vegetables.

Table A–6. Sodium, Potassium, Phosphorus, and Magnesium Content of Foods

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
	milligrams per 100 grams food			
Almonds, dried	4	773	504	270
Roasted, salted	198	773	504	—
Apples, raw, not peeled	1	110	10	8
Apple brown betty	153	100	22	—
Apple juice, bottled	1	101	9	4
Applesauce, sweetened	2	65	5	5
Apricots, raw	1	281	23	12
Canned	1	234	15	7
Dried, sulfured, uncooked	26	979	108	62
Cooked, sweetened	7	278	31	20
Apricot nectar	trace	151	12	—

Table A–6. Sodium, Potassium, Phosphorus, and Magnesium Content of Foods (Continued)

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
	milligrams per 100 grams food			
Asparagus, green, cooked	1	183	50	20 (raw)
Canned, regular pack	236	166	53	—
Low-sodium	3	166	53	—
Frozen, spears, cooked	1	238	67	14
Avocado	4	604	42	45
Bacon, cooked, drained	1021	236	224	25
Canadian, cooked	2555	432	218	24
Baking powder, home use:				
Sodium aluminum sulfate	10,953	150	2904	
Straight phosphate	8220	170	9438	
Tartrate	7300	3800	0	
Low-sodium, commerical	6	10,948		
Low-sodium, noncommerical formula		20,729		
Banana	1	370	26	33
Barley, pearled, light	3	160	189	37
Bass, sea, raw	68	256	—	—
Beans, common, mature:				
White, dry	19	1196	425	170
Cooked	7	416	148	—
Canned with pork and tomato sauce	463	210	92	37
Red, dry	10	984	406	163
Cooked	3	340	140	—
Beans, Lima, immature:				
Cooked	1	422	121	67 (raw)
Canned, regular pack	236	222	70	—
Low-sodium	4	222	70	—
Frozen, Fordhook, cooked	101	426	90	48 (raw)
Mature seeds, dry	4	1529	385	180
Cooked	2	612	154	—
Beans, Mung, sprouts, cooked	4	156	48	—
Beans, snap, green, cooked	4	151	37	32 (raw)
Canned, regular pack	236	95	25	14
Low-sodium	2	95	25	—
Frozen, cooked	1	152	32	21 (raw)
Yellow, cooked	3	151	37	—
Canned, regular pack	236	95	25	—
Low-sodium	2	95	25	—
Beef:				
All cuts, lean, broiled or roasted, average	60	370	246	29
Simmered, average	60	370	194	18
Hamburger, regular, cooked	47	450	194	21
Beef, canned, roast beef	—	259	116	—
Beef, corned, cooked	1740	150	93	—
Hash, canned	540	200	67	—

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
	milligrams per 100 grams food			
Beef, dried	4300	200	404	—
Beef potpie, commercial	366	93	48	—
Home recipe	284	159	71	—
Beef and vegetable stew, canned	411	174	45	—
Home recipe	37	250	75	—
Beets, cooked	43	208	23	25 (raw)
Canned, regular pack	236	167	18	15
Low-sodium	46	167	18	—
Beet greens, cooked	76	332	25	106 (raw)
Beverages, alcoholic				
Beer	7	25	30	
Gin	1	2		
Wine, table	5	92	10	10
Biscuits, baking powder:				
Enriched	626	117	175	—
Self-rising flour	660*	64	317*	—
Biscuit dough, commercial in cans	868	65	497	—
Blackberries, raw	1	170	19	30
Blueberries, raw	1	81	13	6
Frozen, sweetened	1	66	11	4
Bluefish, baked or broiled, prepared with butter	104	—	287	—
Bouillon cube	24,000	100	—	—
Bran, with sugar and malt extract	1060	1070	1176	—
Bran flakes (40 per cent bran)	925	—	495	—
Bran flakes with raisins	800	—	396	—
Brazil nuts	1	715	693	225
Breads:				
Boston brown	251	292	160	—
Cracked wheat	529	134	128	35
French or Vienna	580	90	85	22
Italian	585	74	77	—
Raisin	365	233	87	24
Rye, American	557	145	147	42
Pumpernickel	569	454	229	71
White, 3–4 per cent nonfat solids	507	105	97	22
Whole-wheat bread, 2 per cent nonfat milk solids	527	273	228	78
Broccoli spears, cooked	10	267	62	24 (raw)
Frozen, cooked	12	220	58	21
Brownies with nuts	251	190	148	—
Brussels sprouts, cooked	10	273	72	29 (raw)
Butter, salted	987	23	16	2
Unsalted	under 10			
Buttermilk	130	140	95	14
Cabbage, raw	20	233	29	13 (raw)
Cooked, small amount of water	14	163	20	—

* Based on use of self-rising flour containing anhydrous monocalcium phosphate.

