

NUTRITIONAL STATUS OF SCHOOL GOING ORPHANS AND EFFICACY OF VALUE ADDED COOKIES

By

MEERA KUHARAJAN


(09PD14)

**A THESIS SUBMITTED TO THE
AVINASHILINGAM DEEMED UNIVERSITY FOR WOMEN,
COIMBATORE – 641 043.**

**IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE IN
FOOD SERVICE MANAGEMENT AND DIETETICS**

APRIL 2011

Certified as a Bonafide Research Work


**Signature of the
Head of the Department**


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I. INTRODUCTION

Adequate nutrition is a basic human rite and embedded in the constitution of most developing countries (De Onis *et al.*, 2002). Although nutrition is a basic human need it remains unmet for vast number of children, the latter who are thus unable to achieve their full genetic development potential, due to malnutrition (Rutengwe *et al.*, 2001)

The most devastating problem facing the majority of the world's poor and needy, is hunger and malnutrition, disease and poverty and these will continue to dominate the health conditions of the world's poor nations (Kusin and Karjati, 1994). The consequences of malnutrition include death, disability, stunted physical growth and these, as a result, retard the national socio-economic development (WHO, 2000).

Childhood malnutrition remains as a major public health problem worldwide and has been widely recognized as an important risk factor for child mortality. An estimated 2.8 million child deaths is reported each year in the nine low-income Asian countries including India (Rice, 2001). The four major nutritional problems in South Asia that currently demand attention are: low birth-weights (LBWs) in infants and stunting in under-fives; anaemia; iodine deficiency diseases; and hypovitaminosis A. While the latter three problems are obviously related to micronutrient malnutrition, it is possible that in the genesis of the first, protein energy malnutrition may also play a role (Gopalan, 1998)

Orphans are amongst the most vulnerable of a country's population, it can be expected that nutrition deficiencies are magnified in orphanages. Critical nutrient deficiencies in early life put children at risk for brain mal-development, other significant developmental and growth delays, and a host of medical conditions (Hussain, 2010).

Foster care institutions in the developing world function importantly in protecting and caring for children who are orphaned, abandoned, abused, or

placed under State probation. In Sri Lanka, their importance in social welfare was highlighted in the aftermath of the tsunami disaster and the internal conflict. The Sri Lankan Department of Probation and Child Care Services operate eight State Receiving Homes, which act as transit centers for children until adoption or adulthood. These homes are mandated to provide appropriate nutrition, health care access, clothing, schooling access, and other basic requirements. The Department also serves as the regulatory body for many more voluntary (private) foster care institutions in the country (Jayasekera, 2005). There are currently 488 voluntary children's homes in Sri Lanka. Most are found in Batticalo district which has 66, followed by Colombo with 60 and in Jaffna district 27. Most homes are overcrowded and lack sufficient staff to provide the individual attention child need (UNICHER, 2010). More than 8 thousand children are orphans and most of the children in North Sri Lankan camps and orphanages are suspected with acute health problems, suffering from malnutrition, anaemic, diarrhoeal disease and underweight. The problems include poor hygiene, household crowding, and not helping or encouraging children to eat. In addition, low maternal education has been linked with poor child health, and increased education and training for girls has been recommended (Levin and Morris, 2000; Nyepi, 2006). In many developing countries malnutrition is the leading cause of death in children but with only one in nine deaths coming from severe forms of malnutrition such as kwashiorkor or marasmus (Akuamoah-Boateng, 2002).

Promoting children's health and nutrition in orphanages is, therefore, a priority and requires attention by all. Causes of death of children placed in orphanages are largely preventable and thousands of children can be saved if their nutritional needs are catered for (UNICEF, 1990a, b).

Most of the orphanages have problems in food consumption pattern, kitchen facilities and staff skills, which may due to insufficient funding for nutritional needs, deficient knowledge of sound budgeting and cost control, inappropriate methods of food procurement, no standardized food preparation

method, absence of specific menu, untrained caregivers in food service, inadequate and absolute kitchen equipments.

Attempts are currently underway to quantitatively estimate the extent to which all forms of childhood malnutrition - including deficits in protein and energy and the micronutrients namely iron, vitamin A, iodine and zinc contribute to these adverse outcomes. Among the mentioned deficiencies, Iron deficiency anemia (IDA) is an important nutritional problem affecting all segments of the population especially children. In recent years, nutrition and immunology are increasingly becoming interrelated disciplines. Micronutrient deficiency is associated with an impairment of immune responses and increased susceptibility to infections like respiratory tract infections and skin infections especially in children (West *et al.*, 2000). Infectious diseases in children always worsen any deficiency present and conversely deficiency usually weakens resistance to various infections. These effects are therefore synergistic (World Health Organization (WHO), 2003).

Several intervention programmes have been initiated to combat the micronutrient deficiencies especially iron deficiency anemia (IDA). The most commonly adopted strategy is the dietary supplementation could be an effective, preventive and curative strategy, in contrast to dietary diversification and food fortification, in providing immediate relief (Parman *et al.*, 2000).

Supplements help the child to overcome nutritional deficiencies. Children need all the nutrients in their proper amounts for optimum health. Since their diets most likely cannot provide all of them, nutritional supplements can fill in those gaps. Nutritional supplements also help boost their immune system. The stronger their immune system, the most resistant of body can be against disease.

Fortification of foods is of current interest because of nutritional awareness of consumers. The demand of bakery product is increasing at the rate of 10.07 per cent per annum. India and Sri Lanka are developing countries

with large number of population depending on wheat as staple foods and 25 per cent of wheat is used in the preparation of baked foods. Due to changing life style the people have started demanding the ready to cook or to serve convenience food. Baked products are considered as excellent vehicle for fortification, value addition and feeding at mass scale (Kamaljit, 2010).

Biscuits, cookies, cakes are widely consumed that have relatively long shelf life and good eating qualities. Such qualities of food products make large scale production and distribution possible, in the shortened period. Biscuits can be easily fortified (Mishra *et al.*, 1991) with protein rich flours to provide convenient food in order to supplement protein in the diet.

Supplementation with legumes is one way to meet the needs for protein foods, particularly baked foods. Grain legumes occupy an important place in human nutrition. Especially in the dietary pattern of lower income groups of people in developing countries. Legumes, considered as poor mans meat, are generally good sources of slow release carbohydrate and are rich in proteins. Legumes are normally consumed after processing, which not only improves palatability of foods but also increases the bioavailability of nutrients by inactivating trypsin, growth inhibitors and haemagglutinins (Tharanathan and Mahadevamma, 2003). These are rich in various nutrients particularly protein, minerals and vitamins. It is one of the additional ways of utilizing legume flours in India.

Finger millet (Ragi) is an important staple food in the eastern and central Africa as well as some parts of India (Majumder *et al.*, 2006). It is rich in protein, iron, calcium, phosphorus, fibre and vitamin content. The calcium content is higher than all cereals and iodine content is said to be highest among all the food grains. Finger millet has best quality protein along with the presence of essential amino acids, vitamin A, vitamin B and phosphorus (Gopalan *et al.*, 2004). Thus finger millet is a good source of diet for growing children, expecting women, old age people and patients.

Peanut meal is a good source of protein, fibre, starch and iron. It also contains a number of anti-nutritional factors such as phytic and trypsin inhibitors (Periago *et al.*, 1998)

Banana is rich source of energy since it contains sugars such as fructose, glucose and sucrose and a rich source of iron helpful in preventing anaemia. Bananas contain an amino acid called 'tryptophan' which is converted into serotonin helping to improve the mood of the depressed persons. Eating banana helps to alleviate the depressed mood. (John, 2010)

There is a need to reduce the prevalence of anemia and underweight children and also to improve the nutritional status of school going children through supplementation with micronutrient rich food formulation.

Keeping these in view the present study was focused on the general objectives to formulate a micronutrient rich supplement to combat anaemia and under weight orphan children.

The specific objectives of the study are: To

- Understand the background information of the orphanages and children.
- Identify the most pressing nutritional deficiencies impeding the health and development of young orphans.
- Assess the nutritional status of the school going children.
- Formulate a product by incorporating the macro and micro nutrients such as protein and iron for supplementation, and
- Study the impact of the supplementation among the anaemic and underweight children.

II. REVIEW OF LITERATURE

The literature pertaining to the study entitled “**Nutritional status among school going orphans and efficacy of value added cookies**” are reviewed under the following headings;

- A. Prevalence of nutritional deficiencies and underweight among school going children.
- B. Risk factors associated with anaemia and underweight.
- C. Preventive measures to alleviate the problem.
- D. Importance of the supplements in correcting anaemia and underweight.
- E. Quality analysis of value added cookies.

A. PREVALENCE OF NUTRITION DEFICIENCIES AND UNDERWEIGHT AMONG SCHOOL GOING CHILDREN

Chronic food deficits affect about 792 million people in the world (FAO 2000), including 20 per cent of the population in developing countries. Worldwide, malnutrition affects one in three people and each of its major forms dwarfs most other diseases globally (WHO, 2000). Malnutrition affects all age groups, but it is especially common among the poor and those with inadequate access to health education and to clean water and good sanitation. More than 70 per cent of children with protein-energy malnutrition live in Asia, 26 per cent live in Africa, and 4 per cent in Latin America and the Caribbean (WHO 2000).

Nutritional anaemia due to iron deficiency is a global problem and it affects more than a billion people in the entire world. In the developing world alone, 370 million women suffer from anaemia (Vijayaraghavan, 2007).

According to the World Health Organization (WHO, 2000), 49 per cent of 10 million deaths among children each year in the developing world, is associated with malnutrition. Henon (1998) states that malnutrition in all its

forms exacts a heavy toll among children, in addition to causing the deaths of more than seven million children a year.

Micronutrient deficiencies are highly prevalent in developing countries and lack of nutrient-dense complementary foods, poor bioavailability and frequent infections account for this decline. The role of specific micronutrient deficiencies in the etiology of growth retardation has gained attention more recently (Gibson and Hotz, 2001; Brown *et al.*, 2002; Lutter and Rivera, 2003; Hurrell, 2003; Rivera *et al.*, 2003).

Nutritional anaemia is a recognized public health problem throughout the world. An estimated 30 per cent of the world's population is anaemic, with the global prevalence of anaemia among 6-12 yr old children to be 36 per cent and 77 per cent in developing regions respectively (Verma, 1998).

WHO estimates the number of anaemic people worldwide to be a staggering two billion and that approximately 50 per cent of all anaemia can be attributed to iron deficiency. The most dramatic health effects of anaemia, i.e., increased risk of maternal and child mortality due to severe anaemia, have been well documented. In addition, the negative consequences of iron deficiency anaemia (IDA) on cognitive and physical development of children, and work productivity of adults are of major concern. Moreover, the high prevalence of anaemia in surgical patients may increase the risk of postoperative morbidity and mortality (WHO, 2001, 2003).

To know the iron status of adolescent girls, Khan *et al.* (1996) selected 225 girls (12-15 years) of Bangladesh. It was reported that 22 per cent (46) of the subjects were found to be anaemic having haemoglobin level less than 12g/dl.

A study conducted by Adgeppa *et al.* (1997) in Indonesia including 805 adolescent girls showed that 21.1 per cent of the girls (170) were anaemic having haemoglobin level less than 12 g/dl.

Shahabuddin *et al.* (2000) conducted a study on nutritional status of adolescents in a rural community of Bangladesh. It was reported that 98 per cent (1453 out of 1483) of adolescent girls suffered from anaemia.

Jondhale *et al.* (1999) selected 300 school going adolescent girls (13-15 years) from Parbhani city to know the prevalence of anaemia. Haemoglobin level indicated that 12 to 15 year old girls had moderate anaemia with haemoglobin level of 9.92 g/dl whereas 14 year old girls were anaemic with haemoglobin level of 10.47 g/dl.

The prevalence of anaemia in 504 adolescent girls (10-18 years) representing 24 subcentres of village of Daurala block of Meerut was 34.4 per cent. The prevalence of mild, moderate and severe anaemia among adolescent girls was 19.0 per cent, 14.0 per cent and 1.4 per cent respectively. Majority (55.2 per cent) was having mild anaemia and only 4.0 per cent had severe anaemia (Rawat, 2001).

The prevalence of anaemia in 630 adolescent girls (13-16 years) of rural Wardha was found to be 59.8 per cent. The prevalence of severe, moderate and mild anaemia was 0.6, 20.8 and 38.4 per cent respectively (Kaur *et al.*, 2006).

A study was conducted by Kalpana *et al.* (2007) on 500 adolescent girls (13 to 15 years) of low income families in Coimbatore, which revealed that 76.4 per cent of adolescent girls were anaemic and only 23.6 per cent were non anaemic.

Kowsalya *et al.* (2008) conducted a study on prevalence of anaemia in 100 adolescent girls (13-18 years) in Manipur. The results revealed that, among the total subjects, 30 were moderately anaemic (7-10 g/dl) and 25 girls were mildly anaemic (10-12 g/dl). Ten girls were severely anaemic (<7.0 g/dl).

Muthaya *et al.* (2007) studied the anaemia prevalence in school aged children (5-15 years) in Bangalore. The overall anaemia prevalence in this group was 13.6 per cent. Anemia prevalence was higher in girls than boys (15.3

per cent, n = 993 Vs. 12.0 per cent; n = 1037 respectively, $P < 0.05$). There was no significant difference in anemia prevalence between children in urban and rural locations (14.6 and 12.3 per cent respectively).

Sri Lanka's overall health indicators are on track to achieve the international developmental benchmarks known as the Millennium Development Goals. One exception, though, is the nutritional status of hundreds of thousands of children and mothers. Almost one in three Sri Lankan children is undernourished. Regional disparities exist, most notably in the 'Estate sector', or old tea-growing regions of the country. The Estate sector, in the highlands of Sri Lanka, has traditionally been home to the most remote and underdeveloped areas in the country (UNICEF, 2008).

In Sri Lanka, a study was conducted on 690 adolescent girls to estimate the prevalence of anaemia (Jayatissa *et al.*, 1999). Results indicated that 21.1 per cent (146) of girls were having haemoglobin less than 11.5 g/dl and thus were anaemic.

Data from a Demographic and Health Survey (DHS) by Sri Lanka's health ministry, revealed that child malnutrition is more than 50 percent in some areas of the East and North, with the national average at a record 29 percent. In the Batticaloa, Trincomalee and Ampara districts in the eastern province, child malnutrition is 53, 45 and 44 percent, respectively. In the northern districts of Vavuniya and Jaffna it is 51 percent and 43 percent (IMHO, 2010)

According to the Household Income and Expenditure Survey of 2006/7 only half of Sri Lanka's populations receive the minimum daily calorie intake of 2,030 kcal. A third or more of the next generation of Sri Lankans will be weak and malnourished, less capable of educational and physical achievements, more vulnerable to sicknesses. This is a danger far more comprehensive and permanent to the future of Sri Lanka (Karunaratne, 2010).

B. RISK FACTORS ASSOCIATED WITH ANAEMIA AND UNDER WEIGHT

Socio-demographic and physical activity underlying factors, as mothers' formal education, race, nutritional practices knowledge and decreased physical activities, respectively, were additional risk factors associated with lower haemoglobin levels (Kikafunda, 2009).

In some countries the existence of culturally defined, gender based proscriptions for child feeding causes iron deficiency 2.4 times as likely in school-aged girls, compared to the boys of the same age (Shell-Duncan, 2005).

Iron-deficiency is reported in living in SAC refugee campuses. Most children with anemia are asymptomatic and an abnormal Hb levels are discovered on routine screening (Seal AJ, 2005).

Worms infestation is one of the major causes of childhood malnutrition, anaemia, stunted physical and mental growth, psycho-social problems. The hookworm infestation is a leading cause of iron deficiency anemia, whipworm infestation in children causes growth retardation and anemia while heavy infestation with both roundworm and whipworm causes protein energy malnutrition (Stephenson, 1993).

Furthermore, it is well confirmed that increased risk of iron deficiency in SAC of 12-14 yrs old adolescents is associated with incremented iron demands because of the rapid growth (Hallberg, 1992).

Child under nutrition - measured as poor anthropometric status—is internationally recognized as an important public health indicator for monitoring nutritional status and health in populations. Young children are most vulnerable to under nutrition and face the greatest risk of its adverse consequences (WHO, 1995; Beghin, 1998 and Man *et al.*, 1998).

A number of studies have demonstrated the association between increasing severity of anthropometric deficits and mortality, and under nutrition is thought to be a contributing factor in over half of all child deaths in developing countries (Rice *et al.*, 2000). There is strong evidence that poor growth is associated with delayed mental development (Mendez and Adair, 1999), and several studies have shown a relationship between impaired growth status and poor school performance as well as reduced intellectual achievement (Martorell *et al.*, 1998). In addition, growth retardation in early childhood is associated with significant functional impairment in adult life and reduced work capacity (Moock *et al.*, 1996), which in turn has an impact on economic productivity.

