Methodology

III METHODOLOGY

The methodology pertaining to the study on "Acceptability and Supplementation of Red Palm Oil on Selected Target Groups" involved the following three phases:

PHASE I : IDENTIFICATION OF RECIPES FOR ACCEPTABILITY TRIALS

A. Selection of the area and subjects

B. Formulation of the tools

C. Conduct of household and market survey

PHASE II : SENSORY EVALUATION OF RECIPES

A. Selection of the taste panel members

B. Formulation of the score card

C. Conduct of acceptability trails

D. Selection of recipe for supplementation

PHASE III : MAPPING OF GIRLS FOR SUPPLEMENTATION STUDIES

A. Selection of area

B. Selection of subjects

C. Conduct of socio-economic survey

PHASE IV : SUPPLEMENTATION STUDIES WITH RED PALM OIL

A. Formulation of Red palm oil supplements

B. Supplementation of Red palm oil on selected target groups

C. Nutrient content of the supplement

D. Assessing the effect of Red palm oil on nutritional status of selected target groups

E. Nutritional anthropometry – Height and weight

F. Individual dietary intake

G. Clinical Examination

H. Biochemical Estimation

a) Blood Haemoglobin

b) Serum Total Protein and Albumin

c) Serum Retinol

A. Analysis and Interpretation of Data

PHASE I : IDENTIFICATION OF RECIPES FOR ACCEPTABILITY TRIALS

A. Selection of the area and subjects

As the investigator was a resident of Coimbatore city the target groups of adult women were selected from the three prominent residential areas of Coimbatore namely Saibaba Colony, Ramalingam Colony, Rathinapuri and two villages namely Govanoor and Narashimanaickenpalayam of Periyanaickenpalayam block.

Using the systematic random sampling technique, the target groups of adult women were selected for the study. Every third house in the target area was surveyed and all the adult women subjects in the selected houses were included in the study, till the required number of subjects were selected. A total of 400 subjects comprising of 200 rural and 200 urban women were identified for household survey.

B) Formulation of the tools

According to Kothari (2004), the interview schedule is a proforma containing a set of questions and are very useful in gathering information. It is generally filled by the researchers or the enumerators who are specially appointed for this purpose.

Therefore, Interview schedule I (Appendix I) was used for household survey for the collection of information from all the selected subjects about their socio-economic profile, dietary pattern, consumption of fats and oils and commonly consumed food preparations by the selected households. Interview schedule II for market survey was used to gather information from the selected eating outlets (Appendix II) which comprised of questions pertaining to the availability of sweet and savoury items and types and quantity of fats and oils used in their preparations. All the subjects were personally interviewed and the relevant data were collected. Maximum reliability of the data was ensured by questioning and cross questioning the subjects.

C. Conduct of household and market survey

Household and market survey were conducted to identify the commonly consumed food preparations in the families of 200 rural and 200 urban families in the selected areas of Coimbatore. The investigator visited the subjects personally and collected information using the interview schedule I.

A market survey was conducted by interview cum observation method using Interview schedule II (Appendix II). Food items available in five famous eating outlets located in three commercial areas of Coimbatore city namely Gandhipuram, R.S Puram and Saibaba colony where fast foods and eating outlets were well established. The factors considered for the identification of these food preparations were the ease of preparation, taste, familiarity, suitability to one's dietary pattern, economical viability and nutritional adequacy. The commonly consumed food preparations identified through household and market survey are listed below.

Rice Preparations – Coconut rice, lime rice, tamarind rice, vegetable rice, venpongal and broken rice preparations like dosai, uthappam, adai, pesarattu and uppuma.

Wheat Preparations – Chapathi, paratha, puri, uppuma and wheat flour dosai.

Dhal Preparations – Onion sambar, drumstick sambar, radish sambar, snake gourd kootu and amaranth kootu.

Vegetable Preparations – Ladies finger poriyal, amaranth poriyal, bean poriyal, ridgegourd poriyal and cabbage poriyal.

Savoury items – – Black gram dhal vadai, bengal gram dhal vadai, potato bonda, plantain bajji, onion pakoda, omapodi, ribbon pakoda, potato chips, murukku and somasa. potato cutlet, vegetable omelette, brinjal fry, dhal usili, yam fry.

Sweet items – Boondi ladoo, cheedai, sian, gulab jamoon, banana fritters, kesari, boli, mysorepak, green gram dhal payasam and wheat halwa. Roasted bengal gram ladoo, green gram dhal ladoo, soya flour ladoo, rava ladoo and wheat flour ladoo.