Table A–6. Sodium, Potassium, Phosphorus, and Magnesium Content of Foods (Continued)

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
	milligrams per 100 grams food			
Cabbage, celery or Chinese	23	253	40	14
Cakes (home recipe):*				
Angelfood	283	88	22	—
Chocolate with icing	235	154	131	—
Fruitcake, dark	158	496	113	—
Gingerbread	237	454	65	—
Plain with icing	229	114	104	—
Plain without icing	300	79	102	—
Poundcake, old fashioned	110	60	79	—
Sponge	167	87	112	—
Candy:				
Caramels	226	192	122	—
Chocolate, milk, plain	94	384	231	58
Fudge, plain	190	147	84	—
Hard	32	4	7	trace
Marshmallows	39	6	6	
Peanut brittle	31	151	95	—
Cantaloupe	12	251	16	16
Carrots, raw	47	341	36	23
Cooked	33	222	31	—
Canned, regular pack	236	120	22	—
Low-sodium	39	120	22	—
Cashew nuts, unsalted	15	464	373	267
Cauliflower, raw	13	295	56	24
Cooked	9	206	42	—
Frozen, cooked	10	207	38	13 (raw)
Celery, raw	126	341	28	22
Cooked	88	239	22	—
Chard, Swiss, cooked	86	321	24	65 (raw)
Cheese:				
Cheddar or American	700	82	478	45
Cheddar, process	1136†	80	771†	—
Cottage, creamed	229	85	152	—
Uncreamed	290	72	175	—
Cream	250	74	95	—
Parmesan	734	149	781	48
Swiss	710	104	563	—
Cherries, raw, sweet	2	191	19	14
Canned, syrup pack	1	124	12	9
Frozen, sweetened	2	130	15	8
Chicken, broiled:				
Light without skin	64	411	265	19
Dark without skin	86	321	229	—

* Based on calculations using sodium aluminum sulfate baking powder with monocalcium phosphate monohydrate.

† Values for phosphorus and sodium are based on use of 1.5 per cent anhydrous disodium phosphate as the emulsifying agent. If emulsifying agent does not contain either phosphorus or sodium, the content of these nutrients per 100 grams is sodium, 650 mg; phosphorus, 444 mg.

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
	milligrams per 100 grams food			
Chicken, canned, boneless	—	138	247	—
Chicken potpie, frozen, commercial	411	153	50	—
Chicory	7	182	21	13
Chili con carne, canned with beans	531	233	126	—
Chili powder with seasonings	1574	1000	204	169
Chocolate, bitter	4	830	384	292
Chocolate syrup, thin	52	282	92	63
Clams, raw, soft, meat only	36	235	183	—
Hard, round, meat only	205	311	151	—
Canned	—	140	137	—
Cocoa, breakfast, dry powder	6	1522	648	420
Processed with alkali	717	651	648	—
Coconut, fresh, shredded	23	256	95	46
Dried, sweetened	—	353	112	77
Coffee, instant, dry powder	72	3256	383	456
Beverage	1	36	4	
Collards, cooked	25	234	39	57 (raw)
Cookies, plain and assorted	365	67	163	15
Fig bars	252	198	60	—
Corn, sweet, cooked	trace	165	89	48 (raw)
Canned, whole kernel, regular pack	236	97	49	19
Low-sodium pack	2	97	49	—
Corn cereals, ready-to-eat:				
Corn flakes	1005	120	45	16
Corn flakes, sugar-coated	775	—	24	—
Corn, puffed	1060	—	90	—
Corn, shredded	988	—	39	—
Corn, rice, and wheat flakes	950	—	120	—
Corn grits, dry	1	80	73	20
Cooked	—	11	10	3
Cornbread, southern style degermed cornmeal	591	157	156	—
Cornmeal, white or yellow, dry:				
Whole ground	(1)	(284)	256	106
Degermed, dry	1	120	99	47
Cooked	—	16	14	7
Cowpeas, immature, cooked	1	379	146	55
Canned, regular pack	236	352	112	—
Cowpeas, dry seeds, cooked	8	229	95	230
Crabmeat, canned	1000	110	182	34
Crackers, graham, plain	670	384	149	51
Saltines	(1100)	(120)	90	—
Soda	1100	120	89	29
Cranberry juice	1	10	3	—
Cranberry sauce	1	30	4	2
Cream, half-and-half	46	129	85	—
Light, coffee	43	122	80	11
Whipping, light	36	102	67	9
Cream substitute (cream, skim milk, lactose)	575	—	—	—

Table A–6. Sodium, Potassium, Phosphorus, and Magnesium Content of Foods (Continued)