Adolescence is a period of rapid growth and development. Nutritional requirement in relation to body size is more during adolescence. Majority of the girls do not achieve their full height and weight potential on account of their dietary insufficiencies (Chaturvedi *et al.*, 1994).

World Health Organization (WHO, 1995) has recommended various indices based on anthropometry to evaluate the nutritional status of the school aged children. It has now been established that the Body Mass Index (BMI) is the most appropriate variable for nutritional status among adolescents (Cachera, 1993).

Clinical examination is an important practical method for assessing the nutritional status of a community. The method is based on examination for changes, believed to be related to inadequate nutrition that can be seen or felt in superficial epithelial tissues (Jelliffe, 1966).

Kumari and Singh (2003) conducted clinical examination of 100 schedule caste adolescents from deprived section of society in Pusa. Clinical symptoms were more prominent among female than male members. This might have been due to better nutritional status of males as compared to female adolescents.

The study by Devi and Uma (2005) in Coimbatore revealed that almost all the signs of iron deficiency anaemia were observed and none of them was affected by Koilonychia and poor stamina.

A study carried out by Swarnalata and Yegmmmai (2006) on 100 school adolescents girls (13-15 years) in Coimbatore found out that prevalence of pale conjunctiva was greater (60 per cent) but after supplementation of iron, vitamin A and vitamin C, there was remarkable reduction observed in the prevalence of pale conjunctive.

Kumar *et al.* (2006) studied the clinical examination of 80 adolescent girls from Allahabad and observed the various signs and symptoms of anaemia among adolescents like breathlessness, tiredness and pale nails.

The haemoglobin content of the normal adolescent girls is 12 and more than 12 g/dl is categorised as non-anaemic and haemoglobin level less than 12 g/dl and for boys normal is 13 and more than 13 g/dl is categorized as non-anaemic and haemoglobin level less than 13g /dl are anaemic based on the cut off points given by WHO.

Leela and Priya (2002) conducted a study on iron status and morbidity pattern among 120 school children in Coimbatore. The results revealed that mean haemoglobin level was 12.5, 11.03 and 9.17 g/dl for the non-anaemic, mild and moderate anaemic respectively.

Gowrikar *et al.* (2002) reported that the mean haemoglobin was 9.80 g/dl and overall prevalence of anaemic was 96.5 per cent in 459 girls of 10-18 years of age in Ujjain.

Inadequate consumption was noted for all food groups especially for green leafy vegetables, roots and tubers, fruits and milk among 500 adolescent girls (13-18 years) of Marathawada region (Zanvar *et al.*, 2007).

C. PREVENTIVE MEASURES TO ALLEVIATE THE PROBLEM

Nutrition education has been defined as educational measure for inducing desirable behavioral changes for the ultimate improvement in the nutritional status of individual and family (Deshpande *et al.*, 2003).

When children, as they grow older, begin to eat more outside of home and start to take greater responsibility for meal preparation and food selection specific knowledge and skills are needed to improve the quality of food consumption patterns (Melnik *et al.*, 1998). Several school-based intervention studies conducted in preschool and school-aged children have shown that nutrition counseling has a definite impact on children's nutrition knowledge (Nader *et al.*, 1996 and Auld *et al.*, 1998). Therefore, nutrition education should be conveyed to children from an early age.

Establishing healthy eating habits in young children may prevent various chronic health disorders in childhood and adult life, including obesity, diabetes, hypertension, cardiovascular disease, cancer and dental caries (WHO, 2002). Schools provide an easily accessible setting for interventions targeted at children and parents to promote healthy lifestyles (Franks *et al.*, 2007).

Nutrition education is important, though not sufficient to empower individuals to improve their diet. The Food and Health Action plan identified six key targets to improve the nation's diet, which include reduction of salt, sugar and saturated fat consumption and increased fibre and fruit and vegetable intake (Worsley, 2002). In order to achieve this it may be useful to increase knowledge of the nutritional content of commonly consumed foods (Contento, 1995; Percz Rodrigo and Aracenta, 1997; Worsley, 2002).

The intervention programme conducted by Varalakshmi and Jayashree (2003) showed that the child to child teaching, method of teaching and learning process is more effective than the traditional method of teaching.

Sucharitha *et al.* (2007) revealed that the intervention through girl to girl approach in gaining nutrition knowledge was successful and the study also proved that the girls were more participatory, active and efficient in sharing information.

Wardle *et al.* (2000) reported that nutrition knowledge has a significant correlation with healthy eating habits such as fruits and vegetables intake. He also discovered that individuals with knowledge are 25 times more likely to include fruits and vegetables in their diet compared to those with less or no knowledge on nutrition.

A number of strategies are followed worldwide to combat Iron Deficiency Anaemia (IDA) among vulnerable groups, including iron supplementation, dietary counseling, control of infectious and parasitic diseases and food fortification with iron. Iron fortification of food is now generally considered to be the best long term and cost effective strategy to increase the iron intake and has been reported to contribute to iron intake among those consuming fortified food (Samuelson *et al.*, 2000).

Food fortification has been defined as the addition of one or more essential nutrients to a food, whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups (FAO/WHO, 1994).

Pumpkin (*Cucurbita pepo*) has received considerable attention in recent years because of the seeds. The seed is an excellent source of protein and also has pharmacological activities such as anti-diabetic, antifungal, antibacterial and anti-inflammation activities and antioxidant effects. In addition to good chemical and nutritional values, *Cucurbita pepo* seed flour performed well as composite in cookies production. Wheat flour substitution at 10 per cent is recommended to produce acceptable cookies (Atunowu, 2010).

Awan *et al.* (1995) reviewed the fortification of whole wheat flour. The authors reviewed in detail the problems of malnourishment especially protein deficiency, strategies to improve the protein level of the food and benefits of fortifying the whole wheat flour with protein rich minerals such as cereals, tubers, milk, milk products, fish, fish protein concentrate, oil seed flour, oil seed meal and different legumes. The authors also reviewed the use of composite flour technologies to eliminate protein deficiency. Foods in which composite flour have been employed include cookie, biscuits, nans, breads, chapaties and miscellaneous products.

The protein content increased from 5.1 to 8.2 and 9.0 percent with replacement of 3.0 percent of wheat flour with dried pea and red gram flours respectively (Singh *et al.*, 2000).

Blanched pearl millet flour in combination with refined wheat flour and green gram flour can be successfully incorporated for the development of nutritious biscuits. Sindhuja *et al.*, (2005) carried out studies on composite flour cookies by incorporating amaranth seed flour, on the basis of colour, taste, flavour, surface appearance of the cookies, and increase the iron content. Gupta and Sing (2005) used wheat flour and quality protein maize based biscuits prepared with and without processed defatted maize germ cake supplementation.

Bernardino-Nicanor *et al* (2006) working on fractionation and characterization of guava seed storage protein found that the guava seed could be an alternative source of protein for human and animal consumption.

D. IMPORTANCE OF THE SUPPLEMENTS IN CORRECTING ANAEMIA AND UNDERWEIGHT

Supplementation with legumes is one way to meet the needs for protein foods, particularly baked foods. Biscuits, cookies, cakes are widely consumed that have relatively long shelf life and good eating qualities. Such qualities of

food products make large scale production and distribution possible, in the shortest period. Biscuits can be easily fortified (Mishra *et al.*, 1991) with protein rich flours to provide convenient food in order to supplement protein in the diet. Grain legumes occupy an important place in human nutrition. These are rich in various nutritious particularly protein, minerals and vitamins. It is one of the additional ways of utilizing legume flours in India. As such bengal gram flour commonly consumed by the public and more relished, the present verification was therefore undertaken to explore the possibilities of using bengal gram flour in biscuits without impairing their acceptability.

Legumes are normally consumed after processing, which not only improves palatability of goods but also increases the bioavailability of nutrients by inactivating trypsin, growth inhibitors and haemagglutinins (Tharanathan and Mahadevamma, 2003). Thus incorporation of bengal gram flour at 15-20 per cent level added with optimum fat, water, and baking powder improved the physical characteristics of biscuits (Tyagei *et al.*, 2006) including height, diameter, spread factor along with sensory attributes namely texture, flavour, colour and over all acceptability.

Most snacks are fun to eat but are low in nutritive value. If they are taken in large quantity, they can suppress the appetite for the main meal. For this reason, snack with high protein and high fibre should be developed as a supplementary diet (Shahzadi, 2005). Among legumes that are frequently used in cookies are cowpeas, great northern bean, faba bean, navy bean, lupine bean, chickpea, field pea and soybean (Pate, 1995)

The protein quality of soybean and chickpea were rich in essential amino acids (isoleucine, lysine, total aromatic amino acids and tryptophan) compared with the reference pattern while cereals such as wheat are low in lysine and total protein content as stated by Patel and Rao (1995).

Chickpea is an important source of proteins, carbohydrates and certain minerals, particularly to the populations of developing nations. The chickpea

seed contain 21.11 percent protein, 3.1 percent fat, 53.4 percent carbohydrate, 11.1 percent fibre and 5.9 percent ash

Baked products are the most important sources of dietary fiber in the total food consumption. Pea meal is a good source of protein, fiber, starch and iron. It also contain a number of anti-nutritional factors such as phytic acid and trypsin inhibitors (Periago *et al.*, 1998)

Finger millet (Ragi, Eleusine Coracana) is an important staple food in the eastern and central Africa as well as some parts of India (Majumder *et al.*, 2006). It is rich in protein, iron, calcium, phosphorus, fibre and vitamin content. The calcium content is higher than all cereals and iodine content is said to be highest among all the food grains. Ragi has best quality protein along with the presence of essential amino acids, vitamin A, vitamin B and phosphorus (Gopalan *et al.*, 2004). Thus ragi is a good source of diet for growing children, expecting women, old age people and patients.

Unripe bananas, widely produced in several Latin American countries, are a source of carbohydrates and nutritionally interesting bioactive compounds. There is an excess of production and large quantities of fruits are lost during commerce, as a consequence of deficient post harvest handling. New economic strategies are considered for banana as a food ingredient. Banana flour is a starchy food that contains a high proportion of undigestible compounds such as resistant starch (RS 17.5 per cent), and non-starch polysaccharides, included in the dietary fibre content (DF, 14.5 per cent) (Juárez-García *et al.*, 2006).

Several studies have suggested that consumption of unripe bananas exerts a beneficial effect on human health, associated with indigestible components (Faisant, 1995). Moreover, unripe banana flour could be a source of antioxidant polyphenols (Vergara-Valencia *et al.*, 2007).

E. QUALITY ANALYSIS OF VALUE ADDED COOKIES

The term cookies or biscuits as they are called in many parts of the world, refers to a baked product generally containing the three major ingredients; flour, sugar and fat. They have low final water contents (1-5%) (Pareyt and Delcour, 2008). Other ingredients include milk, salt and aerating agent (Olaoye *et al.*, 2007).

Most biscuits and cookies are chemically leavened baked products (Dogan, 2006). Cookies are nutritive snacks produced from unpalatable dough that is transformed into appetizing product through the application of heat in an oven. They are ready-to-eat, convenient and inexpensive food product, containing digestive and dietary principles of vital importance. Cookies are a rich source of fat and carbohydrate, hence are energy giving food and they are also a good source of protein and minerals (Olaoye *et al.*, 2007).

They are stable foods and have advantages such as long shelf life and good eating quality. The physical properties of the dough and the recipes in cookie depend on the type of cookie and the method used in the dough formation. Quality standards from the raw materials to the end product are essential in cookie making (Dogan, 2006).

Flour is the main ingredient in cookie dough formula which provides the matrix around which other toughening or tenderizing ingredients in varying proportions are mixed to form dough. Flour derived from soft wheat is perfect for producing a wide range of confectionery and baked products including cookies, pastries, cakes, steamed buns and snack foods. Soft wheat is a unique blend of white, soft-grained wheat varieties (Pareyt and Delcour, 2008).

Fat functionality is very versatile in baked products which include providing of flavor and mouth feel and also contributes to the appearance, palatability and texture of the cookies (Zoulias, *et al.*, 2002).

Baking is a unit operation which uses heat to alter the eating quality of foods. A secondary purpose of baking is preservation by destruction of micro-organisms and reduction of the water activity at the surface of the food. Baking involves simultaneous heat and mass transfer; heat is transferred into the food from hot surfaces and air in the oven and moisture is transferred from the food to air that surrounds it and then removed from the oven (Fellows, 2000).

The levels of ingredients in the formula can also be expressed on a flour weight basis, which then, for sugar-snap cookies, gives ca. 60 per cent sugar, 30 per cent shortening, 20 per cent water and sweetener, and 1 per cent for each minor fraction. The term “snap” refers to the audible sound when the cookie fails under a load (Pareyt and Delcour, 2008).

The major effect of wheat substitution with other flours has often been related to quantitative differences in gluten content of the composite flours (Njintang, *et al.*, 2007).

Essentially all cookies, except those that are dried to very low moisture content, are soft and quite flexible when they come out of the oven. With time, they become firm and often brittle. The continuing change in texture and development of the final crispness has been attributed to slow crystallization of sucrose from concentrated sugar syrup formed during the earlier stages of processing (Pareyt and Delcour, 2008).

Sugar’s functionality in cookie systems includes more than only imparting sweetness. In fact, sugar’s functionality holds different aspects and may not be underestimated.

With the presence of shortening, the fat surrounds the proteins and the starch granules isolating them thereby breaking the continuity of the protein and starch structure. The produced dough will then be less elastic, which is desirable in cookie-making, since it does not shrink after lamination. This phenomenon results in eating properties after baking that are described as less

hard, shorter, and more inclined to melt in the mouth (Pareyt and Delcour, 2008).

If the fat level is high as in sugar snap cookies, the lubricating function in the dough is so pronounced that little if any water is required to achieve a desired consistency, little if any gluten is formed, and starch swelling and gelatinization are also reduced giving a very soft texture. The dough breaks easily when pulled, because it is short. Where the sugar level is high again sugar snap cookies, the fat combines in the oven with the syrupy solution preventing it from setting to a hard vitreous mass on cooling. A second function of the fat includes enhancing aeration for leavening and volume (Pareyt and Delcour, 2008).

Some other functions fat plays in cookie (dough) systems include affecting heat transfer and spread (more fat gives more spread). However, it was found that varying the level of shortening does not materially affect the cookie diameter, but alters top crumb in certain instances. Fat also influences the structural integrity and the shelf life of the product (Pareyt and Delcour, 2008).

The concept of using composite flours is not new and has been the subject of numerous studies (Vieira *et al.*, 2007). Experience gained in the use of composite flours has clearly demonstrated that for reasons of both product technology and consumer acceptance, wheat is an essential component in many of these flours. The percentage of wheat flour required to achieve a certain effect in composite flours depends heavily on the quality and quantity of wheat gluten and the nature of the product involved (Mepba, *et al.*, 2007).

Cookies have been suggested as a better use for composite flour than bread because of their ready-to-eat form, wide consumption, relatively long shelf life and good eating quality (Vieira *et al.*, 2007).

Flours milled from other crops such as maize, millet, sorghum and rice had been added to wheat flour to extend the use of the local crops (Ojinnaka *et al.*, 2009). Mepba *et al.* (2007) also tried to produce composite breads and biscuits from mixed flours of wheat and plantain, with up to 30 per cent supplementation of plantain flour (Olaoye *et al.*, 2007).

They are stable foods and have advantages such as long shelf life and good eating quality. The physical properties of the dough and the recipes in cookie depend on the type of cookie and the method used in the dough formation. Quality standards from the raw materials to the end product are essential in cookie making (Dogan, 2006).

Cookie production has occurred since the Rock Age and its formulations and processing have been perfected continuously. In accordance with Butt (2007), cookies are produced by kneading and baking dough prepared from flour and/or starch, fermented or not, containing other nourishing substances. Flour can be derived from fruits, leaves, cereals and tubers. Other ingredients can also be used to prepare cookies to improve their physical, nutritional, sensory, or technological properties such as enzymes, colorings, vitamins, minerals, fibers and flavorings (Leelavathi., 1993).

The breaking strength of a cookie the absolute peak force from the resulting curve is one criterion that measures the hardness of a biscuit (Tyagi, *et al.*, 2006). The mechanical characteristics of biscuits are important in determining the perception of biscuits in the mouth and play an important role in product acceptance (Shrestha and Noomhorm, 2002).

Singh *et al.* (2005) reported a high compression force requirement for breaking biscuits prepared by incorporating 15 per cent Bengal gram flour. According to Sindhuja *et al.*, (2005), with a reduction in the breaking strength, cookies become crispier.