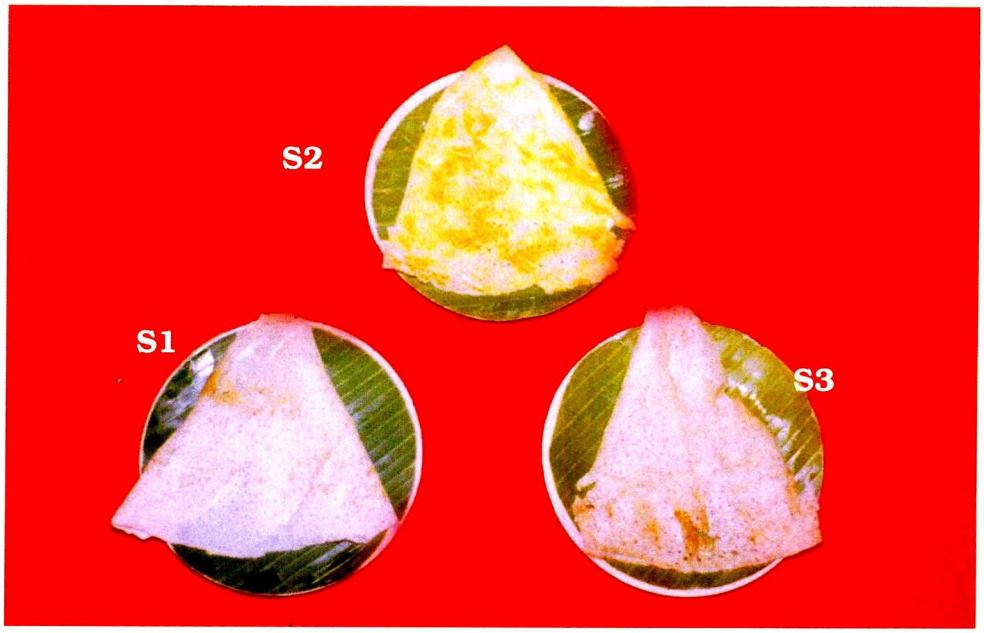
Baked (Sweet) items – Cake, coconut bun, pastry, bread pudding and bread.

Baked (Savoury) items - Vegetable pizza, masala bun, stuffed kulcha, vegetable puff and pancake.

Egg preparations - Scrambled egg, egg omelette, egg kuruma, bombay bread toast and egg noodle.

All the above listed items were prepared using Red palm oil, sunflower oil and refined groundnut oil (Plate I-VI) in the same quantities as used in standard recipes and evaluated for acceptability.

The required quantity of Red palm oil for the entire study was imported through proper channel from Malaysian Palm Oil Promotion Council, Malaysia, where the palm oil production is very high and available in the pure form without any adulterants. The council is also involved in research related to nutrition and health benefits of Red palm oil.



S1 – Sunflower oil **S2 – Red palm Oil** **S3 – Refined Groundnut Oil**

PLATE I : DOSA

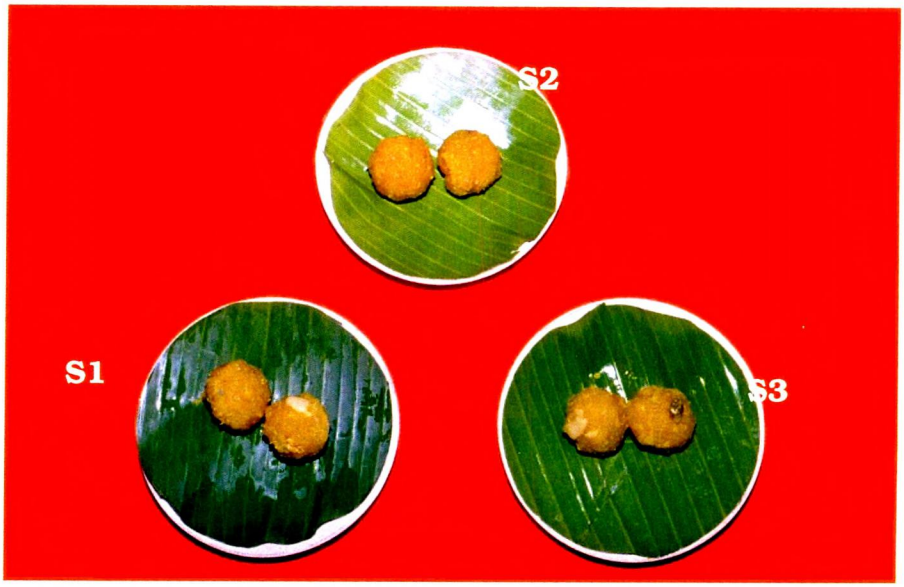
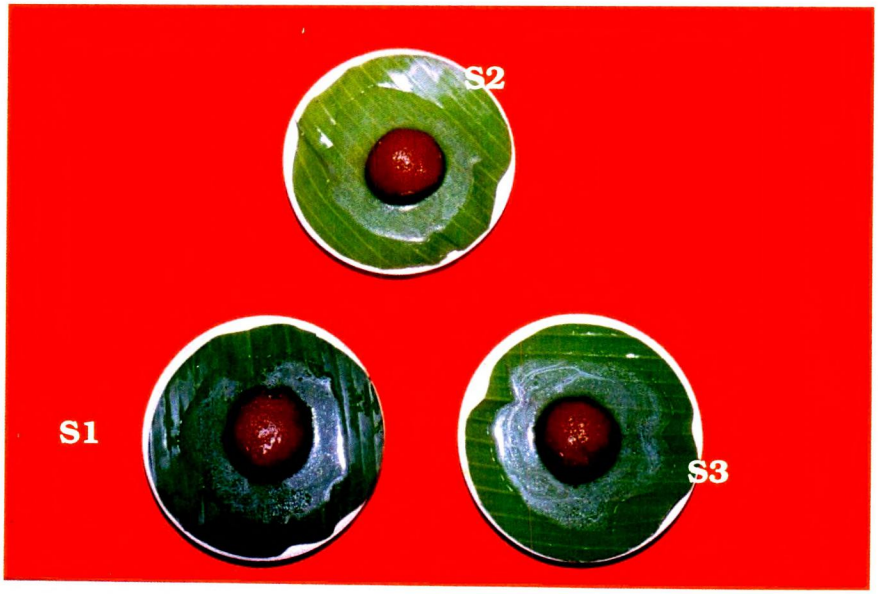