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
	milligrams per 100 grams food			
Cucumbers, not peeled	6	160	27	11
Custard, baked	79	146	117	—
Dandelion greens, cooked	44	232	42	36 (raw)
Dates, domestic	1	648	63	58
Doughnuts, cake type	501	90	190	—
Duck, flesh only, raw	74	285	(203)	—
Eggplant, cooked	1	150	21	16 (raw)
Eggs, whole	122	129	205	11
White	146	139	15	9
Yolk	52	98	569	16
Endive, curly	14	294	54	10
Farina, regular, dry	2	83	107	25
Cooked, salted	144	9	12	3
Instant cooking, cooked	188	13	60	4
Fats, vegetable	0	0	0	0
Figs, raw	2	194	22	20
Canned	2	149	13	—
Dried, uncooked	34	640	77	71
Flounder, raw	78	342	195	30
Fruit cocktail	5	161	12	7
Gelatin, dry	—	—	—	33
Sweetened, ready-to-eat	51	—	—	
Goose, flesh only, raw	86	420	203	—
Grapefruit, raw	1	135	16	12
Canned, sweetened	1	135	14	11
Grapefruit juice, canned	1	162	14	—
Frozen, diluted	1	170	17	9
Grapes, American	3	158	12	13
European	3	173	20	6
Grape juice, bottled	2	116	12	12
Haddock, raw	61	304	197	24
Fried (dipped in egg, milk, bread crumbs)	177	348	247	24
Heart, beef, lean, raw	86	193	195	18
Cooked, braised	104	232	181	—
Herring, raw, Pacific	74	420	225	—
Smoked, hard	6231	157	—	—
Honey, strained	5	51	6	3
Honeydew melon	12	251	16	—
Ice cream, no added salt, approximately 12% fat	40	112	99	14
Ice milk, no added salt	68	195	124	—

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
	milligrams per 100 grams food			
Jams and preserves	12	88	9	5
Jellies	17	75	7	4
Kale, cooked, leaves with stems	43	221	46	37 (raw)
Lamb, average of lean cuts, cooked	70	290	223	21
Lard	0	0	0	0
Lemon juice, fresh	1	141	10	8
Lemonade, frozen, diluted	trace	16	1	1
Lettuce, butterhead	9	264	26	—
Crisphead	9	175	22	11
Looseleaf	9	264	25	—
Lime juice, fresh or canned	1	104	11	—
Limeade, frozen, diluted	trace	13	1	—
Liver, cooked, fried:				
Beef	184	380	476	18
Calf	118	453	537	26
Pork	111	395	539	24
Lobster, canned or cooked	210	180	192	22 (raw)
Macaroni, dry	2	197	162	48
Cooked, firm state	1	79	65	20
Tender	1	61	50	18
Macaroni and cheese, baked	543	120	161	—
Margarine, salted	987	23	16	
Unsalted	under 10			
Milk, whole	50	144	93	13
Skim	52	145	95	14
Dry, nonfat, instant	526	1725	1005	143
Evaporated, undiluted	118	303	205	25
Milk, goat's	34	180	106	17
Milk, human	16	51	14	4
Milk beverages:				
Chocolate flavored, with skim milk	46	142	91	—
Malted, with whole milk	91	200	122	—
Molasses, light	15	917	45	46
Blackstrap	96	2927	84	258
Muffins, corn, enriched degermed cornmeal	481	135	169	—
Plain	441	125	151	—
Mushrooms, raw	15	414	116	13
Canned	400	197	68	8
Mustard, prepared, yellow	1252	130	73	48
Mustard greens, cooked	18	220	32	27 (raw)
Nectarine	6	294	24	13
Noodles, enriched, dry	5	136	183	—
Cooked	2	44	59	—
Oatmeal, dry	2	352	405	144
Cooked, salted	218	61	57	21

Table A–6. Sodium, Potassium, Phosphorus, and Magnesium Content of Foods (Continued)