When flour moisture content is increased, the cookie diameter and dough flow and adhesion increase, at the same time, increased flour moisture contents decrease dough stiffness, consistency, and cohesion (Pareyt and Delcour, 2008). The total appearance of a cookie consists of visual structure, texture, and distributions of color on the top surface, and it is one of the many sensory factors to determine its purchase and consumption (Hutchings, 1999).

Satisfactory cookies have been made from composite flour through a blend of wheat flour with other cereals. Considering studies made in the incorporation of tubers in cookie formulation, cassava and potato was used blended with wheat flour for cookie making. (Ojinnaka *et al.*, 2009). Singh *et al.*, (2008) also studied the effect of incorporating sweet potato flour to wheat flour on the quality characteristics of cookies with an objective of developing cookies with good taste, texture and appearance, which resembles as closely as possible to the wheat flour based product. The textural property and sensory quality of cookies were taken into consideration to improve the quality of cookies.

III. METHODOLOGY

A study on “**Nutritional status among school going orphans and efficacy of value added cookies**” was undertaken to find out the nutritional status among the orphans and the effect of the formulated supplementation.

The planning of the empirical study included the development of questionnaires in order to determine nutritional status and food consumption pattern of the orphans. Nutrient content was analyzed for the formulated cookies and studied the health progress among children after the supplementation.

The research study was undertaken by following the steps given bellow:

- A. Study design
- B. Collection of demographic data
- C. Assessment of nutritional status
- D. Clinical examination
- E. Biochemical assessment
- F. Formulation, standardization, sensory evaluation of the cookies and shelf-life study.
- G. Analysis of the nutrient content
- H. Impact of formulated cookies
- I. Nutrition education

A. STUDY DESIGN

The study populations were purposively chosen comprised of 170 children, from 3 orphanages with 80 boys and 90 girls aged 6-15 years. All the children in the orphanages were included and studied so as to determine their nutrition status and food consumption pattern. Among them 20 children consisting of 10 girls and 10 boys were randomly selected as sub sample for the supplementation study.

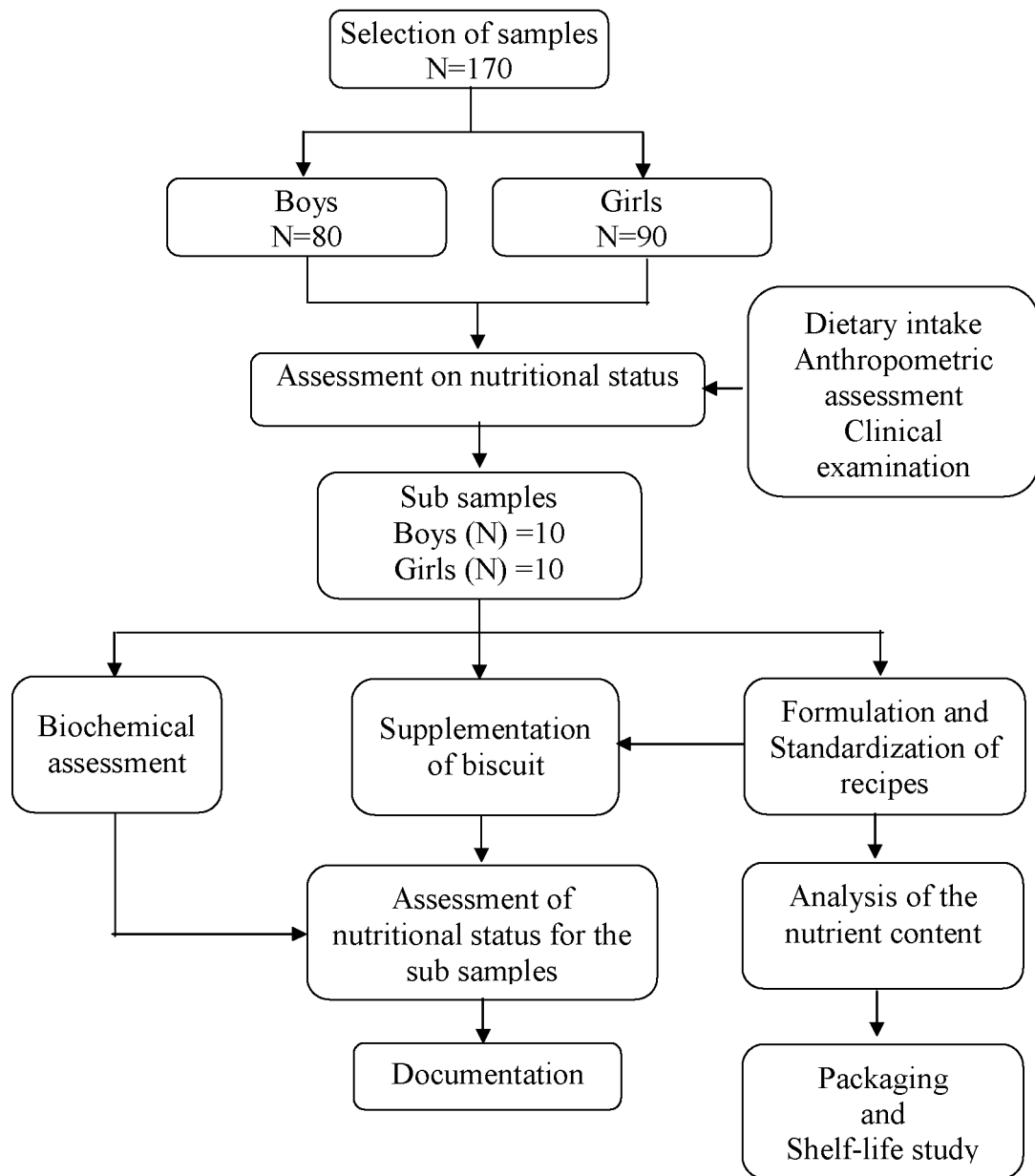


FIGURE 1

RESEARCH DESIGN

The study was undertaken to examine the nutritional status, food consumption pattern, dietary intakes, anthropometry measurement, clinical and biochemical examinations of the orphanage children.

Beneficial ingredients were added in formulated cookies. Cookies were prepared using the blend of wheat flour, chickpea flour and finger millet flour in different proportions. The standard one was selected via sensory evaluation. It was administered to anaemic and underweight children and observed its impact. Nutrition knowledge was assessed before and after nutrition education.

B. COLLECTION OF DEMOGRAPHIC DATA

Standard demographic questions shown in Appendix 1 was used to collect personal data from 170 children between 6 to 15 years old. It captured data on specific variables, including age, gender, health status, menu pattern, educational background, recreation, ethnicity activities performed. The demographic information gathered was important in understanding the backgrounds of orphanage children.

C. ASSESSMENT OF NUTRITIONAL STATUS

1. Quantitative Food Frequency Questions (QFFQ) :

The QFFQ shown in appendix II consisted of two components, namely a list of the foods and a set of frequency of consumption response categories. An extensive list of defined foods was included, with the aim of estimating total food intake and thus dietary diversity. Inventory method was applied to find out the mean value of each nutrient. The raw food ingredients used in food preparation were recorded for the three consecutive days. The mean food intake was taken into account. From this mean value, the mean nutrient intake was computed using the nutritive value of Indian foods. These were compared with the recommended dietary allowance of ICMR and the difference was noted to observe the adequacy of food consumption.

2. Anthropometric Measurements

Anthropometric data, namely, weight-for-age, height-for-age, (Body mass index) BMI-for-age was computed for which weight and height of all the children were examined (Plate 1 and Plate 2).

- **Weight measurement**

The weight measurements were taken before breakfast so as to avoid diurnal variations (de Ridder, 2002). Weight was recorded using a portable spring balance checking for accuracy of 0.05g with standard weights prior to taking the weight. The children were in their normal dress and were made to stand barefoot at the time of measurement.

- **Height measurement**

A modified tape measure was used to measure the height of the children aged 6 to 15 years. Height was measured with a accuracy of 0.1 cm. The child facing towards front, shoulder relaxed, buttocks and heels touch the wall. The child's arms were relaxed at the sides, legs straight and knees together and head in the Frankfort's plane (Gibson, 1990 and Hans de Ridder, 2002)

- **Body Mass Index**

The anthropometric measurements of the selected children were used for calculating the body mass index which was expressed as ratio of weight (kg) to height in meter square.

$$\text{BMI} = \frac{\text{Weight(kg)}}{\text{Height m}^2}$$

Further, the individuals were classified into different classes based on National Center for Health Statistics (2000) classification.



**PLATE I
MEASUREMENT OF HEIGHT**



**PLATE II
MEASUREMENT OF WEIGHT**

BMI-percentile-for-age of 2 to 20 years	Status of child
At or the 95 th percentile	Overweight
Between the 85 th and 95 th percentile	At risk for being overweight
Between 15 th and 85 th percentile	Probably at a healthy weight
Between 5 th and 15 th percentile	Possibly at risk for underweight
Under the 5 th percentile	Underweight

D. CLINICAL EXAMINATION

Clinical assessment includes a physical examination and medical history to identify signs of, or contributors to, malnutrition among the selected 170 children. Key areas include physical appearance, evaluation of opportunistic infections and co-morbid conditions, occurrence of diarrhoea or food allergy, medications, use of nutritional supplements and functional status. A review of the documentation in the medical record will provide the necessary information to facilitate the nutrition assessment. A clinical schedule given in appendix III was used to identify the manifestation of deficiency disorder among the selected children.

E. BIOCHEMICAL EVALUATION

Finger prick blood sample was collected from the 20 children who were randomly got selected to measure haemoglobin in the field. An additional 5 ml venous blood sample was drawn into tubes without anticoagulant for the determination of serum albumin and total protein. Blood samples were kept on ice during transport to the laboratory.

- **Haemoglobin (Hb)concentration**

Haemoglobin concentration was determined for all selected children finger prick blood sample of selected children using the laboratory investigations by cyanmeth-haemoglobin method (Anon, 2001). In this method

20µl blood is mixed with 5 ml Drabkin's solution and vortexed in order to convert all haemoglobin into cyanmeth-haemoglobin. The concentration of haemoglobin was determined at 540 nm by comparison with a known standard in a colorimeter.

- **Serum albumin**

Serum albumin concentration was determined from the 5 ml of blood sample from all the 20 sub samples using the laboratory investigation by biochemical semi analyzer. The bromocresol green method was followed for the determination of serum albumin before and after the supplementation.

F. FORMULATION, STANDARDIZATION, SENSORY EVALUATION OF THE COOKIES AND SHELF-LIFE STUDY

1. Formulation and Standardization of Cookies

- Two variety of value added cookies were formulated using the protein and iron rich food. One with the combination of Bengal gram flour and ground pea nut and the other one with finger millet (ragi) flour and fresh banana.
- Bengal gram flour cookies: Refined wheat flour, Bengal gram flour, ground pea nut, sugar powder, butter and baking powder were purchased from the local market. Legume and nut fortified biscuit were prepared using blends of wheat flour, Bengal gram flour and ground pea nut in proportions of 80:20:20, 60:40:20 and 40:60:20 respectively and were evaluated for various physical and sensory characteristics. Based on preliminary trials, the cookies with a combination of 20 percent Bengal gram flour was found to be highly desirable and selected as the standard one.
- Finger millet flour cookies: Refined wheat flour, finger millet flour, fresh ripe banana, sugar powder, butter and baking powder were

purchased from the local market. Millet and fruit fortified biscuit were prepared using blends of wheat flour, finger millet flour and ripe banana in proportions of 80:20:10, 60:40:10 and 40:60:10 respectively and were evaluated for various physical and sensory characteristics. Based on preliminary trials, cookies with 20 percent finger millet flour identified as highly acceptable and was selected as the standard one.

- The cookies were prepared (Plates 3, 4, 5, and 6) by the continuous mixture of the raw materials, previously weighed in analytical scale, rolling and pressing the dough with a metallic cylinder in a way that all the cookies presented the same thickness until it reached 4.0 cm diameter. The cookies were then baked for ten minutes at monitored temperature of 150 ± 2 °C. After that, they were cooled in room temperature (23 °C) and conditioned packing until analyses.

1. Sensory evaluation

The organoleptic characteristics of cookies were determined by using taste panel consisting 20 members drawn from the neighbourhood. The sensory evaluation was done using a 9-point hedonic scale. The consumer panel evaluated cookies made with three levels of flour blend for both cookies. Cookies were prepared a day ahead of sensory evaluation and stored at room temperature. Panelists were provided with distilled water and unsalted crackers to clean their mouths between samples. The cookie samples were presented in random order and panelists were asked to rate their assessment of color, aroma, taste, crispiness and overall acceptability.

2. Shelf-life study

Cookies were kept for 60 days and the shelf-life was assessed by sensory evaluation using the hedonic ranking and determined the microbial count and the moisture content.



**PLATE III
CHICKPEA FLOUR COOKIES**



**PLATE IV
FINGER MILLET COOKIES**



**PLATE V
BAKING PROCESS**



**PLATE VI
WEIGHMENT OF THE
PRODUCT**

G. ANALYSIS OF THE NUTRIENT CONTENT

The physicochemical analysis had done for the freshly prepared cookies and for the 60 days shelf-life cookies. The parameters analyzed were: energy, protein, carbohydrate, fat, fibre, iron, calcium, vitamin-A, vitamin-C, moisture content, microbial count, all according to AOAC (2000).

H. IMPACT OF FORMULATED COOKIES

Twenty sub samples were randomly got selected from the selected children. The standardized cookies were supplemented for the sub samples and 10 were selected for each cookies supplementation including five girls and boys respectively. The supplementation was carried out for 90 days from December 24th 2010 to march 24th 2011. Two cookies was given weighing 21g were given to each child per day.

Biochemical analysis was done before and after the supplementation to find out the effectiveness of the supplement. Blood samples were drawn from the selected 20 sub samples to find out the progress in haemoglobin, serum albumin and total protein.

I. NUTRITION EDUCATION

Nutrition education is defined as the process by which beliefs, attitudes, environmental influences and understanding about food lead to practice are scientifically sound, practical and consistent with individual needs and available food resources.

Education was carried out with flow charts and power point presentation, questionnaire and also through personal interaction with the children. The listed educational materials included information on food groups, importance of iron and sources of iron, causes for iron deficiency anaemia, reasons and symptoms of anaemia including malnutrition. A structured questionnaire was used before and after the nutrition education to find out the impact of their nutritional knowledge level.

IV. RESULTS AND DISCUSSION

The result of the study entitled “**Nutritional status among school going orphans and efficacy of value added cookies**” are discussed under the following headings:

- A. Background information of the orphanages
- B. Nutritional status of the selected subjects
- C. Formulation of the supplement
- D. Quality analysis of the supplement
- E. Efficacy of the value added supplementation and
- F. Impact of nutrition education

A. BACKGROUND INFORMATION OF THE ORPHANAGES

The Hindu Board of Education runs a Children’s home which is perhaps the largest in the island. It provides shelter, food, clothing, healthcare, education, recreation and vocational training to above 250 children from north Sri Lanka.

Almost all the children are from families affected by war. Some of them have lost either one or both parents; some are from broken families; still others are below the poverty line. They are all needy. The Divisional Secretary, Nallur have the authority to admitting children in the orphanage.

The back ground information related to age, gender, educational status, menu pattern, recreation activities, medical history and health care were collected and discussed below.

The background information of the orphanage children are discussed under the following headings:

1. Distribution of subjects according to age and gender
2. Educational status

3. Menu pattern and adequacy of food supplied in the orphanage
4. Recreation and other activities
5. Medical history of the samples
6. Health care of the children

1. Distribution of subjects according to age and gender

The data in Table I show the age and gender distribution of the children. The age of the children varied between 6 to 15 years old.

TABLE I
DISTRIBUTION OF SUBJECTS ACCORDING TO AGE AND GENDER

Age Group (Years)	Female	Per cent	Male	Per cent
6-7	5	5.55	9	11.25
8-9	9	10	9	11.25
10-11	20	22.2	9	11.25
12-13	19	21.1	31	38.75
14-15	37	41.1	22	27.5
Total	90	100	80	100

Orphanages are accepting children with certain age limitations. For boys the age limit is 6 to 16 years and for girls it is 6 to 18 years. Participation rate of females was 52.8 percent, while males it was 47.2 percent. Among male the children in the age group 12-13 years were predominant with 38.75 per cent while among females 41.1 per cent were predominant in the age group of 13-14 years.

2. Educational status

The selected children were sent to school for education. The educational status of the selected subjects is given in Table II and Figure 2.