PLATE IIA : BOONDI LADDOO



S1 – Sunflower oil S2 – Red palm Oil S3 – Refined Groundnut Oil

PLATE IIB : GULAB JAMUN

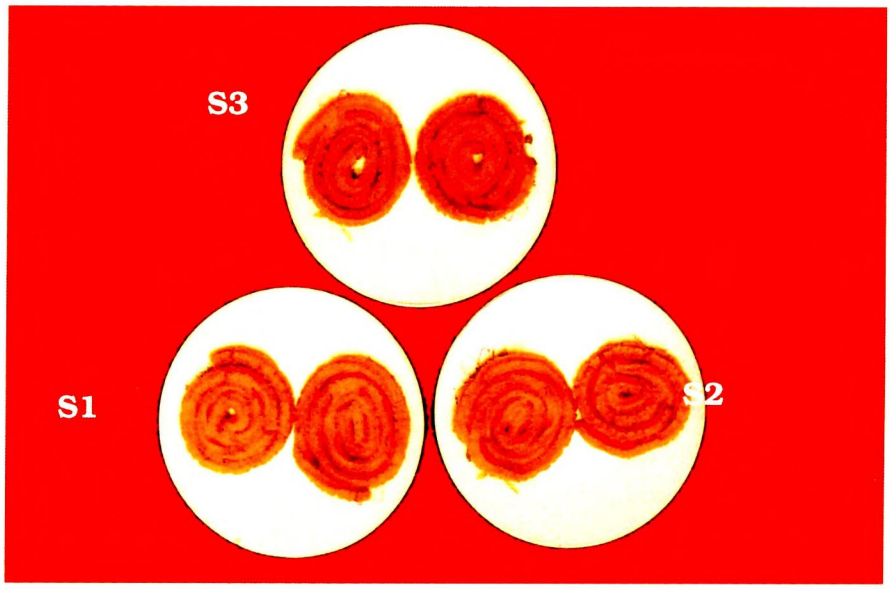
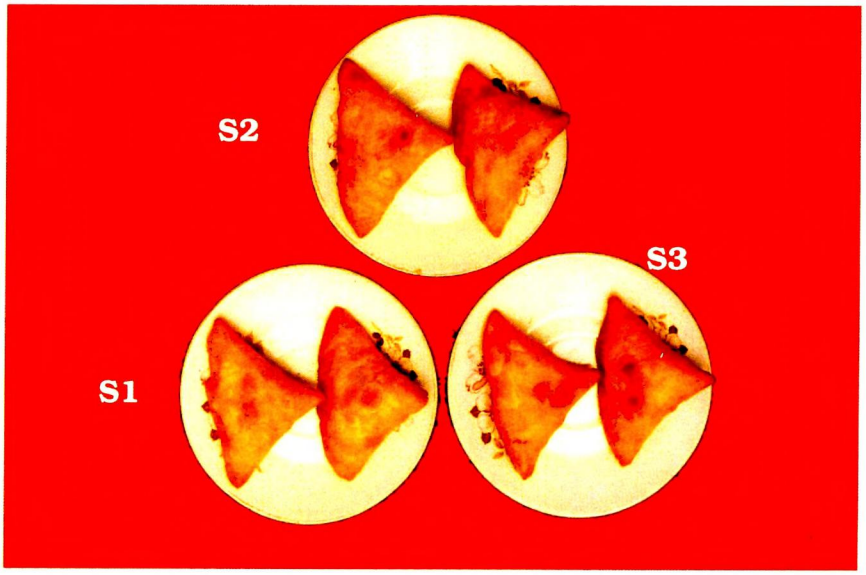
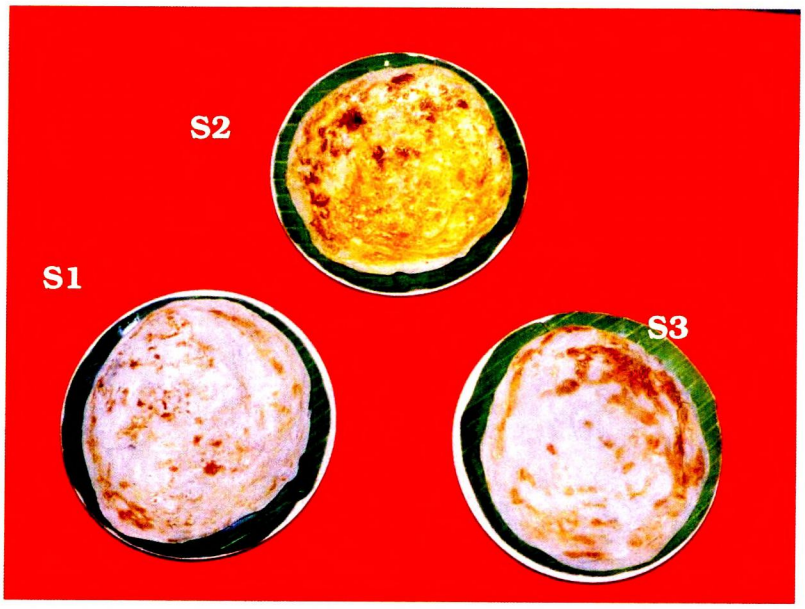