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
		milligrams per 100 grams food		
Oil, vegetable	0	0	0	0
Okra, cooked	2	174	41	41 (raw)
Olives, green	2400	55	17	22
Ripe	813	34	16	—
Onions, mature. raw	10	157	36	12
Cooked	7	110	29	—
Onions, young green	5	231	39	—
Oranges, peeled	1	200	20	11
Orange juice, fresh	1	200	17	11
Canned	1	199	18	—
Frozen, diluted	1	186	16	10
Oysters, Eastern, raw	73	121	143	32
Pancakes, buckwheat, from mix	464	245	337	—
Wheat, home recipe	425	123	139	—
Papayas, raw	3	234	16	—
Parsley	45	727	63	41
Parsnips, cooked	8	379	62	32 (raw)
Peaches, raw	1	202	19	10
Canned	2	130	12	6
Dried, sulfured, uncooked	16	950	117	48
Cooked with sugar	4	261	32	15
Frozen	2	124	13	6
Peach nectar	1	78	11	—
Peanuts, roasted	5	701	407	175
Salted	418	674	401	175
Peanut butter	607	670	407	173
Pears, raw	2	130	11	7
Canned	1	84	7	5
Pear nectar	1	39	5	—
Peas, green, cooked	1	196	99	35 (raw)
Canned, regular pack	236	96	76	20
Low-sodium pack	3	96	76	—
Frozen, not thawed*	129*	150	90	24
Peas, dry, split, raw	40	895	268	180
Cooked	13	296	89	—
Pecans	trace	603	289	142
Peppers, sweet, green, raw	13	213	22	18
Perch, ocean, Atlantic, raw	79	269	207	—
Persimmons, Japanese	6	174	26	8
Pickles, dill	1428	200	21	12
Relish, sweet	712	—	14	—
Pies, home recipe:				
Apple	301	80	22	—
Cherry	304	105	25	—

* Average weighted in accordance with commercial practices in freezing vegetables.

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
	milligrams per 100 grams food			
Pie, Custard	287	137	113	—
Lemon meringue	282	50	49	—
Mince	448	178	38	—
Pumpkin	214	160	69	—
Piecrust, baked	611	50	50	—
Pike, walleye, raw	51	319	214	—
Pineapple, raw	1	146	8	13
Canned	1	96	5	8
Pineapple juice, canned	1	149	9	12
Pizza, cheese, home recipe	702	130	195	—
Plums, raw	2	299	17	9
Canned, purple	1	142	10	5
Popcorn, salted	1940	—	216	—
Pork, fresh:				
Ham, lean, roasted	65	390	308	29
Picnic ham, lean, simmered	65	390	176	18
Pork, cured:				
Ham, light cure, lean, cooked	930	326	200	20
Canned, spiced or unspiced	(1100)	(340)	156	—
Potatoes, baked	4	503	65	22 (raw)
Boiled, unsalted	2	285	42	—
French fried	6	853	111	—
Mashed, with milk, table fat, salted	331	250	48	—
Potato chips	variable to 1000	1130	139	—
Pretzels	1680*	130	131	
Prunes, dried, uncooked	8	694	79	40
Cooked, without sugar	4	327	37	20
Prune juice, canned	2	235	20	10
Pudding, home recipe:				
Bread with raisins	201	215	114	—
Chocolate	56	171	98	—
Cornstarch (blanc mange)	65	138	91	—
Rennin, using mix	46	128	92	—
Rice with raisins	71	177	94	—
Tapioca cream	156	135	109	—
Pumpkin, canned, unsalted	2	240	26	12 (raw)
Radishes, raw	18	322	31	15
Raisins, dried	27	763	101	35
Raspberries, red, raw	1	168	22	20
Frozen	1	100	17	—
Rhubarb, cooked	2	203	15	13
Rice, white, dry	5	92	94	28
Cooked, salted	374	28	28	8
Rice cereals:				
Flakes	987	180	132	—
Puffed, without salt	2	100	92	—

* Sodium content is variable. For example, very thin pretzel sticks contain about twice the average amount listed.

Table A–6. Sodium, Potassium, Phosphorus, and Magnesium Content of Foods (Continued)

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
	milligrams per 100 grams food			
Rolls, commercial, plain	506	95	85	—
Sweet	389	124	107	—
Whole-wheat	564	292	281	—
Rutabagas, cooked	4	167	31	15 (raw)
Rye flour, light	1	156	185	73
Rye wafers	882	600	388	—
Salad dressings:*				
Blue cheese	1094	37	74	
Commercial, mayonnaise type	586	9	26	
French	1370	79	14	10
Home cooked	728	116	93	
Mayonnaise	597	34	28	2
Thousand island	700	113	17	
Salmon, pink, raw	64	306	—	—
Canned	387†	361	286	30
Sardines, Pacific, canned in tomato sauce	400	320	478	24
Sauerkraut	747‡	140	18	—
Sausage:				
Bologna	1300	230	128	—
Frankfurters, raw	1100	220	133	—
Pork links, cooked	958	269	162	16
Scallops, bay, steamed	265	476	338	—
Shad, raw	54	330	260	—
Shad, baked, with butter or margarine	79	377	313	—
Sherbet, orange	10	22	13	—
Shrimp, raw	140	220	166	42
Canned, dry pack	—	122	263	51
Syrup, table blend	68	4	16	
Soup, canned, diluted with equal part water:				
Bean with pork	403	158	51	—
Beef bouillon	326	54	13	—
Beef noodle	382	32	20	—
Chicken noodle	408	23	15	—
Clam chowder, Manhattan type	383	75	19	—
Cream soup (mushroom), prepared with milk	424	114	69	—
Minestrone	406	128	24	—
Pea, green	367	80	46	—
Tomato	396	94	14	9
Vegetable with beef broth	345	98	16	—
Spaghetti, dry	2	197	162	—
Cooked, tender	1	61	50	—

* For salad dressings without salt, sodium content is low, ranging from less than 10 mg to 50 mg per 100 grams; the amount is usually indicated on the label.