TABLE II
EDUCATIONAL STATUS OF THE SELECTED SUBJECTS

Class	Female	Per Cent	Male	Per Cent
1-2	5	5.55	9	11.25
3-4	9	10	9	11.25
5-6	20	22.2	9	11.25
7-8	19	21.1	31	38.75
9-10	37	41.1	22	27.5
Total	90	100	80	100

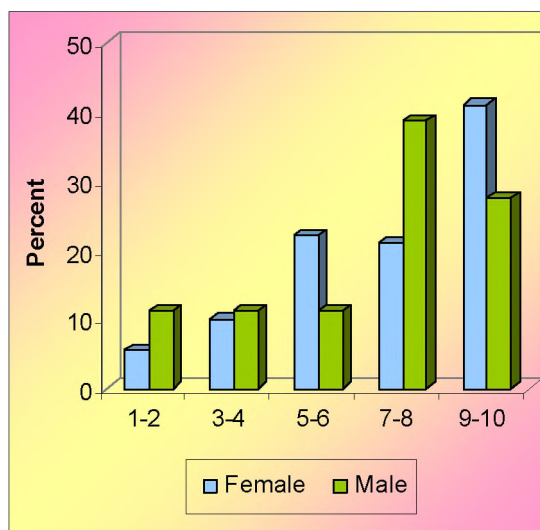


Figure 2

Education in Sri Lanka has a long history which dates back two millennia and the Constitution of Sri Lanka provide for education as a fundamental right. The Sri Lanka's population has a literacy rate of 92 per cent, higher than that expected for a third world country; it has the highest literacy rate in South Asia and overall, one of the highest literacy rates in Asia. Orphanages are providing education for all the children. All children attended Muthuthambi Maha Vidyalayam which is a Government school within the campus. The children from the orphanage constitute the majority in the school.

3. Menu Pattern and Adequacy of Food Supplied in the Orphanages

Orphanages are having weekly cyclic menu pattern. There may be changes due to any special occasions like New Year, Diwali, Christmas or any others offers from out side.

Four meal patterns were followed in the orphanages. Adequacy of food supplied is shown in Table III.

TABLE III
ADEQUACY OF FOOD

Adequacy	Menu	Breakfast		Lunch		Evening tea		Dinner	
		N	%	N	%	N	%	N	%
Quantity	Adequate	170	100	170	100	170	100	170	100
	Fairly adequate	-	-	-	-	-	-	-	-
	Inadequate	-	-	-	-	-	-	-	-
Quality	Good	48	28	48	28	48	28	48	28
	Fair	122	72	122	72	122	71	122	72
	Poor	-	-	-	-	-	-	-	-

Orphanages are providing adequate quantity of food for all children. Three meal patterns including morning tea and evening tea with snacks were offered to the children. Self serving was allowed for above ten year old children and for the other children the care takers helped in the feeding.

4. Recreation and Other Activities

Tuition classes are arranged by the Board outside school hours. These classes were conducted by specialist teachers. There was ample scope for games and recreation. All the children watched television daily. Cultural and religious functions were an important aspect of life at the Home. Other than Thai Pongal, New Year, Deepavali, Navarathri, Christmas and the Guru poojas of siva saints were observed with devotion. Daily prayer in morning and evening were compulsory.

5. Medical History and Health Care of the Selected Subjects

Diseases or disorders in early stage of human life determine, to a great extent, the physical and mental well being of a person.

The selected samples from the orphanage do not have a medical history or illness for asthma and diabetes. Only one girl between six to seven years had defect in her auditory, one boy among eight to nine years and two girls between ten to eleven years had problem with emotional and social behavior. One percent of the selected samples were identified with the history of speech and language problem. None of them had physical dysfunction, vision problems and suffered from any chronic or infectious diseases. No body was allergic or had any known food intolerance. No special diet was given None of the children was on medication or a vitamin supplement.

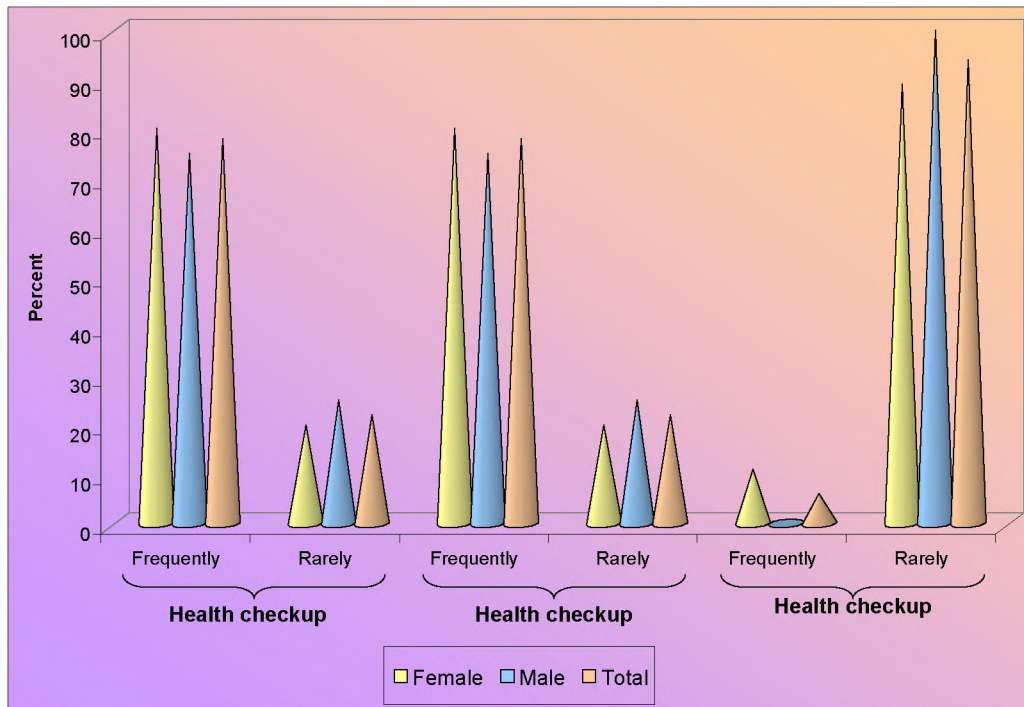
6. Health Care

Health of the orphan children were monitored regularly to promote the well being of the children and the steps undertaken for health care is portrayed in Table IV and Figure 3.

TABLE IV
HEALTH CARE

Health care	Frequency	Female	%	Male	%	Total	%
Health checkup	Frequently	72	80	60	75	132	78
	Rarely	18	20	20	25	38	22
Dental care	Frequently	72	80	60	75	132	78
	Rarely	18	20	20	25	38	22
Worm treatment	Frequently	10	11	-	-	10	6
	Rarely	80	89	80	100	160	94

Health check-ups were conducted twice in a month by the medical students from Jaffna Teaching Hospital as voluntary service. It is observed that 78 percent of children were having regular health and dental checkups and 94 percent of the children were rarely getting worm treatments. None of them had vaccination.



**FIGURE 3
HEALTH CARE**

B. NUTRITIONAL STATUS OF THE SELECTED SUBJECTS

Nutritional status can be assessed using clinical signs of malnutrition, dietary survey, anthropometry and biochemical indicators. Inadequacies in nutritional intake eventually alter functional capacity and result in many adverse health outcomes that are distinct expressions of malnutrition's different levels of severity. Initially, children adapt to inadequate diets through reduced physical activity and slowed rates of growth.

Nutritional status of the selected subjects is discussed under the following headings:

1. Status of body mass index
2. Clinical signs for nutrient deficiencies

1. Status of Body Mass Index

Anthropometry has an important advantage over other nutritional indicators: body measurements are sensitive over the full spectrum of malnutrition, whereas biochemical and clinical indicators are useful only at the extremes. In addition, anthropometric measurements are non-invasive, inexpensive and relatively easy to obtain. The main disadvantage of anthropometry is its lack of specificity, as changes in body measurements are also sensitive to several other factors, including infection, altitude, stress and genetic background (de Onis 2001).

The internationally recommended way to assess under nutrition at the population level is to take body or anthropometric measurements (e.g. weight and height). Based on combinations of these body measurements anthropometric indices are constructed. These indices are essential for the interpretation of measurements, as the value for body weight alone, for example, has no meaning unless it is related to an individual's age or height (WHO 1995b).

Anthropometry offers a reliable method to assess the nutritional status of the children (Bhasin *et al.*, 1990). Anthropometry is the single most universally applicable, inexpensive, and non-invasive method available to assess the size, proportion and composition of human body (World Health Organization, 1995).

WHO has recommended various indices based on anthropometry to evaluate the nutritional status of children (WHO, 1995). An attempt has been made to assess the nutritional status of the school age children (6-15 years) of orphanage using National Center for Health Statistics recommended anthropometric indices. The body mass indexes of the children for the various age groups were projected in Table V and Figure 4.

TABLE V
STATUS OF BODY MASS INDEX OF THE SELECTED SUBJECTS

Age Group (Years)	BMI	Male			Female		
		Standard	N=80	%	Standard	N=90	%
6-7	Healthy weight	14.2-17.5	3	3.75	14.0-17.5	1	1.1
	Risk of under weight	13.8-14.2	4	5.0	13.5-14.0	-	-
	Under weight	<13.8	2	2.5	<13.5	4	4.4
8-9	Healthy weight	14.5-18.5	6	7.5	14.4-19.0	2	2.2
	Risk of under weight	14.0-14.5	3	3.75	13.6-14.4	2	2.2
	Under weight	<14.0	-	-	<13.6	5	5.5
10-11	Healthy weight	15.0-20.0	9	11.25	15.0-22.0	7	7.7
	Risk of under weight	14.2-15.0	-	-	14.4-15.0	3	3.3
	Under weight	<14.2	-	-	<14.4	10	11.1
12-13	Healthy weight	16.0-21.8	16	20.0	16.0-22.5	-	-
	Risk of under weight	15.0-16.0	12	15.0	15.5-16.0	6	6.6
	Under weight	<15.0	3	3.75	<15.5	13	14.4
14-15	Healthy weight	17.2-23.5	14	17.5	17.0-24.0	19	21.1
	Risk of under weight	15.5-17.2	7	8.75	15.8-17.0	6	6.6
	Under weight	<15.5	1	1.25	<15.8	12	13.3
Total			80	100		90	100

SOURCE: Developed by the National Center for Health Statistics

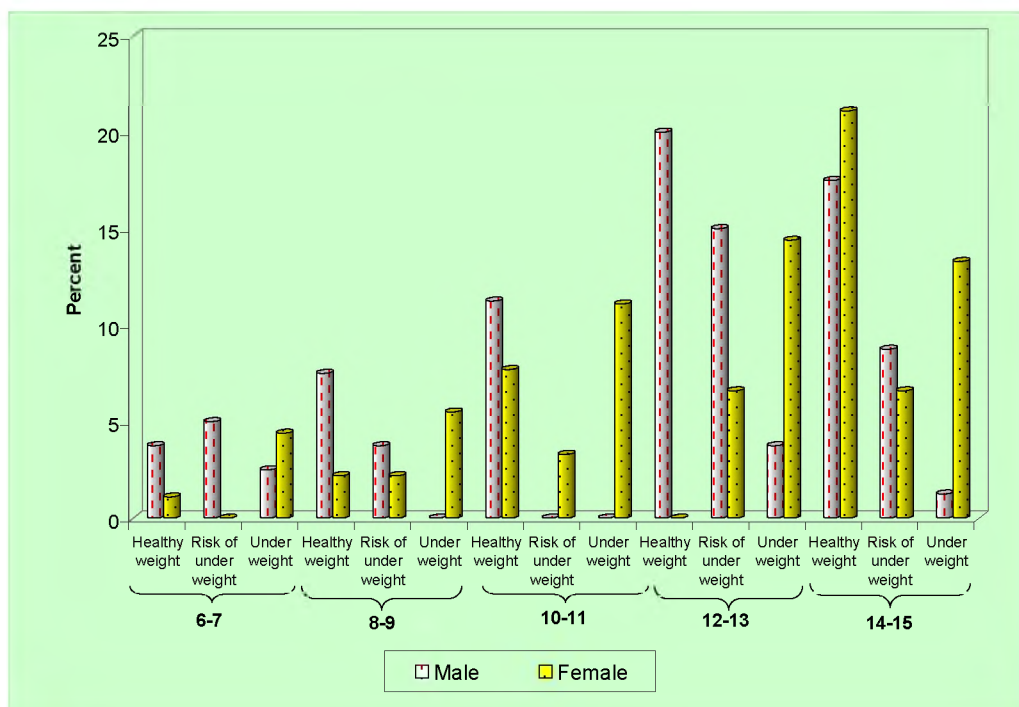


FIGURE 4
STATUS OF BODY MASS INDEX OF THE SELECTED SUBJECTS

Height and weight are important criteria to judge the nutritional level of an individual. Height and weight were taken for all to find out their BMI. Nearly 51.6 per cent of children were not in healthy weight for their age. On the other hand there is no over weight problems in orphanage children. It is evident that, male were more prone for risk of under weight than female children. However 14.4 percent and 13.3 percent of female children were underweight as against, 3.75 percent and 1.25 percent of male children in the age group of 12-13 and 14-15 years who were underweight respectively.

2. Clinical Signs Observed Among Selected Samples

Clinical signs observed among the various age groups of children are projected in Figure 5 and Table VI.

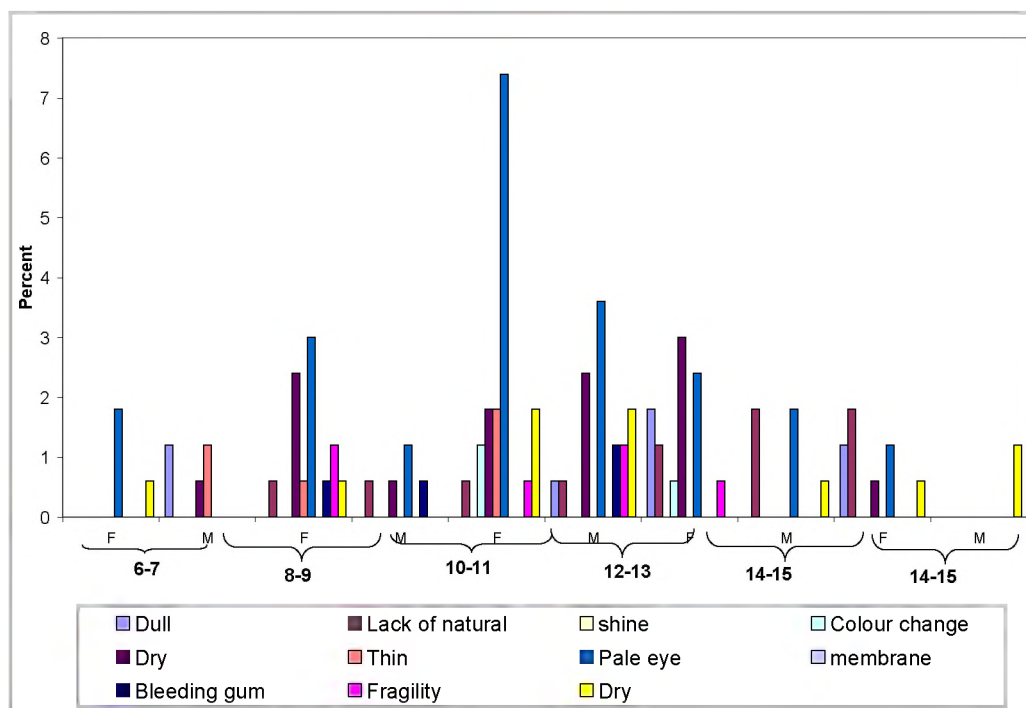


FIGURE 5

CLINICAL SIGNS OBSERVED AMONG SELECTED SAMPLES

T6 landscape

Clinical assessment relates the nutrient deficiency. Signs of the physical examination express the possible nutrition related cause. Signs of dull, dry, lack of natural shine in hair may possibly due to protein-energy deficiency. Colour changes and thin hair may be due to other nutrient deficiencies like manganese, copper and zinc. Deficiency of iron in body shows eye membrane as pale in colour. Bleeding gums was possible by prolonged vitamin C deficiency. Fragility of nails indicated the deficiency of protein and dryness of skin showed the lack of vitamin A in body. It is observed from the clinical assessment that 21.8 per cent children are prone to iron deficiency, possibilities for protein-energy deficiency is 27.8 per cent, vitamin-C deficiency 3.5 per cent and vitamin-A deficiency eight per cent. It is obvious that 8-13 year old children were the more affected compared to other age groups.

Dietary Assessment of the Selected Samples

Children globally obtain their energy, macro and micro nutrients from a variety of sources. However, identifying these sources and comparing them to age groups, present difficulties, since food are sometimes classified in different ways (Jardine, 1997). According to Lucas (2000), children have very high energy and nutrient needs for normal body growth development and activity.

Dietary assessments are discussed under the following headings:

1. Type of diet
2. Frequency of consumption of food
3. Mean nutrient intake

1. Type of Diet

The Table VII expresses the type of diet followed in the orphanage children homes.