PLATE IIIA : MURUKKU



S1 – Sunflower oil **S2 – Red palm Oil** **S3 – Refined Groundnut Oil**

PLATE IIIB : SAMOSA



S1 – Sunflower oil S2 – Red palm Oil S3 – Refined Groundnut Oil

PLATE IV : BOLI

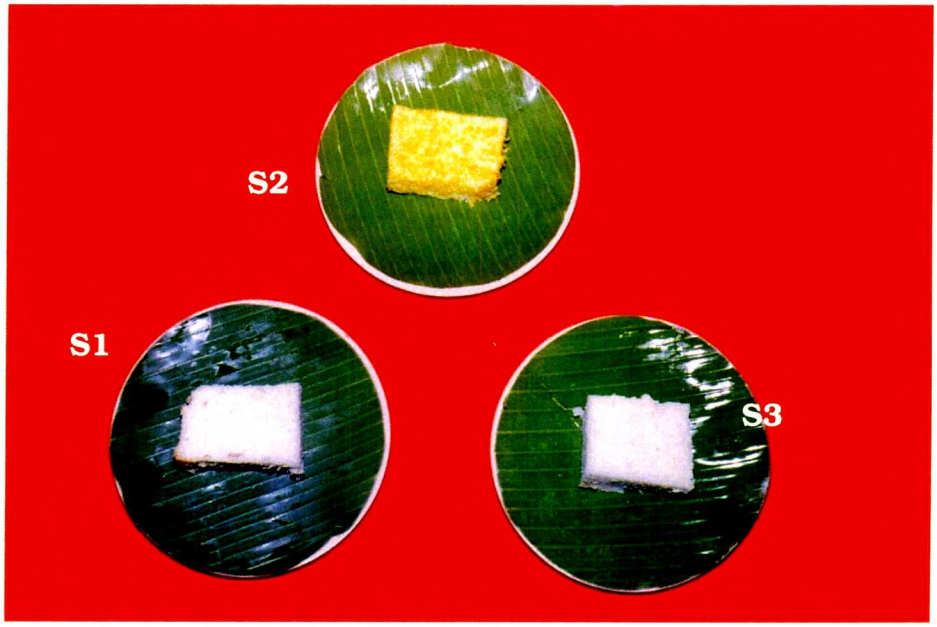
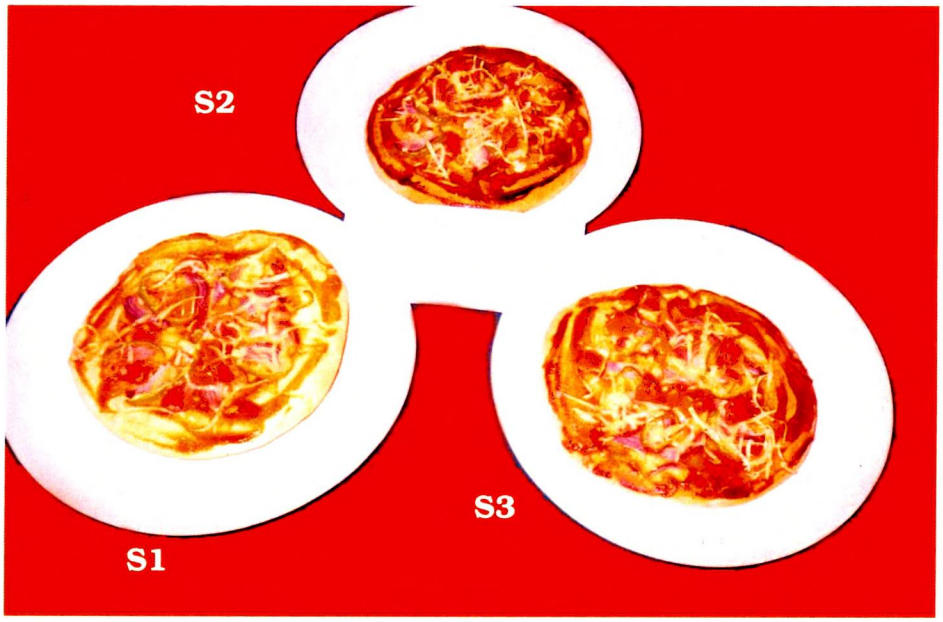


PLATE VIA : CAKE



S1 – Sunflower oil **S2 – Red palm Oil** **S3 – Refined Groundnut Oil**

PLATE VIB : VEGETABLE PIZZA

PHASE II : SENSORY EVALUATION OF RECIPES

Sensory evaluation is a multi disciplinary science that uses human panelists and their senses of sight, smell, taste, touch and hearing to measure the sensory characteristics and acceptability of food products. Thus, quality of food is judged in terms of appearance, colour, taste, texture and doneness (Chandrasekhar, 2002) and considered as the key factors in successful product development.

Most of the traditional foods have established pattern of uses and expectation of the quality. To have successful incorporation in these foods, the products prepared with Red Palm Oil must meet the traditional and original quality, which matches with colour, flavour, appearance, texture and the overall eating quality and nutritional and chemical composition. To put the position of Red palm oil in the right perspective, it is essential to compare its characteristics with other common cooking oils. Data gathered from the household and market survey, indicate that refined groundnut oil and sunflower oil were commonly used by the majority of the chefs in food outlets and homemakers in the rural and urban areas of Coimbatore. Hence sunflower oil and refined groundnut oil were used for the preparation of the selected recipes, as cooking oils against Red palm oil. Steps involved in sensory evaluation of the recipes are :

A) Selection of the taste panel members

Taste panel is a group of assessors chosen to participate in a sensory test (Chandrasekhar, 2002). To avoid errors due to physical, psychological, environmental and individual characteristics, a panel of assessors are used rather than a single assessor. Twenty skilled personnels were selected on the basis of their health, co-operation, willingness and knowledge of sensory analysis and also the ability to discriminate the various criteria for sensory evaluation.