† If canned without salt, the sodium value is about the same as for raw salmon.

‡ Based on salt content of 1.9 per cent; may vary significantly from this level.

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
	milligrams per 100 grams food			
Spaghetti with meat balls, canned	488	98	45	—
Spaghetti in tomato sauce with cheese, home recipe	(382)	163	54	—
Spinach, raw	71	470	51	88
Cooked	50	324	38	—
Canned, regular pack	236	250	26	63
Low-sodium	32	250	26	—
Squash, summer, cooked	1	141	25	16
Winter, cooked	1	258	32	17 (raw)
Strawberries, raw	1	164	21	12
Frozen	1	112	17	9
Sugar, brown	30	344	19	—
Granulated	1	3	0	trace
Sweetpotatoes, baked	12	300	58	31 (raw)
Boiled	10	243	47	—
Candied	42	190	43	—
Tangerines, raw	2	126	18	—
Tangerine juice, canned	1	178	14	—
Tapioca, dry	3	18	18	3
Tea, instant, dry powder	—	4530	—	395
Beverage	—	25		22
Tomatoes, raw	3	244	27	14
Canned, regular pack	130	217	19	12
Low-sodium	3	217	19	—
Tomato catsup, regular pack	1042	363	50	21
Tomato juice, canned, regular pack	200	227	18	10
Canned, low-sodium	3	227	18	—
Tongue, beef, braised	61	164	117	16 (raw)
Tuna, canned, in oil, solids and liquid	800	301	294	—
Turkey, light meat, roasted	82	411	(251)	28
Dark meat, roasted	99	398	(251)	—
Turnips, cooked, diced	34	188	24	20 (raw)
Turnip greens, canned, regular pack	236	243	30	58 (raw)
Frozen, not thawed	23	188	41	—
Veal, lean, stewed	80	500	140	—
Roasted	80	500	235	19
Vinegar, cider	1	100	9	1
Waffles, home recipe	475	145	173	—
Walnuts, black	3	460	570	190
English	2	450	380	131
Watermelon	1	100	10	8
Wheat bran, crude	9	1121	1276	490
Wheat cereals, cooked:				
Wheat and malted barley, dry	1	—	350	168
Cooked	72	trace	59	31
Wheat, rolled, cooked	trace	84	76	—

Table A–6. Sodium, Potassium, Phosphorus, and Magnesium Content of Foods (Continued)

Food and Description	Sodium	Potassium	Phosphorus	Magnesium
		milligrams per 100 grams food		
Wheat cereals, ready-to-eat:				
Wheat flakes	1032	—	309	—
Wheat puffed, without salt	4	340	322	—
Wheat, shredded, plain	3	348	388	133
Wheat flours:				
All-purpose or family	2	95	87	25
Cake	2	95	73	
Self-rising	1079	90*	466	—
Whole-wheat	3	370	372	113
Wheat germ	3	827	1118	336
White sauce, medium	379	139	93	—
Yeast, baker's:				
Compressed	16	610	394	59
Dry active	(52)	(1998)	(1291)	—[1]
Brewer's, dry	121	1894	1753	231
Yogurt, made from partially skimmed milk	51	143	94	—

* 90 mg potassium per 100 grams contributed by flour. Small quantities of additional potassium may be contributed by other ingredients.

Table A–7. Cholesterol Content of the Edible Portion of Foods*

Food	Cholesterol *mg per 100 gm food*	Food	Cholesterol *mg per 100 gm food*
Beef, raw	70	Ice cream	45
Brains, raw	>2000	Kidney, raw	375
Butter	250	Lamb, raw	70
Caviar or fish roe	>300	Lard and other animal fat	95
Cheese:		Liver, raw	300
Cheddar	100	Lobster	200
Cottage, creamed	15	Margarine:	
Cream	120	All vegetable fat	0
Other (25% to 35% fat)	85	Two-thirds animal fat, one-third vegetable fat	65
Cheese spread	65	Milk:	
Chicken, flesh only, raw	60	Fluid, whole	11
Crab	125	Dried, whole	85
Egg, whole	550	Fluid, skim	3
Egg, white	0	Mutton	65
Egg, yolk:		Oysters	>200
Fresh	1500	Pork	70
Frozen	1280	Shrimps	125
Dried	2950	Sweetbreads (thymus)	250
Fish, steak or fillet	70	Veal	90
Heart, raw	150		

* Adapted from Table 4 in *Composition of Foods—Raw, Processed, Prepared.* Handbook No. 8, U.S. Department of Agriculture, Washington, D.C., 1963, p. 146.