TABLE VII
TYPE OF DIET FOLLOWED IN THE ORPHANAGES

Type of diet	Female	Percent	Male	Percent	Total	Percent
Vegetarian	72	80	60	75	132	78
Non- Vegetarian	18	20	20	25	38	22
Total	90	100	80	100	170	100

Homes run by the Hindu trusts provide only vegetarian diet and the other homes provide vegetarian and non- vegetarian foods for the children.

2. Frequency of Consumption of Food

Children globally obtain their energy, macro-and micronutrients from a variety of sources. However, identifying these sources and comparing them to age groups, present difficulties, since food are sometimes classified in different ways (Jardine, 1997). According to Lucas (2000), children have very high energy and nutrient needs for normal body growth development and activity. Frequency of consumption of food by the selected orphan children are shown in Appendix II

3. Mean Nutrient Intake and Recommended Dietary Allowance

The mean nutrient intake of orphanage children and the recommended dietary allowance are projected in Table VIII and Figures 6.

TABLE VIII
MEAN NUTRIENT INTAKE OF CHILDREN

Nutrients	Age Group Years	Mean intake	Male	Female
			RDA	RDA
Energy (kcal/day)	6-11	1860	1400	1400
	12-15	1860	1920	1890
Protein (g/day)	6-11	52	30	30
	12-15	52	50	50
Fat (g/day)	6-11	43	31	31
	12-15	43	45	38
Iron (mg/day)	6-11	10	17	19
	12-15	10	29	27
Calcium (mg/day)	6-11	422	680	680
	12-15	422	800	800
Vitamin A (µg/day)	6-11	3261	4270	4270
	12-15	3261	4800	4800
Vitamin C (g/day)	6-11	28	40	40
	12-15	28	40	40

A possible reason for these low intakes could be that of poor food procurement, lack of a planned menu for the orphanage and inadequate nutrition knowledge of caregivers. Lucas (2000) suggested, that poorly planned menus could affect adequate nutritional intake. Frank (1996) indicated, that growth failure observed in institutionalized children did not necessarily reflect an insufficient quantity and quality of available food, but rather too few caregivers ensure that the available food was fed to those too young to feed themselves, a lack of tactical stimulation and care during the planning of meals for infants, children and adolescents.

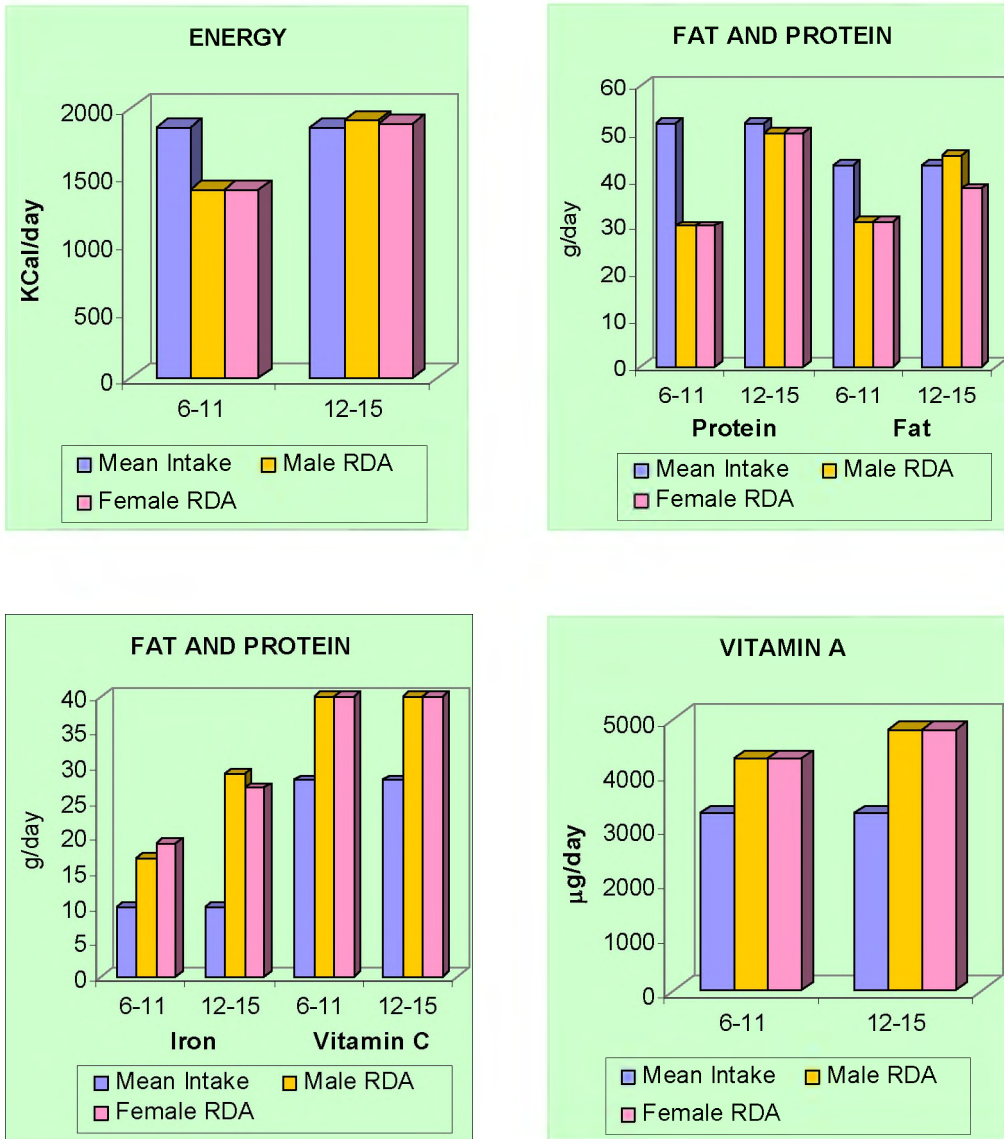


FIGURE 6
MEAN NUTRIENT INTAKE

These findings of nutrient intakes could probably suggest that the children were at risk of micronutrient deficiencies. In general, the mean levels of daily energy intake were below the RDA for 12-15 age group children, whereas protein intake was higher than the RDA for all the ages. Except protein all the nutrient intake was below the RDA's for all age groups. It may be one of the reasons for iron deficiency leading to anaemia and underweight among the selected children.

C. FORMULATION OF THE SUPPLEMENT

Humans require at least 22 mineral elements for their wellbeing (Graham *et al.*, 2007). These can be supplied by an appropriate diet. However, it is estimated that over 60 per cent of the world's 6 billion people are iron (Fe) deficient, over 30 per cent are zinc (Zn) deficient, 30 per cent are iodine (I) deficient and 15 per cent are selenium (Se) deficient. In addition, calcium (Ca), magnesium (Mg) and copper (Cu) deficiencies are common in many developed and developing countries (Thacher *et al.*, 2006).

Low cost flour blends could provide good quality vegetable protein sources in the preparation of foods and could serve to alleviate chronic protein malnutrition in underdeveloped and developing countries (Jan *et al* 2000). Grain legumes occupy an important place in human nutrition. These are rich in various nutrients particularly protein, minerals and vitamins. It is one of the additional ways of utilizing legume flours in India. As such bengal gram flour commonly consumed by the public and more relished, the present verification was therefore undertaken to explore the possibilities of using bengal gram flour in biscuits without impairing their acceptability. Pea meal is a good source of protein, fiber, starch and iron. It also contain a number of anti-nutritional factors such as phytic acid and trypsin inhibitors (Periago *et al.*, 1998)

Finger millet (Ragi) is rich in protein, iron, calcium, phosphorus, fibre and vitamin content. The calcium content is higher than all cereals and iodine content is said to be highest among all the food grains. Ragi has best quality

protein along with the presence of essential amino acids, vitamin A, vitamin B and phosphorus (Gopalan *et al.*, 2004). Thus ragi is a good source of diet for growing children.

Two varieties of cookies were formulated for the supplementation. First one with the blend of chickpea flour (bengal gram flour) and peanut flour, another one with finger millet flour and fresh banana combination.

Formulations of both cookies are discussed under the following headings:

1. Standardization of the cookies.
2. Evaluating the shelf-life

1. Standardization of the Cookies

Cookie is a baked flour confectionery dried down to low moisture content. It is principal food throughout the world which gives more nutrients than any other single food source (Bender, 1999). Cookie is mainly made from cereals, sweeteners, shortenings and leavening agents. Wheat is the most widely used cereals for cookie making in that it provides necessary gluten to the biscuit structure.

The term cookies or biscuits as they are called in many parts of the world, refers to a baked product generally containing the three major ingredients; flour, sugar and fat. They have low final water contents (1-5 per cent) (Pareyt and Delcour, 2008). Other ingredients include milk, salt and aerating agent (Olaoye *et al.*, 2007).

Most biscuits and cookies are chemically leavened baked products (Dogan, 2006). Cookies are nutritive snacks produced from unpalatable dough that is transformed into appetizing product through the application of heat in an oven. They are ready-to-eat, convenient and inexpensive food product, containing digestive and dietary principles of vital importance. Cookies are a

rich source of fat and carbohydrate, hence are energy giving food and they are also a good source of protein and minerals (Olaoye *et al*, 2007).

The sensory evaluations for standardization were done through score card and hedonic rating scale. The Tables IX, X, XI and XII express the standard fortified blend for both cookies.

TABLE IX
ORGANOLEPTIC QUALITIES OF CHICKPEA FLOUR COOKIES

Attributes	Maximum score	Chickpea flour : Wheat flour blend (100g)			Chickpea flour : Wheat flour blend Correlations		
		V ₁	V ₂	V ₃	V ₁	V ₂	V ₃
Colour	5	3.25	3.25	3.0	1	0.398	. ^a
Texture	5	3.3	3.0	2.55	1	. ^a	0.089
Taste	5	4.25	3.2	2.35	1	.0326	0.103
Flavor	5	4.1	3.25	2.3	1	0.109	0.362
Total	20	14.9	12.7	10.2			

^a Cannot be computed because at least one variable is constant.

The organoleptic evaluation of cookies was carried out by a panel of semi trained judges using 5 points scale indicating poor (1), fair (2), good (3), very good (4), and excellent (5) quality. Both the cookies were prepared in different variations on flour blends. Color is very important parameter in judging properly baked cookies. It doesn't only reflect the suitable raw material used for the preparation but also provides information about the formulation and quality of the product (Hussain, *et al.*, 2006). As it can be seen from Table X, color has been observed to be significantly affected by both temperature and blend proportion but not their interaction.

Twenty percent of adding chickpea flour was accepted. Since the maximum score of 14.9 was observed in the formulated recipe. It can be inferred that variation 1 was found to be desirable by obtaining the highest score when compared with variation 2 and 3.

TABLE X
HEDONIC RATING FOR ACCEPTABILITY OF CHICKPEA FLOUR
COOKIES

Hedonic Rating	Score	Chickpea and Peanut Cookies		
		V ₁	V ₂	V ₃
Like Extremely	9	3	1	-
Like Very much	8	16	14	13
Like Moderately	7	1	5	3
Like Slightly	6	-	-	3
Neutral	5	-	-	1
Dislike Slightly	4	-	-	-
Mean value		8.1	7.8	7.4

Cookies were prepared a day ahead of sensory evaluation and stored at room temperature. On the day of evaluation, cookies were placed in small cups labeled with three-digit random codes. Panelists were provided with distilled water and unsalted crackers to clean their mouths between samples. The cookie samples were presented in random order and panelists were asked to rate their assessment of color, aroma, taste, crispness and overall acceptability on a 1–9-point hedonic scale (1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much and 9 = like extremely). A score of 5 or below was considered a limit of acceptability for all sensory attributes tested. Cookies with 20 per cent of chickpea flour scored the maximum of 8.1 for over all acceptability.

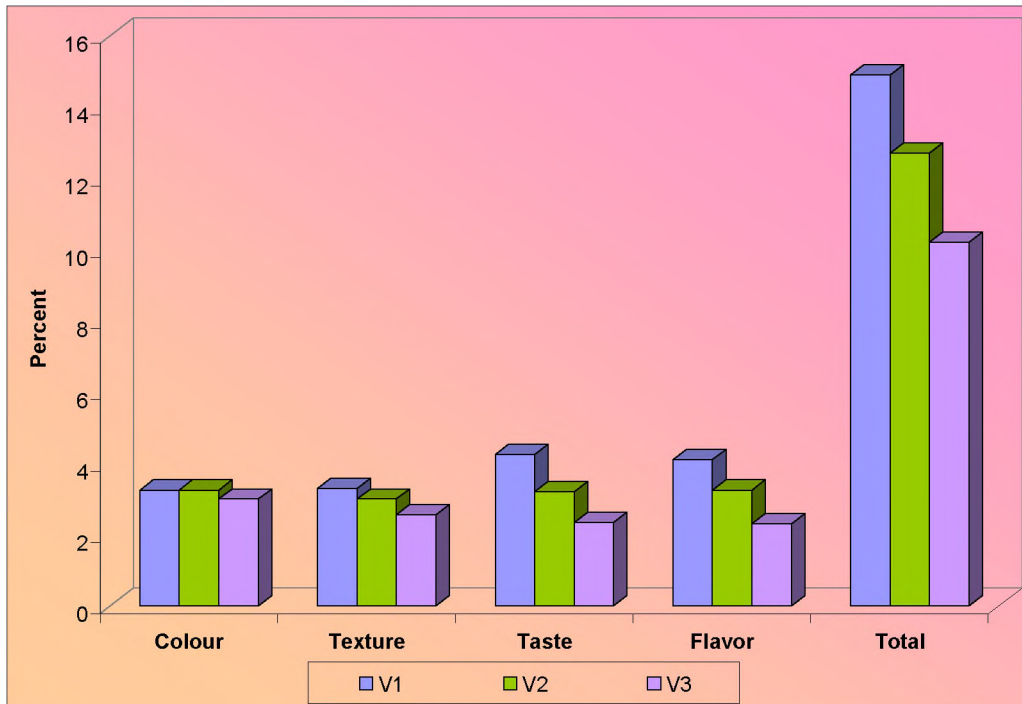


FIGURE 7
ORGANOLEPTIC QUALITIES OF CHICKPEA FLOUR COOKIES

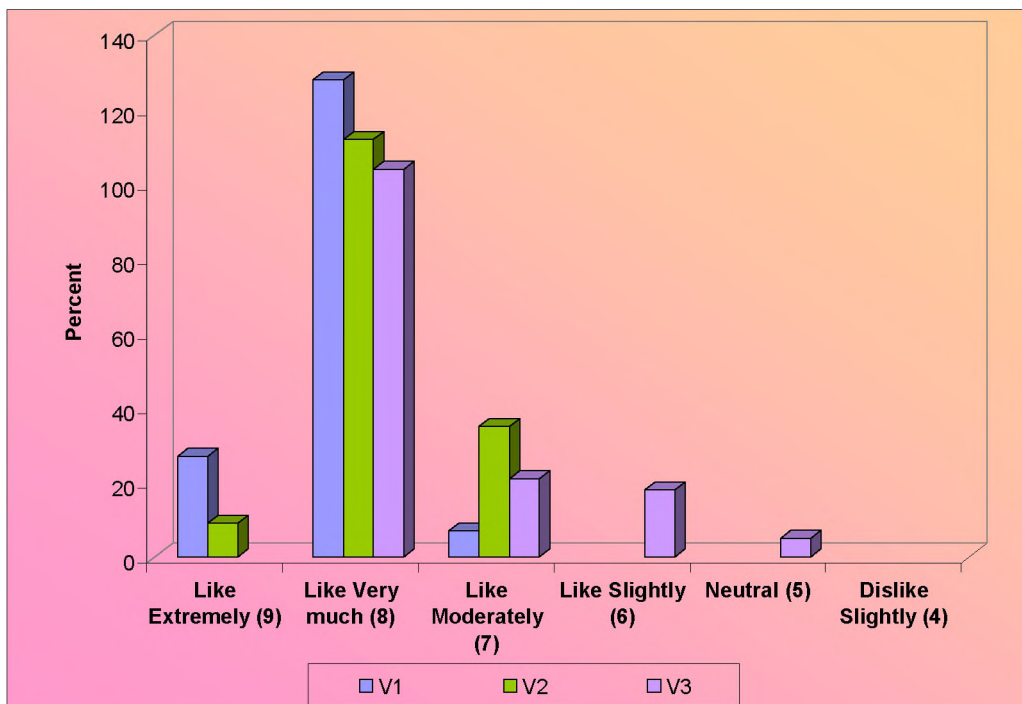


FIGURE 8
HEDONIC SCORE FOR CHICKPEA FLOUR COOKIES

TABLE XI
ORGANOLEPTIC QUALITIES OF FINGER MILLET FLOUR
COOKIES

Score	Maximum score	Finger millet flour : Wheat flour blend (100g)			Finger millet flour : Wheat flour blend correlations		
		V ₁	V ₂	V ₃	V ₁	V ₂	V ₃
Colour	5	3.0	2.7	2.25	. ^a	. ^a	. ^a
Texture	5	3.0	2.45	2.25	. ^a	. ^a	. ^a
Taste	5	3.65	3.05	2.15	1	0.016	0.016
Flavor	5	3.65	3.1	2.25	1	0.279	0.424
Total	20	13.3	11.3	8.9			

^a cannot be computed because at least one variable is constant.