B) Formulation of the score card

The sensory evaluation of a food product is carried out to find the acceptance of the consumer. Scoring is a form of rating of the prepared food items using a numerical scale where the numbers form an interval or ratio scale, i.e. the different scores have definite and demonstrated mathematical relationship to each other (Piggot, 1988). A five point score card was formulated for the acceptance of colour, taste, flavour and texture and grades were given according to the degree of acceptance.

C) Conduct of acceptability trials

The seventy food items selected for acceptability trials were prepared at different points of time and presented to the panel members for sensory evaluation. The recipe which obtained the higher acceptability score through sensory evaluation of the products by the panel members was considered as the best acceptable product. All the panel members were invited at a time to score the organoleptic quality of the selected preparations, so as to prevent a biased result and the remarks were recorded. Acceptability trials were carried out thrice to obtain more reliable results.

D) Selection of recipe for supplementation

Out of seventy recipes selected for acceptability trial, sweet ladoo preparation was considered for the supplement, which was used in supplementation studies for the selected target groups.

PHASE III : MAPPING OF GIRLS FOR SUPPLEMENTATION STUDIES

A) Selection of area

Five Government and Government aided educational institutions, four schools and an university, in Coimbatore District were selected for the study. Prior

to the actual conduct of the study, a good rapport was established among the teachers, students and their parents through proper counseling and also the purpose and procedure involved in the study were explained. The subjects were effectively motivated through an interactive session by the investigator and teachers to extend their full co-operation for the successful conduct of this study.

B) Selection of subjects

Growth, development and the maintenance of health require attention to the diet and nutrition throughout the life cycle. Among various stages of life cycle, childhood and adolescence are the periods of rapid growth and development. Therefore, children need extra care to promote and maintain their health and nutritional status.

Early childhood and adolescence are the critical periods for addressing macro and micronutrient deficiency diseases especially in girls. With the onset of puberty and inadequate dietary intake, young girls become highly susceptible to have nutritional deficiency diseases and necessitating to promote health and well-being of the present as well as future generation.

A total of 1554 girls in the age of 4-18 years, attending the selected educational institutions were included in the present study. The selected girls were classified according to ICMR (2005), as pre schoolers (4-6 years), school going girls (7-9 and 10-12 years), pre-adolescent girls (13-15 years) and post adolescent girls (16-18 years). The number of girls in each age group is given in Table 3.1.

Table 3.1
Age wise distribution of the selected subjects

Age (Years)	No. of girls
Pre-School girls	
3-6	294
School going girls	
7-9	289
10-12	318
Adolescent girls	
13-15	329
16-18	324
Total	**1554**

i) Criteria used for the selection of subsample

Kothari (2004) and Ahuja (2003) state that when the researcher deliberately selects certain units for the study, from the universe for constituting a sample representing the universe, it is purposive sampling. In the purposive sampling method, the investigator uses his or her own judgement about the respondent to choose and pick the best to meet the purpose of the study. Hence, purposive sampling was adopted for the selection of sub-samples, the main reasons being that the samples had to be:

1. In the age group of 4-18 years from either low or middle income families.
2. Anthropometric measurements below the standard values of NCHS.
3. Beta-carotene content in the regular diet.
4. Haemoglobin level below the standard values (WHO, 2004).

According to Housing Urban Development Corporation (HUDCO, 2004) the total family income per month for low income groups range from Rs.2500 to Rs.4500, for middle income Rs.4501 to Rs.7500 and for high income Rs.7501 and above. Those income levels were considered and the sub-samples for further study were selected from low and middle-income families, since their food and nutrient intake were almost similar.

Anthropometric measurements are relatively economical to carry out, objective in nature, understandable by the population at large, give results which can be numerically graded and supply reliable information concerning adequacy of growth and protein energy malnutrition (Jelliffe and Jelliffe, 1989). These measurements were recorded for the selected 1554 girls and were considered for the selection girls for in depth study.

Screening the girls for anemia was one of the criteria used to select girls for further study. Haemoglobin level is an important component in diagnosing the prevalence of anemia. Haemoglobin level was analysed by Cyanomethaemoglobin method for all the 1554 girls aged between of 4-18 years.

Data related to consumption of beta-carotene content of the diet was recorded through 48 hours recall method and also considered as one of the criteria used for the selection of subsample for supplementation studies.

C. Conduct of socio-economic survey for the study groups

A detailed interview schedule (Appendix III), was formulated by the investigator to collect information regarding socio-economic status, dietary pattern, nutritional and health status and morbidity pattern of the study group constituting 1554 girls aged between 4 to 18 years and was administered to the parents of the selected girls for mapping of girls for supplementation studies.

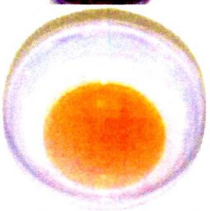
PHASE IV : SUPPLEMENTATION STUDIES OF RED PALM OIL

The major nutritional problem that has been recognized in the country, since the second decade of 20th century is vitamin A deficiency. There are several approaches to control vitamin A deficiency. In areas where vitamin A deficiency is not severe food-based strategies are more appropriate while medicinal supplementation is focused in severe vitamin A deficiency (Vijaya *et al.*, 2005).

Red palm oil is nature's richest source of carotenoids with concentration in the order of 700-1000ppm. This is about 15 times more than that present in carrots. The carotenoids in Red palm oil are mainly beta-carotene (55%), alpha carotene (35%) with smaller percent of lycophene, phytoene and zeacarotenes (Malaysian Palm Oil Information Series, 2004). Supplementation of sweet snack incorporated with Red Palm Oil was effective in improving vitamin A status as a daily dose of 600 microgram synthetic vitamin A (Manorama *et al.*, 1996).