Table A–8. Composition of Some Alcoholic Beverages

Beverage	Approximate Measure	ml	Energy calories*	Alcohol (Per cent by weight)	Carbohydrate per cent
Ale, American	1 glass	250	155	6	5
Beer	1 glass	250	110	4	4
Brandy	1 cordial glass	20	65	45	
Creme de menthe	1 cordial glass	20	75	36	30
Gin	1 jigger	45	126	40	
Rum	1 jigger	45	140	44	
Whisky	1 jigger	45	132	42	
Wine					
Champagne, dry	1 champagne glass	135	105	10	2
Champagne, sweet	1 champagne glass	135	161	10	13
California, red	1 claret glass	120	95	10	3
white	1 claret glass	120	89	9	3
port	1 sherry glass	30	50	15	14
sherry	1 sherry glass	30	38	15	6

* Alcohol yields 7 calories per gram. The percentages of alcohol vary widely in different brands.

Table A–9. Federal Standards of Identity for Enriched Foods

(Minimum and Maximum Levels in Milligrams per Pound)

Food	Thiamine	Riboflavin	Niacin	Iron
Bread, rolls, and other baked foods	1.1–1.8	0.7–1.6	10.0–15.0	8.0–12.5
Flour*	2.0–2.5	1.2–1.5	16.0–20.0	13.0–16.5
Farina	2.0–2.5	1.2–1.5	16.0–20.0	13.0– —†
Macaroni, noodle, paste products‡	4.0–5.0	1.7–2.2	27.0–34.0	13.0–16.5
Corn meal and grits	2.0–3.0	1.2–1.8	16.0–24.0	13.0–26.0
Rice§	2.0–4.0	1.2–2.4	16.0–32.0	13.0–26.0

* Calcium enrichment is also required for self-rising flour.

† A maximum level of iron enrichment for farina has not been established.

‡ Levels of enrichment allow for 30–50 per cent losses in preparation.

§ Because of technical difficulties in the application of riboflavin, the enrichment levels for this vitamin in rice are optional pending further study and hearings.

Table A–10. Average Weight for Height Table*

(For boys from birth to school age)

Height (*Inches*)	Age (*Months*)											
	1	3	6	9	12	18	24	30	36	48	60	72
20	8											
21	9	10										
22	10	11										
23	11	12	13									
24	12	13	14									
25	13	14	15	16								
26		15	17	17	18							
27		16	18	18	19							
28			19	19	20	20						
29			20	21	21	21						
30			22	22	22	22	22					
31				23	23	23	23	24				
32				24	24	24	25	25				
33					26	26	26	26	26			
34						27	27	27	27			
35						29	29	29	29	29		
36							30	31	31	31		
37							32	32	32	32	32	
38								33	33	33	34	
39								35	35	35	35	
40									36	36	36	36
41										38	38	38
42										39	39	39
43										41	41	41
44											43	43
45											45	45
46												48
47												50
48												52
49												55

* Used by the courtesy of the American Child Health Association. Prepared by Robert M. Woodbury.

Table A–11. Average Weight for Height Table*

(For boys from 5 to 19 years)

Height (Inches)	Age (Years)														
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
38	34	34													
39	35	35													
40	36	36													
41	38	38	38												
42	39	39	39	39											
43	41	41	41	41											
44	44	44	44	44											
45	46	46	46	46	46										
46	47	48	48	48	48										
47	49	50	50	50	50	50									
48		52	53	53	53	53									
49		55	55	55	55	55	55								
50		57	58	58	58	58	58	58							
51			61	61	61	61	61	61							
52			63	64	64	64	64	64	64						
53			66	67	67	67	67	68	68						
54				70	70	70	70	71	71	72					
55				72	72	73	73	74	74	74					
56				75	76	77	77	77	78	78	80				
57					79	80	81	81	82	83	83				
58					83	84	84	85	85	86	87				
59						87	88	89	89	90	90	90			
60						91	92	92	93	94	95	96			
61							95	96	97	99	100	103	106		
62							100	101	102	103	104	107	111	116	
63							105	106	107	108	110	113	118	123	127
64								109	111	113	115	117	121	126	130
65								114	117	118	120	122	127	131	134
66									119	122	125	128	132	136	139
67									124	128	130	134	136	139	142
68										134	134	137	141	143	147
69										137	139	143	146	149	152
70										143	144	145	148	151	155
71										148	150	151	152	154	159
72											153	155	156	158	163
73											157	160	162	164	167
74											160	164	168	170	171

* Used by the courtesy of the American Child Health Association. Prepared by Bird T. Baldwin and Thomas D. Wood.