The organoleptic evaluation of cookies was carried by the same way of chickpea flour cookies.

A decrease in the acceptability of the cookies colour was observed with an increase in the amount of finger millet flour in the blend. The colour of the 20 per cent finger millet flour cookie was found superior than the rest of the blends mean scoring 3.0. Flavor is the main criterion that makes the product to be liked or disliked. Flavor, as color, was observed to be significantly affected by blend proportion and temperature but not by their interaction. The mean flavor score of the cookies was found to decrease with an increase in the proportion of finger millet flour in the cookie. Since the maximum score of 13.3 was observed in the 20 per cent formulated recipe. There is no correlation between the cookies which made with different ratio of finger millet flour blend.

TABLE XII
HEDONIC RATING OF FINGER MILLET FLOUR COOKIES

Hedonic Ranking	Finger millet and Banana Cookies		
	V ₁	V ₂	V ₃
Like Extremely (9)	1	-	-
Like Very much (8)	15	12	4
Like Moderately (7)	4	3	11
Like Slightly (6)	-	4	2
Neutral (5)	-	1	2
Dislike Slightly (4)	-	-	1
Mean value	7.85	7.3	6.9

Cookies were prepared a day ahead of sensory evaluation and stored at room temperature. On the day of evaluation, cookies were placed in small cups labeled with three-digit random codes. Panelists were provided with distilled water and unsalted crackers to clean their mouths between samples. The cookie samples were presented in random order and panelists were asked to rate their assessment of color, aroma, taste, crispness and overall acceptability on a 1–9-point hedonic scale (1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much and 9 = like extremely). A score of 5 or below was considered a limit of acceptability for all sensory attributes tested.

Crispness, which is related to the formation of the spongy-like structure of the cookies, is dependent on the moisture content. Crispness fundamentally is important in determining the consumer acceptability of cookies (Pareyt and Delcour, 2008). In cookies, loss of moisture from the interior is required to produce the desired crisp texture (Fellows, 2000). Overall acceptability was affected by blend proportion and not by temperature and their interaction. A decrease in the acceptability was observed with an increase in the amount of finger millet flour in the composite flour cookie. The maximum score of 7.85 was observed in V₁ cookies.

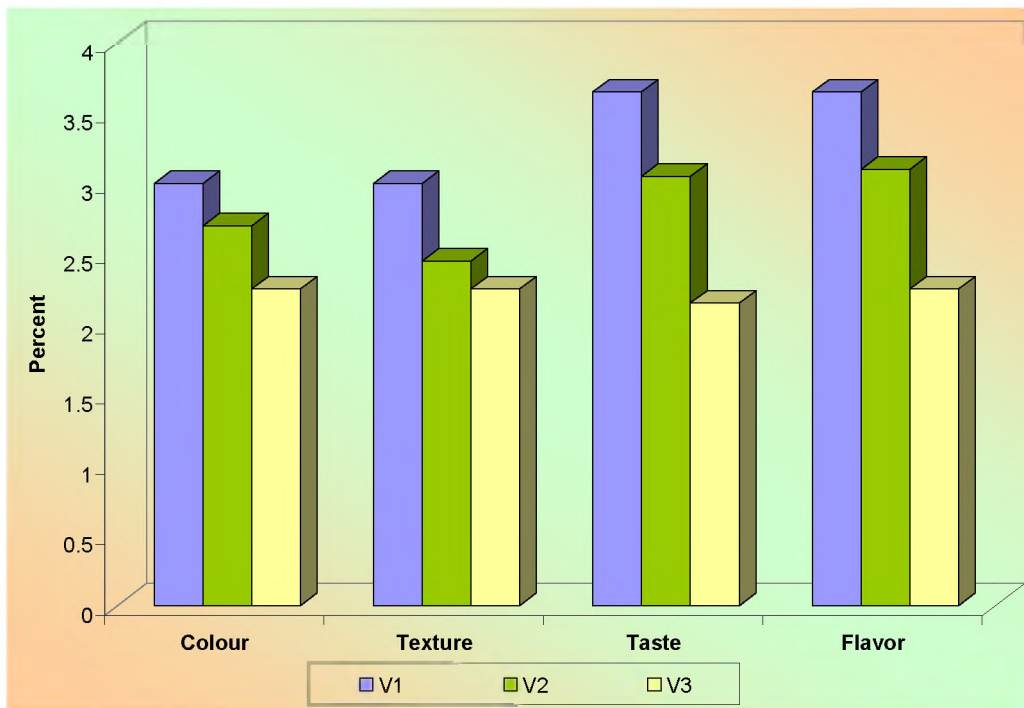


FIGURE 9
ORGANOLEPTIC QUALITIES OF FINGER MILLET FLOUR COOKIES

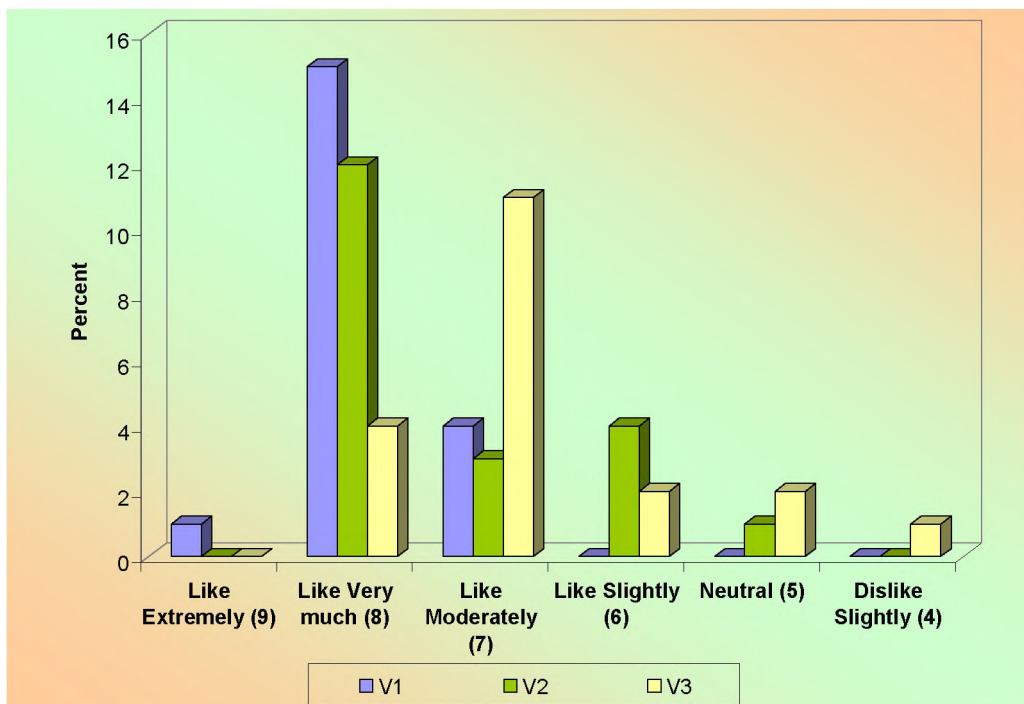


FIGURE 10
HEDONIC RATING OF FINGER MILLET FLOUR COOKIES

2. Components of Standardized Cookies

Cookies were prepared using the modified recipe for supplement shown in Table XIII.

TABLE XIII
COMPONENTS OF STANDARDIZED COOKIES

Chickpea	Amount (g)	Finger Millet	Amount (g)
Refined wheat flour	80	Refined wheat flour	80
Chickpea flour	20	Finger millet flour	20
Roasted peanut	20	Fresh banana	10
Fat	250	Fat	200
Sugar	250	Sugar	250
Baking powder	1	Baking powder	1
Salt	1	Salt	1
Yield number of portion	1	Yield number of portion	1
Weight/ portion	21g	Weight/ portion	22g
Cost/portion	5	Cost/portion	6

Table XIII expresses the components of the chickpea flour cookies. Fat is an important property in food formulations because fats improve the flavor and mouth feel of foods (Odoemelam, 2005). The fat and sugar were mixed until fluffy. Appropriate amounts of flour, baking powder, roasted grind peanut and salt were slowly introduced into the mixture. The dough was rolled and cut into circular shapes of 4 cm diameter. Baking was carried out at 150°C for 10 min. Two cookies were considered as per portion it hold 21g of net weight and cost rupees five.

Finger millet Cookies were prepared using the modified recipe for supplement cookies shown in Table XIII. The fat and sugar were mixed until

fluffy. Appropriate amounts of flour, baking powder, fresh banana and salt were slowly introduced into the mixture. The dough was rolled and cut into circular shapes of 4 cm diameter. Baking was carried out at 150°C for 10 min. Two cookies were considered as per portion it hold 22g of net weight and cost rupees 6.

3. Evaluating the Shelf-life

Biscuits are the most popular bakery items consumed nearly by all sections of the society in Egypt. Some of the reasons for such wide popularity are low cost in compared with other processed foods (affordable cost), good nutritional quality and availability in different forms, varied taste and longer shelf-life. Bakery products are sometimes used as a vehicle for incorporation of different nutritionally rich ingredients (Sudha *et al.*, 2007).

Sensory evaluation is usually performed towards the end of the product development or formulation cycle and is carried out to assess the reaction of judges towards the product and they rate the liking on a scale. Mean squares for sensory evaluation of cookies (Table XIV, XV and XVI) showed that sensoric attributes differed significantly due to treatments and storage.

**TABLE XIV
SENSORY PROFILE FOR SHELF-LIFE OF CHICKPEA FLOUR
COOKIES**

Attributes	Maximum score	Chickpea flour and Pea nut cookies			Chickpea flour and peanut cookies Correlation		
		1 st day	15 th day	30 th day	1 st day	15 th day	30 th day
Colour	5	3.25	3.0	3.1	1	. ^a	0.546*
Texture	5	3.3	3.0	2.5	1	. ^a	0.087
Taste	5	4.25	3.35	3.0	1	0.444*	0.326
Flavor	5	4.1	4.2	4.25	1	0.215	0.036
Total	20	14.9	14.6	12.8			

.^a cannot be computed because at least one variable is constant.

*. Correlation is significant at the 0.05 level.

The maximum score was obtained at 1 day by all the cookies which were significantly decreased as the storage increased. But the flavor of the chickpea flour cookies got increased from 4.1 to 4.25. No significant changes in colour were observed among both the cookies. As regarding taste of cookies, maximum score was obtained by fresh cookies (1 day) which was gradually decreased with storage days. The results concerning with the score for texture of cookies disclosed maximum score was obtained by fresh cookies (1 day) which was gradually decreased with storage days. However it is identified that the colour, taste, flavour and Crispness was retained and found to be acceptable even after 30 days. After the 30 days of shelf-life the colour is 0.05 per cent significantly correlates and after the 15 days of shelf-life the taste of the chickpea flour cookies significantly correlates at 0.05 per cent level.

TABLE XV

SENSORY PROFILE FOR SHELF-LIFE OF FINGER MILLET FLOUR COOKIES

Attributes	Maximum score	Finger millet flour and Banana cookies			Finger millet flour and Banana Correlation		
		1 st day	15 th day	30 th day	1 st day	15 th day	30 th day
Colour	5	3.0	3.0	3.0	. ^a	. ^a	. ^a
Texture	5	3.0	2.6	2.4	. ^a	. ^a	. ^a
Taste	5	3.65	3.4	2.6	1	0.016	0.016
Flavor	5	3.65	3.15	2.75	1	0.279	0.424
Total	20	13.3	12.15	10.75			

^a cannot be computed because at least one variable is constant.

The maximum score was obtained at 1st day cookies which were significantly decreased as the storage increased. No significant changes in colour were observed among both the cookies. As regarding taste of cookies, maximum score was obtained by fresh cookies (1 day) which was gradually

decreased with storage days. The results concerning with the score for texture of cookies disclosed maximum score was obtained by fresh cookies (0 days) which was gradually decreased with storage days. However it is identified that the colour, taste, flavour and crispness was retained and found to be acceptable even after 30 days. There is no significant correlation between the shelf-life of finger millet flour cookies.

Hedonic Rating for the Shelf-Life Acceptability

Cookies were evaluated for color, flavor, taste, texture, crispness and overall acceptability by trained taste panel using 9-Point Hedonic Score System with following individual scores: liked extremely-9, liked very much-8, liked moderately-7, liked slightly-6, neither liked nor disliked- 5, disliked slightly-4, disliked moderately-3, disliked very much-2 and disliked extremely-1, to find out the most suitable composition of cookies for commercialization.

TABLE XVI

HEDONIC RATING FOR THE SHELF-LIFE ACCEPTABILITY OF COOKIES

Hedonic Rating	Chickpea flour and Pea nut cookies			Finger millet flour and Banana cookies		
	1st day	15th day	30th day	1st day	15th day	30th day
Like Extremely (9)	2	1	-	-	-	-
Like Very much (8)	14	11	9	13	7	4
Like Moderately (7)	4	7	5	5	7	3
Like Slightly (6)	-	7	5	2	3	7
Neutral (5)	-	1	5	-	1	1
Dislike Slightly (4)	1	1	1	-	2	5
Mean score	7.9	7.6	7.1	7.55	6.8	6.0

Overall acceptability was determined on the basis of quality scores obtained from the evaluation of color, taste, flavor, texture and mouth feel of the cookies. Analysis of variance disclosed a highly significant effect of storage on overall acceptability of cookies. As a whole the maximum score was obtained by fresh cookies (1 day) which gradually decreased with storage days.

Overall acceptability was determined on the basis of quality scores obtained from the evaluation of color, taste, flavor, texture and mouth feel of the cookies. Analysis of variance disclosed a highly significant effect of storage on overall acceptability of cookies. As a whole the maximum score was obtained by fresh cookies (1 day) which gradually decreased with storage days.

D. QUALITY ANALYSIS OF THE SUPPLEMENT

Fortification with high protein legume flours could provide a good opportunity to improve the nutritional quality of protein consumed by many people. Also, fortification of wheat flour with non-wheat proteins increases protein quality by improving its amino acid profiles (Stark., 1993).

Biochemical analysis was done for the fresh and shelf-life cookies. The physicochemical parameters analyzed were: energy, protein, carbohydrate, fat, dietary fibre, iron calcium, vitamin-A and vitamin-C. The nutrient content of the cookies are shown in Table XVII.

1. Nutrient Content of the Formulated Cookies

TABLE XVII
NUTRIENT CONTENT OF FORMULATED COOKIES

Parameters	Chickpea flour and Peanut cookies (100g)		Finger millet flour and Banana cookies (100g)	
	Fresh	60 th day	Fresh	60 th day
Energy (kcal)	675	647	464	383
Protein (g)	8	7	9.8	7.5
Fat (g)	34	34	22	21
Carbohydrate (g)	85	79	88	61
Dietary fibre (g)	2.8	5.0	2.50	5.8
Total sugar (g)	32.0	35.0	24.0	28.0
Iron (mg)	8.0	2.0	16.0	16.0
Vitamin A (µg)	25.0	14.0	52.5	48.5
Vitamin C (mg)	2.4	0.55	14.0	2.5

During the shelf-life period all the nutrients were got decreased except total sugar and fat, vitamin C may be lost during heating.