A) Formulation of Red palm oil supplements

An ideal food for prevention and control of malnutrition should be of high nutritive value, acceptable by children, readily available at economical price and well tolerated both in illness and health (Swaminathan, 1999). Provision of adequate dietary energy and macro and micronutrients for growth and development should be the principle determinant of the diet for growing children. Studies conducted by Rao (1999) proved that the nutritional supplement in early childhood has long lasting effects on body size and health and these benefits acquired by some group of children remain throughout adulthood. Development of supplementary foods based on low cost, locally available indigenous food items familiar to homemakers has been one of the strategies suggested to improve nutritional status and to combat malnutrition among children. Hence, development of supplements using low cost, locally available cereals, pulses with or without oil seeds has been one of the strategies suggested to control protein energy malnutrition among low socio-economic groups especially growing children (Dhaiya and Kapoor, 1994). Keeping all these points in mind, the investigator formulated macro and micronutrient rich sweet ladoo for supplementation (Plate VII).



RED PALM OIL

SUGAR

ROASTED BENGAL GRAM POWDER

SWEET LADOO

RED PALM OIL SUPPLEMENT

PLATE VII

Pulses are valuable for their protein content. In a vegetarian diet or a diet containing low amount of animal foods, pulses are major contributors of protein, which is essential for proper muscular formation in our body (Gopalan *et al.*, 2004). Initially Jaggery was used to increase iron content of the supplement but it was not accepted by the young children through sensory evaluation. Hence jaggery was replaced by sugar for the preparation of ladoo. The ingredients used for the preparation of sweet ladoo were pulse, sugar, Red palm oil and cardamom. Three varieties of sweet ladoo were prepared using roasted bengal gram, green gram dhal and soy flour (vigor). These pulses were chosen for the incorporation with Red palm oil as it is low cost, yet rich in calories, protein, vitamins and minerals and are used by all income groups.

Totally twelve variations were prepared and used for sensory evaluation to select the best supplement for supplementation studies for different age groups. Quantity of ingredients used in each of the variant are given in the following Table 3.2.

TABLE 3.2
Quantity of ingredients used for the different variation

Age groups	Ingredients (g)	Variations			
		I	II	III	IV
Pre school girls	Roasted bengal gram	10.0	12.5	15.0	15.0
4-6 years	Sugar	10.0	10.0	15.0	15.0
	Red palm oil	3.0	4.0	5.0	10.0
School going girls	Green gram dhal	10.0	12.5	15.0	15.0
7-9 years	Sugar	10.0	10.0	15.0	15.0
10-12 years	Red palm oil	3.0	4.0	5.0	10.0
Adolescent girls	Soy flour (vigor)	10.0	12.5	15.0	15.0
13-15 years	Sugar	10.0	10.0	15.0	15.0
16-18 years	Red palm oil	3.0	4.0	5.0	10.0

Ingredients used were accurately weighed and the pulses were carefully roasted to enhance aroma and texture and finely powdered with sugar and cardamom.

B) Supplementation of Red palm oil on selected target groups

Red palm oil is valuable for its energy density with its unique characteristics of being rich in both natural carotenoids and vitamin E, as tocopherol and tocotrienol. Red palm oil has higher bioavailability of its micronutrients and is excellent as these fat soluable vitamins are embedded in oil medium (Malaysian Palm Oil Information Series, 2004). Vitamin A plays an essential role in vision and health of the eye which is now recognized as a critical factor in child health and survival (Sachithananthan and Chandrasekar, 2005).Cooking with Red palm oil is an easy way to make sure of getting different carotenoids of alpha and beta carotene, lycopene, phytoene and zeacarotene (http:// safarimkt.com/palm%20oil/20benefit.htm).

According to Gopalan (1998) inclusion of three grams of Red palm oil in the daily diet of growing children provides adequate beta carotene and enhances vitamin A status. Four grams of Red palm oil for 60 days in the diet of anemic adolescent girls increase their serum retinol level (Manorama and Rukmini, 2000).

Roasted bengal gram based sweet ladoo selected for supplementation was prepared using RPO and given daily in the mid-morning for the experimental group (n=20) in each age group for a period of 90 days (Plate VIII). Control group consisting of 20 girls in each age group was selected for comparison. The control group did not receive any supplement during the study period.

SUPPLEMENTATION ON TARGET AGE GROUPS

PLATE VIII

Table 3.3 indicates the quantity of ingredients used for the preparation of supplement for different age groups.

Table 3.3
Ingredients used for the supplement

Age group	No	Ingredients used	Quantity (g)
Pre school girls 4-6 years	20	Roasted bengal gram Sugar Red palm oil	10.0 10.0 3.0
School going girls 7-9 years 10-12 years	20 20	Roasted bengal gram Sugar Red palm oil	12.5 12.5 4.0
Adolescent girls 13-15 years 16-18 years	20 20	Roasted bengal gram Sugar Red palm oil	15.0 15.0 5.0

The experimental group was carefully monitored for ensuring the consumption of sweet ladoo throughout the study period of 90 days. The variation in the quantity of ingredients used in the preparation of sweet ladoo for various age groups was mainly based on the acceptability by the girls in each of the study groups. In this, specified quantity of Red palm oil was included because girls consumed the sweet ladoo completely, without having any plate wastage.

C) Nutrient content of the supplement

Five grams of Red palm oil contribute 45 kcal of energy, 5g of fats (monounsaturated fatty acids 2.32g, polyunsaturated fatty acids 0.68g and saturated fatty acids 2.00g), natural carotene 2500µg, beta-carotene 1185 mcg, other carotene 390 mcg and vitamin E 4 mcg (Malaysian Palm Oil Information Series, 2005).