Table A–12. Average Weight for Height Table*

(For girls from birth to school age)

Height (*Inches*)	Age (*Months*)											
	1	3	6	9	12	18	24	30	36	48	60	72
20	8											
21	9	10										
22	10	11										
23	11	12	13									
24	12	13	14	14								
25	13	14	15	15								
26		15	16	17	17							
27		16	17	18	18							
28			19	19	19	19						
29			19	20	20	20						
30			21	21	21	21	21					
31				22	22	23	23	23				
32					23	24	24	24	25			
33						25	25	25	26			
34						26	26	26	27			
35						29	29	29	29	29		
36							30	30	30	30	31	
37							31	31	31	31	32	
38								33	33	33	33	
39								34	34	34	34	34
40									35	36	36	36
41										37	37	37
42										39	39	39
43										40	41	41
44											42	42
45												45
46												47
47												50
48												52

* Used by the courtesy of the American Child Health Association. Prepared by Robert M. Woodbury.

Table A–13. Average Weight for Height Table*

(For girls from 5 to 18 years)

Height (Inches)	Age (Years)													
	5	6	7	8	9	10	11	12	13	14	15	16	17	18
38	33	33												
39	34	34												
40	36	36	36											
41	37	37	37											
42	39	39	39											
43	41	41	41	41										
44	42	42	42	42										
45	45	45	45	45	45									
46	47	47	47	48	48									
47	49	50	50	50	50	50								
48		52	52	52	52	53	53							
49		54	54	55	55	56	56							
50		56	56	57	58	59	61	62						
51			59	60	61	61	63	65						
52			63	64	64	64	65	67						
53			66	67	67	68	68	69	71					
54				69	70	70	71	71	73					
55				72	74	74	74	75	77	78				
56					76	78	78	79	81	83				
57					80	82	82	82	84	88	92			
58						84	86	86	88	93	96	101		
59						87	90	90	92	96	100	103	104	
60						91	95	95	97	101	105	108	109	111
61							99	100	101	105	108	112	113	116
62							104	105	106	109	113	115	117	118
63								110	110	112	116	117	119	120
64								114	115	117	119	120	122	123
65								118	120	121	122	123	125	126
66									124	124	125	128	129	130
67									128	130	131	133	133	135
68									131	133	135	136	138	138
69										135	137	138	140	142
70										136	138	140	142	144
71										138	140	142	144	145

* Used by the courtesy of the American Child Health Association. Prepared by Bird T. Baldwin and Thomas D. Wood.

Table A–14. Desirable Weights for Men of Ages 25 and Over*

Weight in Pounds According to Frame (In Indoor Clothing)

Height (*with shoes on*) 1-*inch heels*		Small Frame	Medium Frame	Large Frame
Feet	*Inches*			
5	2	112–120	118–129	126–141
5	3	115–123	121–133	129–144
5	4	118–126	124–136	132–148
5	5	121–129	127–139	135–152
5	6	124–133	130–143	138–156
5	7	128–137	134–147	142–161
5	8	132–141	138–152	147–166
5	9	136–145	142–156	151–170
5	10	140–150	146–160	155–174
5	11	144–154	150–165	159–179
6	0	148–158	154–170	164–184
6	1	152–162	158–175	168–189
6	2	156–167	162–180	173–194
6	3	160–171	167–185	178–199
6	4	164–175	172–190	182–204

Table A–15. Desirable Weights for Women of Ages 25 and Over*†,

Weight in Pounds According to Frame (In Indoor Clothing)

Height (*with shoes on*) 2-*inch heels*		Small Frame	Medium Frame	Large Frame
Feet	*Inches*			
4	10	92– 98	96–107	104–119
4	11	94–101	98–110	106–122
5	0	96–104	101–113	109–125
5	1	99–107	104–116	112–128
5	2	102–110	107–119	115–131
5	3	105–113	110–122	118–134
5	4	108–116	113–126	121–138
5	5	111–119	116–130	125–142
5	6	114–123	120–135	129–146
5	7	118–127	124–139	133–150
5	8	122–131	128–143	137–154
5	9	126–135	132–147	141–158
5	10	130–140	136–151	145–163
5	11	134–144	140–155	149–168
6	0	138–148	144–159	153–173

* Metropolitan Life Insurance Company, New York.