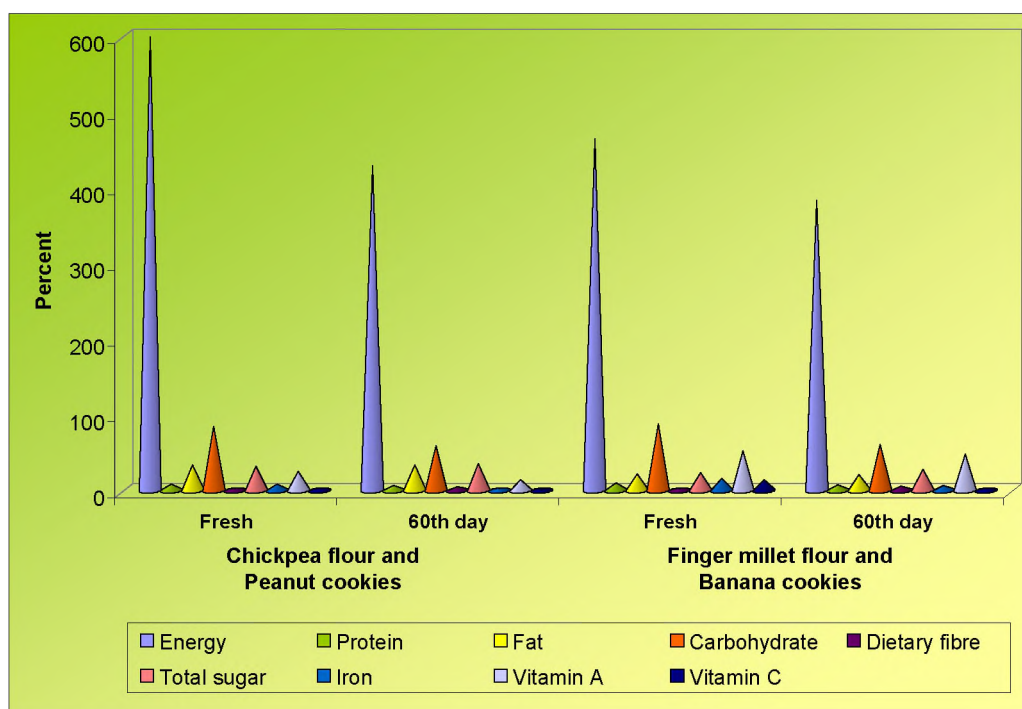


FIGURE 11
NUTRIENT CONTENT OF FORMULATED COOKIES

2. Biochemical Analysis

Water activity is defined as “free”, “unbound”, or “available water” in a system and this parameter measures the availability of water for deteriorative changes or microbial growth. This value is very important considering the development of a product, and it is an analysis of quality control and can be used for the determination of shelf-life (PHAM, 2001).

The water activity is also considered as a good indicator of the baking process and therefore many cookie industries use it as a parameter of quality. The water activity of cookies does not have an established value due to the reason that it is related to the cookie ingredients (Wedzicha, 2007; Ameer *et al*, 2007).

Water Holding Capacity (WHC) is an important functional property required in food formulations especially those involving dough handling (Oselebe *et al.*, 2008). Increase in water absorption capacity implies increase in digestibility of the starches.

Cookies are ideal for nutrient availability, palatability, compactness and convenience. They differ from other baked products like bread and cakes because of having low moisture content, comparatively free from microbial spoilage and long shelf life of the product (Oselebe *et al.*, 2008). The Table XVIII expresses the moisture and plat count of the cookies.

TABLE XVIII
MOISTURE AND MICROBIAL COUNT

Parameters	Chickpea flour and Peanut cookies		Finger millet flour and Banana cookies	
	Fresh	60 th day	Fresh	60 th day
Moisture (%)	2.19	9.75	3.81	8.5
Total microbial count	Absent	03×10 ³ cfu/g	Absent	03×10 ³ cfu/g

Microbiological evaluation, as an objective and widely used test in studying the food quality, was performed. There was no microbial content in the fresh cookies but it was found after the 60 days of shelf-life period. The moisture content was increasing according to the period of shelf-life. Tyagi *et al*, (2006), also reported that the slight increase in moisture content of mustard fortified biscuits might be due to the higher water binding capacity of mustard flour used. These cookies can be kept in a dry place with air tight packing for 2 months without any spoilage.

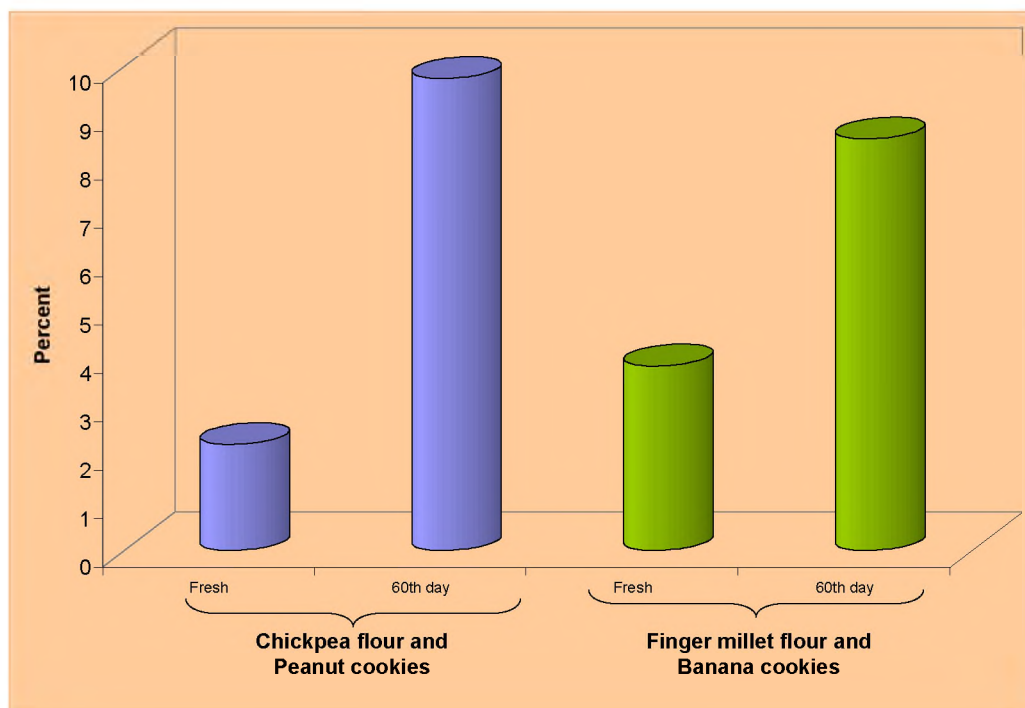


FIGURE 12

MOISTURE AND MICROBIAL COUNT

3. Nutrient Content of Cookies

The following Table XIX projects the nutrient content of formula added cookie.

TABLE XIX
NUTRIENT CONTENT OF COOKIES

Parameters	Chickpea flour and Peanut cookies (100g)	Finger millet flour and Banana cookies (100g)
	Fresh	Fresh
Energy (kcal)	62.89	48.79
Protein (g)	0.8	1.0
Fat (g)	3.57	2.31
Carbohydrate (g)	8.88	9.24
Dietary fibre (g)	0.29	0.26
Total sugar (g)	3.36	2.52
Iron (mg)	0.84	1.68
Vitamin A (µg)	2.6	5.5
Vitamin C (mg)	0.25	1.47

The mean net weight of a cookie is 10.5 g, width is 4.2 cm and the thickness is 0.6 cm. 2 cookies were given per child as supplement. Chickpea flour cookies gives 126 kcal energy, 1.6g of protein and 1.68g of iron. 98 kcal of energy, 2g of protein and 3.3g of iron per day comes from finger millet flour cookies.

E. EFFICACY OF THE VALUE ADDED SUPPLEMENTATION

The blood samples were taken from the selected samples before and after the supplementation. The progress in heamoglobin, serum albumin and total protein were assessed before and after to find out the effect of the supplementation.

1. Progress in Haemoglobin

Haemoglobin concentration alone cannot be used to diagnose iron deficiency. However, the concentration of haemoglobin should be measured, even though not all anaemia is caused by iron deficiency. The prevalence of anaemia is an important health indicator and when it is used with other measurements of iron status the haemoglobin concentration can provide information about the severity of iron deficiency (WHO/CDC,2007). Table XX and Figure 13 projects the haemoglobin profile of the children before and after the supplementation.

TABLE XX
PROGRESS IN HAEMOGLOBIN LEVEL

Reference Value of Serum Albumin (G/Dl)		BF	AF	't' Value
FEMALE	Normal 3.4 to 5.4 (g/dl)	-	-	2.6070*
	Hypoalbuminemia < 3.5 (g/dl)	10	10	
MALE	Normal 3.4 to 5.4 (g/dl)	3	3	3.0168*
	Hypoalbuminemia < 3.5 (g/dl)	7	7	

* Significant at 0.005 level (2 tailed)
BF-Before Supplementation;
AF-After Supplementation

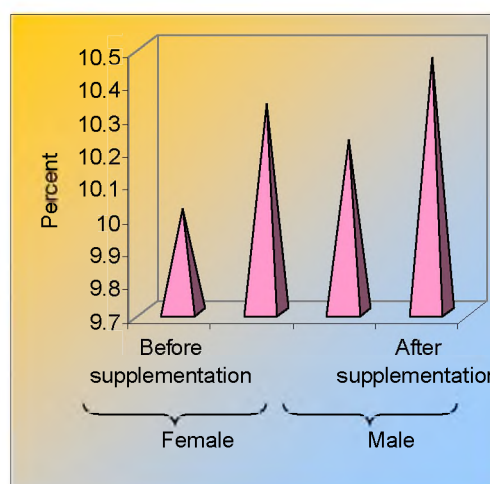


FIGURE 13

It is noted that the supplementation of cookies helped to increase the haemoglobin level of 9 children each male and female as against 5 and 7 children before and after the supplementation. So the children who were moderately anaemic became normal after the three months of supplementation. The t-value shows that the improvement of haemoglobin significant of 0.1 per cent level for both male and female.

2. Progress in Serum Albumin

Hypoalbuminemia is a medical condition where levels of albumin in blood serum are abnormally low. It is a specific form of hypo-proteinemia. Hypoalbuminemia can be caused by various conditions, including nephrotic syndrome, hepatic cirrhosis, heart failure, and malnutrition; Table XXI and Figure 12 projects the serum albumin profile of the children before and after the supplementation.

TABLE XXI
PROGRESS IN SERUM ALBUMIN

Reference Value of Serum albumin (g/dl)	Female		Male	
	Before supplement	After supplement	Before supplement	After supplement
Normal 3.4 to 5.4 (g/dl)	-	-	3	3
Hypoalbuminemia < 3.5 (g/dl)	10	10	7	7

The serum albumin level in the selected children was bellow the normal level. There was no effective change before and after the supplementation. Effort may be taken to improve the serum albumin level by extending the supplementation period.

F. IMPACT OF NUTRITION EDUCATION

Nutrition education was given to the selected 20 subjects through power point presentation and through individual interaction. The impact of nutrition knowledge was evaluated by nutrition check list. The progress in nutrition education was projected in Table XXII.

TABLE XXII
IMPACT OF NUTRITION EDUCATION

Knowledge check list	Before Education	After Education	't' value
Personal hygiene	11.8	18.6	9.9101*
Knowledge on food and nutrition	9.3	19.6	
Knowledge on nutrition deficiency	7.9	16.5	

Nutrition education programme was conducted for the selected 20 children and the progress was assessed through nutrition check list. 't'-test analysis stated that nutrition education is highly significant.

V. SUMMARY AND CONCLUSION

Childhood malnutrition remains as a major public health problem worldwide and has been widely recognized as an important risk factor for child mortality. Nutrition is a basic human need it remains unmet for vast number of children, the latter who are thus unable to achieve their full genetic development potential, due to malnutrition.

Orphans are amongst the most vulnerable group of a country's population, it can be expected that nutrition deficiencies are magnified in orphanages. Critical nutrient deficiencies in early life put children at risk for brain mal-development, other significant developmental and growth delays, and a host of medical conditions. Most of the orphanages have problems in food consumption pattern, kitchen facilities and staff skills, which may due to insufficient funding for nutritional needs, deficient knowledge of sound budgeting and cost control, inappropriate methods of food procurement, no standardized food preparation method, absence of specific menu, untrained caregivers in food service, inadequate and absolute kitchen equipments.

In recent years, nutrition and immunology are increasingly becoming interrelated disciplines. Micronutrient deficiency is associated with an impairment of immune responses and increased susceptibility to infections like respiratory tract infections and skin infections especially in children.

Supplements help the child to overcome nutritional deficiencies. Children need all the nutrients in their proper amounts for optimum health. Since their diets most likely cannot provide all of them, nutritional supplements can fill in those gaps. Nutritional supplements also help boost their immune system. The stronger their immune system, the most resistant of body can be against disease.

Biscuits, cookies, cakes are widely consumed that have relatively long shelf life and good eating qualities. Such qualities of food products make large

scale production and distribution possible, in the shortened period. Biscuits can be easily fortified with protein rich flours to provide convenient food in order to supplement protein in the diet.

Keeping these in mind, the objectives of the study was focused to identify the pressing nutritional deficiencies impeding the orphanage children, formulate value added cookies for supplementation and assess its impact among anaemic underweight children.

A total of 170 children constituting 80 male and 90 female children were purposively chosen in the age group of 6-15 years. All the children in the orphanages were included and studied so as to determine their nutrition status and food consumption pattern. Among them 20 children consist of 10 girls and 10 boys who were randomly selected as sub sample for the supplementation study.

The study is undertaken to examine the nutritional status, food consumption patterns, dietary intakes, anthropometry measurement, clinical and biochemical examinations of the orphanage children.

Beneficial ingredients were added in formulated cookies. Cookies were prepared using blend of wheat flour, chickpea flour and finger millet flour in different proportions. The standard one was selected based on sensory evaluation. It was administered to anaemic and underweight children and observed its impact. Nutrition knowledge was assessed before and after nutrition education.

The salient findings of the study are summarized below:

- Participation rate of females was 52.8 percent, while males were 47.2 percent. Among them major contribution was from 12-13 years age group.
- Education to all the children were provided to selected orphanages.
- The food offered to all children in the orphanages were adequate.

- All the children watched television daily. Cultural and religious functions are an important aspect of life at the Home. Daily prayer in morning and evening were compulsory.
- Only one girl between six to seven years had defect in her auditory, one boy among eight to nine years and two girls between 10 to 11 years had problem with emotional and social behavior. Two girls were identified with the history of speech and language problem. This is one percent of the selected samples.
- It is observed that 78 percent of children were having regular health and dental checkups and 94 percent of the children were rarely getting worm treatments. None of them had vaccination.
- It is evident that compared to female, male were more prone for risk of underweight. However 14.4 percent and 13.3 percent of female children were underweight against, 3.75 percent and 1.25 percent of male children in the age group of 12-13 and 14-15 years were underweight respectively.
- Clinical assessment revealed that 21.8 per cent children were prone to iron deficiency, possibilities for protein-energy deficiency was 27.8 per cent. The least percent of eight and 3.5 percent of children had vitamin C and vitamin A deficiency signs. In general, 8-13 years were the more affected compared to other age groups.
- Twenty percent of adding chickpea flour was accepted. Since the maximum score of 14.9 out of 25 scores was observed in the formulated chickpea flour cookie.
- Based in hedonic rating also cookies with 20 per cent of chickpea flour scored the maximum of 8.1 for over all acceptability

- The mean flavor score of the cookies was found to decrease with an increase in the proportion of finger millet flour in the cookie as the maximum score of 13.3 was observed in the 20 per cent formulated recipe.
- A decrease in the acceptability was observed with an increase in the amount of finger millet flour in the composite flour cookie. The maximum score of 7.85 was observed in V1 cookies.
- The results concerning with the score for texture of cookies disclosed maximum score was obtained by both fresh cookies (1 day) which was gradually decreased with long storage days. However it is identified that the colour, taste, flavour and crispiness were retained and found to be acceptable even after 30 days.
- There was a slight difference in the nutrient content during storage period except total sugar, dietary fibre and iron.
- The moisture content was increasing according to the period of shelf-life. These cookies can be kept in a dry place with air tight packing for 2 months without any spoilage.
- There is no significant changes in three variations of chickpea flour cookies.
- There is no correlation between the cookies which made with different ratio of finger millet flour blend.
- After the 30 days of shelf-life the colour is 0.05 per cent significantly correlates and after the 15 days of shelf-life the taste of the chickpea flour cookies significantly correlates at 0.05 per cent level.
- There is no significant correlation between the shelf-life of finger millet flour cookies.
- 't'-test analysis stated that nutrition education is highly significant.

- Supplementation of two cookies weighing ---g was given to children. Chickpea flour cookies gives 126 kcal energy, 1.6g of protein and 1.68g of iron. 98 kcal of energy, 2g of protein and 3.3g of iron per day which derived from finger millet flour cookies.
- Supplementation of cookies promoted the haemoglobin level of 9 children. It is also noted that the children who were moderately anaemic became normal after three month of supplementation.
- After the nutrition education the knowledge on food and nutrition was gained.

CONCLUSION

The present study was undertaken to develop iron and protein rich health products using locally available legumes and millets which are commonly consumed by the population and taking into consideration its nutritional importance, these food crops could be further fortified to enrich their nutrient content. The acceptability of the value added cookies were evaluated and the most acceptable one was supplemented to the selected 20 children. The findings of the present study revealed the beneficial effects of the value added health products on anaemic and underweight children of school going orphans.