Table 3.4 gives the energy, protein, carbohydrate, fat, beta-carotene, thiamin, calcium and iron content of the supplement used for the selected target groups.

Table 3.4
Nutrient content of the supplement

Nutrients	Supplement of		
	Pre-school girls	School going girls	Adolescent girls
Energy (Kcal)	104.00	132.00	160.00
Protein (g)	2.26	2.82	3.40
Fat (g)	3.52	4.65	5.78
Carbohydrate (g)	15.75	19.70	23.62
Beta-carotene (mcg)	722.00	962.00	1201.00
Thiamin (mg)	0.02	0.025	0.03
Calcium (mg)	5.92	7.40	8.90
Iron (mg)	0.96	1.21	1.45

Quantity of pulses and sugar used was based on the ability of the flour mix to lend itself for making balls in correct shape and texture with Red palm oil. Then the processed ingredients were evenly mixed with Red palm oil and made into small balls and termed as sweet ladoo.

D) Assessing the effect of Red palm oil nutritional status of the selected target groups

Assessment of nutritional status is a comprehensive evaluation of a person's health status using socio-economic, health, drug and diet history, anthropometric measurements, physical examination and laboratory tests.

For the present study, nutritional anthropometry, biochemical estimation, clinical examination and individual dietary intake by food weighment method were used to assess the nutritional status of the selected target groups.

1. Nutritional anthropometry

Anthropometry is the universally applicable, inexpensive and most sensitive parameter for assessing the nutritional status of children. It reflects both health and nutritional status and also predicts performance, health and survival. Use of anthropometric measurements depend on accurate age as well as appropriate standard for comparison. The most commonly used indicators of nutritional status are (i) standing height (ii) body weight (iii) mid arm, chest and head circumferences.

a) Height

Height of an individual is principally a measure of skeletal bony tissue (Jelliffe and Jelliffe, 1989). The selected girls in the study groups were allowed to stand against a wall bare foot and with heels, buttocks, shoulders and back of the head touching the wall. The head was held comfortably erect with the arms hanging freely at the sides in a natural manner. With the help of scale which was kept perpendicular to the wall and then a mark was made on the wall, after which a non stretchable measuring tape was used to record the height of the subjects in cm. Height of the subjects in the selected target groups was measured, before and after nutritional intervention studies.

b. Weight

Body weight is the most widely used, simplest, reproducible anthropometric measurement for the evaluation of nutritional status of the population. It is more sensitive measure of nutritional adequacy than that of height and reflects recent nutritional intake. Weight also provides a crude evaluation of overall fats and muscle stores (Brahman, 2005).

Weight of the selected girls in the study groups (experimental and control) was recorded using digital electronic human weighing machine. Girls were asked

to stand on the weighing machine, bare footed without touching anything, knees straight and looking forward. The readings were carefully recorded nearest to 0.1kg. Weight was recorded before and after the nutritional intervention period (Plate IX).

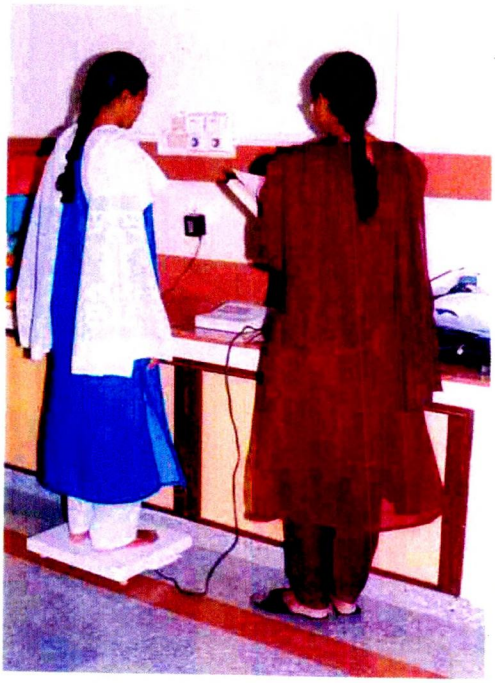
2. Individual dietary intake by food weighment survey

According to Bamji *et al.* (2003), diet is a vital determinant of health and nutritional status of an individual. Precise information on food consumption pattern of people through application of appropriate methodology is often needed, not only for assessing the nutritional status of the population but also for calculating the relationship of nutrient intakes with deficiency as well as degenerative diseases.

Food weighment survey is relatively more accurate and it involves direct weighment of food, though it is time consuming and needs cooperation of other family members throughout the study period.

In order to obtain the actual dietary intake of the girls in the study groups, 25 percent of girls in each group were covered and the actual food weighment method was adopted for three consecutive days.

Weight of all the raw ingredients used for cooking, total weight of cooked foods and foods consumed by the individual at each meal were recorded accurately (Appendix IV). From the individual consumption values, raw equivalents of ingredients were calculated which showed the actual total food intake by each of the subjects selected for food weighment survey. With the help of "Nutritive value of Indian Foods" by Gopalan *et al.* (2004), the nutrient intake of each individual was computed for three consecutive days. From these values, the mean food and nutrient intakes was calculated and compared with the recommended dietary allowances suggested by Indian Council of Medical Research (2004) to assess the excess / deficit of food and nutrient intake by the selected girls in the study groups, before and after supplementation studies.



RECORDING HEIGHT AND WEIGHT

PLATE IX

3. Clinical examination

Clinical examination is based on examination for changes believed to be related to inadequate nutrition that can be seen or felt in superficial epithelial tissues, skin, eyes, hair, buccal, mucus or in organs near the surface of the body (Jelliffe and Jelliffe, 1989).