† For girls between 18 and 25, subtract 1 pound for each year under 25.

Table A–16. Normal Constituents of the Blood in the Adult

Physical measurements		
specific gravity		1.025–1.029
viscosity (water as unity)		4.5
bleeding time (capillary)	min	1–3
prothrombin time (plasma) (Quick)	sec	10–20
sedimentation rate (Wintrobe method)		
men	mm in 1 hr	0–9
women	mm in 1 hr	0–20
Hematologic studies		
cell volume	per cent	39–50
red blood cells	million per cu mm	4.25–5.25
white blood cells	per cu mm	5000–9000
lymphocytes	per cent	25–30
neutrophils	per cent	60–65
monocytes	per cent	4–8
eosinophils	per cent	0.5–4
basophils	per cent	0–1.5
platelets	per cu mm	125,000–300,000
Proteins		
total protein (serum)	gm per 100 ml	6.5–7.5
albumin (serum)	gm per 100 ml	4.5–5.5
globulin (serum)	gm per 100 ml	1.5–2.5
albumin: globulin ratio		1.8–2.5
fibrinogen (plasma)	gm per 100 ml	0.2–0.5
hemoglobin		
males	gm per 100 ml	14–17
females	gm per 100 ml	13–16
Nitrogen constituents		
nonprotein N (serum)	mg per 100 ml	20–36
(whole blood)	mg per 100 ml	25–40
urea (whole blood)	mg per 100 ml	18–38
urea N (whole blood)	mg per 100 ml	8–18
creatinine (whole blood)	mg per 100 ml	1–2
uric acid (whole blood)	mg per 100 ml	2.5–5.0
amino acid N (whole blood)	mg per 100 ml	3–6
Blood gases		
CO_2 content (serum)	volumes per cent	55–75
	mM per liter	(24.5–33.5)
CO_2 content (whole blood)	volumes per cent	40–60
	mM per liter	(18.0–27.0)
oxygen capacity (whole blood)		
males	volumes per cent	18.7–22.7
females	volumes per cent	17.0–21.0
oxygen saturation		
arterial blood	per cent	94–96
venous blood	per cent	60–85

Table A–16. Normal Constituents of the Blood (Continued)

Carbohydrates and lipids		
glucose (whole blood)	mg per 100 ml	70–90
ketones—as acetone (whole blood)	mg per 100 ml	1.5–2
fats (total lipids) (serum)	mg per 100 ml	570–820
cholesterol (serum)	mg per 100 ml	100–230
bilirubin (serum)	mg per 100 ml	0.1–0.25
icteric index (serum)	units	4–6
Acid-base constituents		
base, total fixed (serum)	mEq per liter	142–150
sodium (serum)	mg per 100 ml	320–335
	mEq per liter	(139–146)
potassium (serum)	mg per 100 ml	16–22
	mEq per liter	(4.1–5.6)
calcium (serum)	mg per 100 ml	9.0–11.5
	mEq per liter	(4.5–5.8)
magnesium (serum)	mg per 100 ml	1.0–3.0
	mEq per liter	(1.0–2.5)
phosphorus, inorganic (serum)	mg per 100 ml	3.0–5.0
	mEq per liter	(1.0–1.6)
chlorides, expressed as Cl (serum)	mg per 100 ml	352–383
	mEq per liter	(99–108)
as NaCl (serum)	mg per 100 ml	580–630
	mEq per liter	(99–108)
sulfates, inorganic as SO_4 (serum)	mg per 100 ml	2.5–5.0
	mEq per liter	(0.5–1.0)
lactic acid (venous blood)	mg per 100 ml	10–20
	mEq per liter	(1.1–2.2)
serum protein base binding power	mEq per liter	(15.5–18.0)
base bicarbonate HCO_3 (serum)	mEq per liter	(19–30)
pH (blood or plasma at 38°C)		7.3–7.45
Miscellaneous		
phosphatase (serum)	Bodansky units per 100 ml	5
iron (whole blood)	mg per 100 ml	46–55
ascorbic acid (whole blood)	mg per 100 ml	0.75–1.50
carotene (serum)	mcg per 100 ml	75–125

ml = milliliters
mg = milligrams
mcg = micrograms
mEq = milliequivalents
gm = grams
cu mm = cubic millimeters

$$\text{mEq per liter} = \frac{\text{mg per liter}}{\text{equivalent weight}}$$

$$\text{mM (millimoles) per liter} = \frac{\text{mg per liter}}{\text{molecular weight}}$$

$$\text{equivalent weight} = \frac{\text{atomic weight}}{\text{valence of element}}$$

$$\text{volumes per cent} = \text{mM per liter} \times 2.24$$