Nutritional assessment was carried out by the investigator to a certain extent, identified the causes for iron deficiency and underweight through physical assessment and food frequency questionnaires. The nutrition education given by the investigator to the selected children proved to be beneficial through the proper intake of food and the increment in the heamoglobin levels and serum albumin of the selected subjects through the supplementation of value added cookies. Thereby this study revealed a positive impact of value added cookies supplementation in combating anaemia and underweight among school going orphans.

RECOMMENDATIONS

In view of the results of this study, the use of chickpea-wheat flour blend and finger millet-wheat flour blend in cookie formulation appeared to be promising from nutritional, quality, acceptability and economical point of view.

Therefore, the following recommendations are made:

- The use of chickpea flour and finger millet flour in cookie production by substituting with wheat flour should also be encouraged and advocated since it has protein, iron and dietary fibre which make it a very good supplement for children and adults.
- A comprehensive study on optimization of ingredient and baking condition and shelf life stability of baked products of wheat flour blended with other cereals, legumes and seeds should be conducted to come up with complete and usable information.
- Banana flour can also be incorporated in developing value added cookies owing its nutritious benefits and also its appetizing flavour.
- Other fruits which are easily available can also be incorporated in value added cookies.
- Other bakery products can also be developed with easily available and low cost fruits, millets, legumes and seeds.

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AVINASHILINGAM DEEMED UNIVERSITY FOR WOMEN COIMBATORE-43

QUESTIONNAIRE ON NUTRITIONAL STATUS AMONG SCHOOLGOING ORPHANS AND EFFICACY OF VALUE ADDED COOKIES

I. DEMOGRAPHIC DATA

Name of the institution:

Address:

A. Personal details of the children

1. Name :
2. Age:
3. Gender :
4. Religion :

B. Educational status

1. Does the child goes to school: Yes No

2. If yes

Name of the school:

Class :

C. Menu pattern followed in the home

Time/Menu pattern	Cycle menu	Desirous menu	Any other
Breakfast			
Lunch			
Evening tea			
Dinner			

D. Adequacy of food

Adequacy of Food/ Menu		Breakfast	Lunch	Evening Tea	Dinner
Quantity	Adequate				
	Fairly adequate				
	Inadequate				
Quality	Good				
	Fair				
	Poor				

E. Recreation and other activities

- Does the child goes for any tutorial classes or do have inside premises:
Yes No
- Does the child learn music or any other instruments:
Yes No
- Does the child participate in any games or plays in the park:
Yes No
- Does the child watch television or listen to the radio:
Yes No
- Does the child go for computer classes:
Yes No
- Does the child participates in the prayer:
Yes No
- If there any other activities:

F. Medical history

- Does the child suffering from
Asthma : Mild Moderate Severe
Diabetes: Type 1 Type 2
- Does the child suffer from any food allergy : Yes No
- Does the child suffered from diarrhoea
During the last six month : Yes No
- Does the child under go any medication Yes No
- Does the child have any nutritional
Supplementation Yes No
- Does the child have any of the following problem which may adversely affect the child's education:
 1. Vision
 2. Physical Dysfunction
 3. Auditory
 4. Emotional/ Social Behavior
 5. Speech/ Language

G. Health care

- Health checkup for the child per week or month:
Yes No
- Dental care per month or once in 6 month:
Yes No

- Worm treatment once in 6 month or per year:

Yes No

- Vaccination:

Yes No

II NUTRITIONAL ASSESSMENT

A. Anthropometric Measurements:

Weight (kg) :

Height (cm) :

Body Mass Index :

B. Physical examination:

1. Hair

- | | | | |
|--------------------------|--------------------------|--------------------|--------------------------|
| a. Dull | <input type="checkbox"/> | e. Dry | <input type="checkbox"/> |
| b. Lack of natural shine | <input type="checkbox"/> | f. Thin | <input type="checkbox"/> |
| c. Colour change | <input type="checkbox"/> | g. Loss of curl | <input type="checkbox"/> |
| d. Easy plucked | <input type="checkbox"/> | h. DE pigmentation | <input type="checkbox"/> |

2. Eye

- | | | | |
|----------------------|--------------------------|-----------------|--------------------------|
| a. Pale eye membrane | <input type="checkbox"/> | c. Dry membrane | <input type="checkbox"/> |
| b. Night blindness | <input type="checkbox"/> | d. Gray spots | <input type="checkbox"/> |

3. Gum

- | | | | |
|-------------|--------------------------|------------|--------------------------|
| a. Bleeding | <input type="checkbox"/> | b. Redness | <input type="checkbox"/> |
|-------------|--------------------------|------------|--------------------------|

4. Face

- | | | | |
|------------------------------------|--------------------------|-----------|--------------------------|
| a. Moon face | <input type="checkbox"/> | b. Pallor | <input type="checkbox"/> |
| c. Scaling of skin around nostrils | <input type="checkbox"/> | | |

5. Nails

- | | | | |
|-----------------|--------------------------|------------|--------------------------|
| a. Fragility | <input type="checkbox"/> | b. Bending | <input type="checkbox"/> |
| c. Spoon-shaped | <input type="checkbox"/> | | |

6. Skin

- | | | | |
|-------------------|--------------------------|---|--------------------------|
| a. Dryness | <input type="checkbox"/> | d. yellow colored | <input type="checkbox"/> |
| b. Sandpaper feel | <input type="checkbox"/> | e. Pallor | <input type="checkbox"/> |
| c. Flakiness | <input type="checkbox"/> | f. Swollen and dark of fat under bilateral oedema | <input type="checkbox"/> |

III DIETARY ASSESSMENT

A. Food providing in the home

1. Vegetarian diet
2. Non-vegetarian diet
3. Vegetarian diet with egg

B. Does the child like the food providing

Yes

Fair

No

C. Food habits/ Food Frequency Record

FOOD ITEMS	DAILY	WEEKLY ONCE	WEEKLY TWICE	WEEKLY THRICE	OCCASIONALLY
Cereals					
Pulses					
Roots and tubers					
Green leafy vegetables					
Other vegetables					
Fruits					
Nuts and oil seeds					
Fats and oils					
Deep fried food					
Milk and milk product					
Sugar and Jaggery					
Fish/ sea food					
Chicken					
Mutton					
Cool drinks					
Chocolates/ ice-cream					
Tin food/ junk food					
Others					

APPENDIX II

FREQUENCY CONSUMPTION OF FOOD BY THE SELECTED ORPHAN CHILDREN

Food Items	Daily	Weekly 2 days	Weekly 3 days	Occasionally	Total
Cereals	170	-	-	-	170
Pluses	132	20	18	-	170
Roots and tubers	170	-	-	-	170
Green leafy vegetables	18	20	132	-	170
Other vegetables	170	-	-	-	170
Fats and Oils	170	-	-	-	170
Milk and milk products	170	-	-	-	170
Sugar and Jaggery	170	-	-	-	170
Deep fried food		132	38	-	170
Fruits	152	18	-	-	170
Chocolates/ ice-cream	-	-	-	170	170
Cool drinks	-	-	-	170	170
Fish/ sea food	-	20	18	-	38
Chicken	-	20	-	18	38
Mutton	-	-	-	20	20
Eggs	-	38	-	-	38
Nuts	170	-	-	-	170
Tin foods/ junk food	-	-	-	20	20
Others	-	-	-	-	-

The data in table 2 indicate, the the most frequently consumed food items per month. Cereals, vegetables, fats and oils, milk and milk products, sugar and jaggeri and nuts are daily included in the food preparation. Fruits were consumed daily by 152 of the selected samples. 132 of the selected children include deep fried foods twice in a week. Occasionally they are having chocolates or ice-cream and coo drinks. 38 children were taking non-vegetarian food groups.

APPENDIX II

Appendix II: KNOWLEDGE CHECK LIST

1. Personal Hygiene

1. Do you wash your hands before eating?
 - a. Yes
 - b. No
2. Do you cut finger nails regularly?
 - a. Yes
 - b. No
3. Do you walk barefooted outside the home?
 - a. Yes
 - b. No
4. Do you brush your teeth before going to bed?
 - a. Yes
 - b. No
5. Do you wash fruits and vegetables before consumption?
 - a. Yes
 - b. No

II. Knowledge on food and nutrition

6. Yellow and orange colour of foods will keep eyes health?
 - a. Yes
 - b. No
7. A child who eats all vegetables and fruits is free from diseases?
 - a. Yes
 - b. No
8. Do you know about sources of iron?
 - a. Yes
 - b. No
9. Do you know lack of green leafy vegetables in the diet will lead to deficiency disease?
 - a. Yes
 - b. No
10. Do you know vitamin C fruits help in absorption of iron?
 - a. Yes
 - b. No
11. Do you know tea and coffee drinking immediately after eating inhibit iron absorption?
 - a. Yes
 - b. No
12. Do you know about sources of protein?
 - a. Yes
 - b. No
13. Do you know legumes and meat are rich in protein?
 - a. Yes
 - b. No
14. Do you know drinking milk is good for growth?
 - a. Yes
 - b. No
15. Do you know soybean and bengal are a good protein source?
 - a. Yes
 - b. No

III. Knowledge on nutrition deficiency

16. Do you know about hemoglobin?

- a. Yes b. No

17. Do you know your hemoglobin level?

- a. Yes b. No

18. Do you know normal hemoglobin level of the individual?

- a. Yes b. No

19. Do you know about iron?

- a. Yes b. No

20. Do you know about importance of iron?

- a. Yes b. No

21. Do you know about functions of iron?

- a. Yes b. No

22. Do you know about anaemia?

- a. Yes b. No

23. Do you know causes of anaemia?

- a. Yes b. No

24. Do you know about symptoms of anaemia?

- a. Yes b. No

25. Do you know iron and folic acid tablets prevent anaemia in children?

- a. Yes b. No

26. Do you know about protein?

- a. Yes b. No

27. Do you know about importance of protein?

- a. Yes b. No

28. Do you know about functions of protein?

- a. Yes b. No

29. Do you know your weight for age?

- a. Yes b. No

30. Do you know lack of protein intake will lead to underweight?

- a. Yes b. No

TABLE VI
CLINICAL SIGNS OBSERVED AMONG SELECTED SAMPLES

Age in Years		6-7				8-9				10-11				12-13 ears				14-15				Total			
Clinical Signs		F	%	M	%	F	%	M	%	F	%	M	%	F	%	M	%	F	%	M	%	F	%	M	%
Hair	Dull	-	-	2	1.2	-	-	-	-	-	-	1	0.6	3	1.8	-	-	2	1.2	-	-	5	5.5	3	3.8
	Lack of natural shine	-	-	-	-	1	0.6	1	0.6	1	0.6	1	0.6	2	1.2	3	1.8	3	1.8	-	-	7	7.7	5	6.2
	Colour change	-	-	-	-	-	-	-	-	2	1.2	-	-	1	0.6	-	-	-	-	-	-	3	3.3	-	-
	Dry	-	-	1	0.6	4	2.4	1	0.6	3	1.8	4	2.4	5	3.0	2		1	0.6	-	-	13	14.5	8	10
	Thin	-	-	2	1.2	1	0.6	-	-	3	1.8	-	-	-	-	-	-	2		-	-	6	6.6	2	2.5
Eye	Pale eye membrane	3	1.8	-	-	5	3.0	2	1.2	12	7.4	6	3.6	4	2.4	3	1.8	2	1.2	-	-	26	28.8	11	13.7
Gum	Bleeding gum	-	-	-	-	1	0.6	1	0.6	2		2	1.2	-	-	1		-	-	-	-	3	3.3	4	5
Nail	Fragility	-	-	-	-	2	1.2	-	-	1	0.6	2	1.2	1	0.6	-	-	-	-	-	-	4	4.4	2	2.5
Skin	Dry	1	0.6	-	-	1	0.6	-	-	3	1.8	3	1.8	-	-	1	0.6	1	0.6	2	1.2	6	6.6	6	7.5

DIETARY MODIFICATION

- Iron is the most important mineral that is required in the formation of red blood cells in the body. In the absence of iron, body is unable to produce required amount of red blood cells. This makes the person anemic.
- Some of the best and reliable sources of iron are eggs, poultry, legumes, fortified cereals, fresh green leafy vegetables, etc.
- Vitamin B12 is also very essential for the synthesis of iron and production of red blood cells. If your body is not getting enough of this then it can decrease the count of RBC in the body.
- Provide sufficient amount of vitamin B12 in the form of dairy products, eggs and fish.
- Folic acid or foliate is also very essential in the formation of the red blood cells in the body.
- Folic acid is found mainly in beans, mushrooms, leafy vegetables and fruits. Consume them adequately to get required amount of folic acid.



Excellent Sources	
Cereals	Other Vegetables
Rice, flakes Samai Bajra Ragi	Lotus stem Sundakai, dry
Pulses & Legumes	Nuts & Oil Seeds
	Kattelu Coconut meal, deoiled
Bengal gram, roasted Lentil Soyabean Peas, dry	Fruits
	Dates, dried Currants, black Melon, water Raisins
Leafy Vegetables	Fish
Amaranth Cauliflower Colocasia leaves Thauasai muningai Manathakkali leaves Parsley Radish leaves	Dry fish
	Meat & Poultry
	Beef, meal Sheep, liver
	Milk
	Skimmed Buffalo milk



IRON DEFICIENCY ANAEMIA

“PREVENTION IS BETTER THEN CURE”

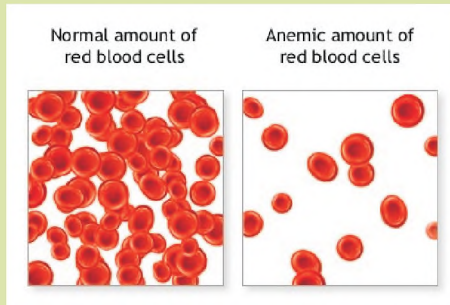


BY
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IRON DEFICIENCY ANAEMIA

Anemia is a condition in which the red blood cells within the blood fall below the normal count. The main reason for this condition is deficiency of iron in the body. People who consume balance diet rich in all essential nutrients usually don't suffer from this disease.



Anemia is characterized into three types depending upon the severity of the disease.

Three different forms of anemia are:

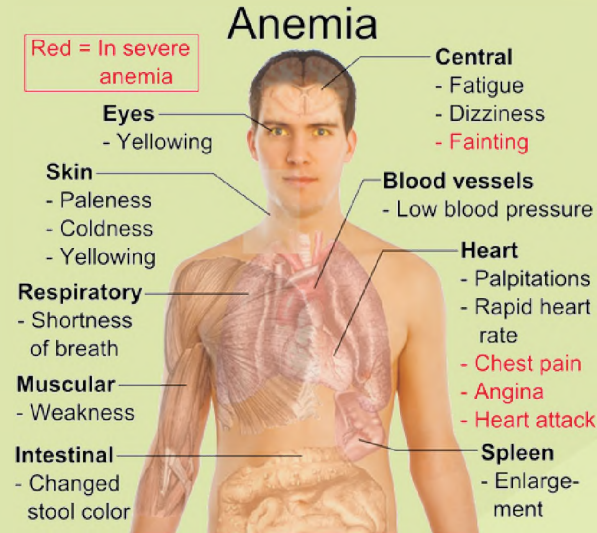
- Mild,
- Short-term and
- Chronic anemia

CAUSES OF ANAEMIA

The main causes of anaemia are:

- ⬢ Dietary deficiency
- ⬢ Due to hook worm infestation-occult blood loss
- ⬢ Inflammatory bowel disease
- ⬢ Neglect of female child
- ⬢ Chronic diarrhoea may be associated with considerable unrecognized blood loss.
- ⬢ Excess blood loss during menstruation.

SYMPTOMS



SIGNS OF IRON DEFICIENCY ANEMIA

- ⬢ Feeling tired and weak
- ⬢ Decreased work and school performance
- ⬢ Slow cognitive and social development during childhood
- ⬢ Difficulty maintaining body temperature
- ⬢ Decreased immune function, which increases susceptibility to infection
- ⬢ Glossitis (an inflamed tongue)

RISK FACTORS

Diet: A diet that lacks iron, folic acid, or vitamin B₁₂ can prevent body from making enough red blood cells. Body also needs small amounts of vitamin C,

riboflavin, and copper to make red blood cells.

Conditions that make it hard for body to absorb nutrients also can prevent your body from making enough red blood cells.

Hormones: Body needs the hormone erythropoietin) to make red blood cells. This hormone stimulates the bone marrow to make these cells. A low level of this hormone can lead to anemia.

PREVENTIVE MEASURES

Nutrition Education

- ⬢ Encourage to include greens in diet.
- ⬢ Use of iron acquired foods during processing like rice flakes and dry fruits.
- ⬢ Regular consumption of foods rich in vitamin-C
- ⬢ Promotion of home gardening



Supplementation

- ⬢ In case of severe conditions, iron supplements can meet the urgent requirement of body.
- ⬢ Supplements with ascorbic acid are essential.
- ⬢ Treating anemia with natural supplements is always better.