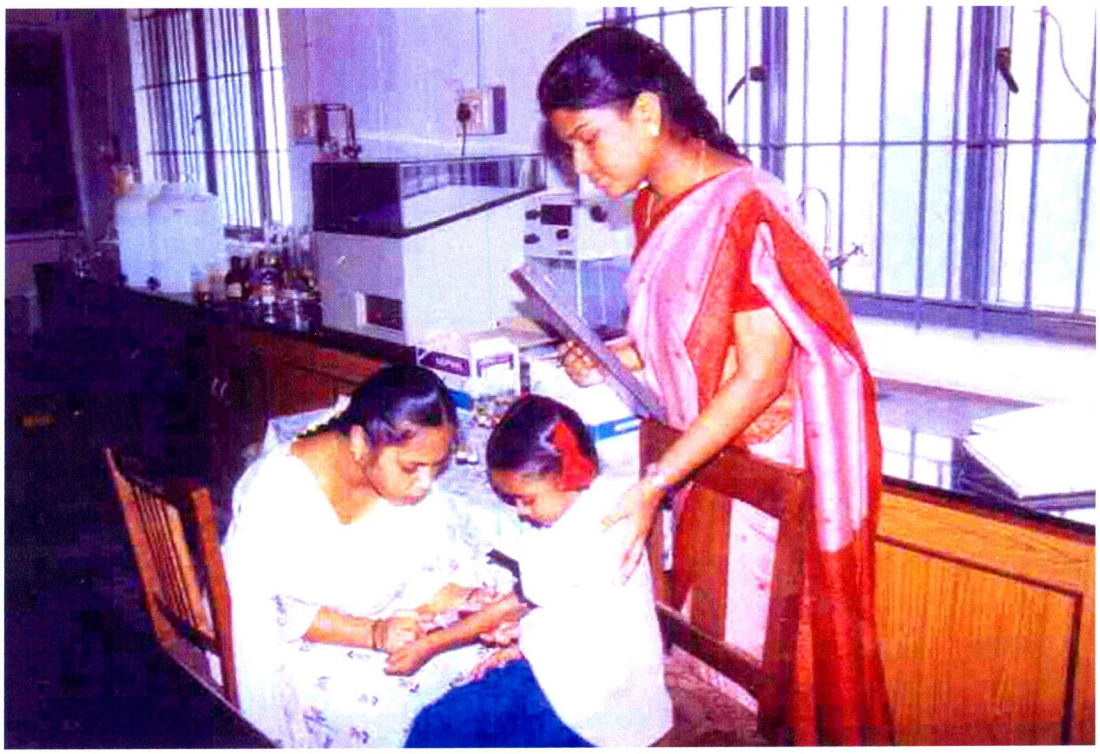
Clinical examination was conducted before and after supplementation studies for all girls in the study groups using a questionnaire (Appendix V) prescribed by Indian Council of Medical Research, New Delhi, India.

4. Biochemical estimation

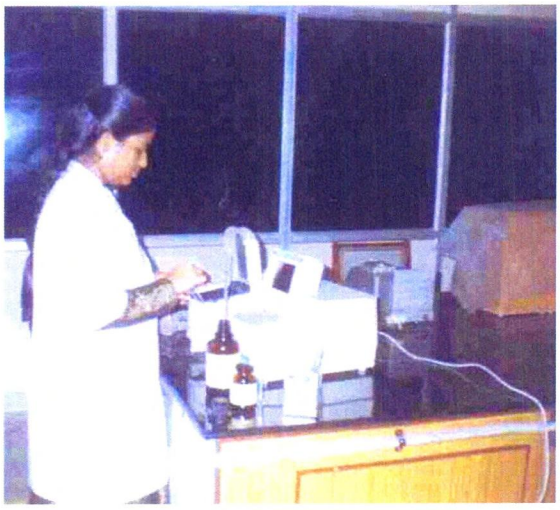
According to Gordon (2000), biochemical tests are the most objective and sensitive measures of nutritional status. Biochemical tests helped to detect deficiencies before symptoms are clinically evident. Biochemical estimation helps to confirm clinical and dietary data, so that diagnosis can be made and the nutritional and medical care can be planned and implemented effectively.

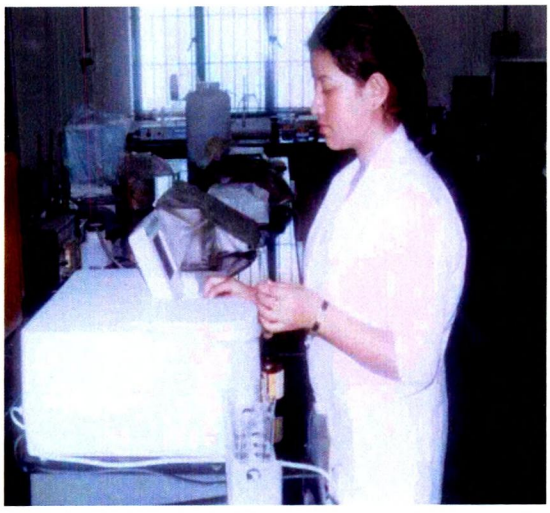
Blood is the primary tissue examined, because it is the means of transporting nutrients, metabolites and waste products.

Ten milliliter of venous blood was drawn using separate disposable syringes by qualified medical technician and transported to the laboratory where analysis were done (Plate X). Standard methods used for the analysis of the following blood parameters.



COLLECTION OF BLOOD SAMPLE

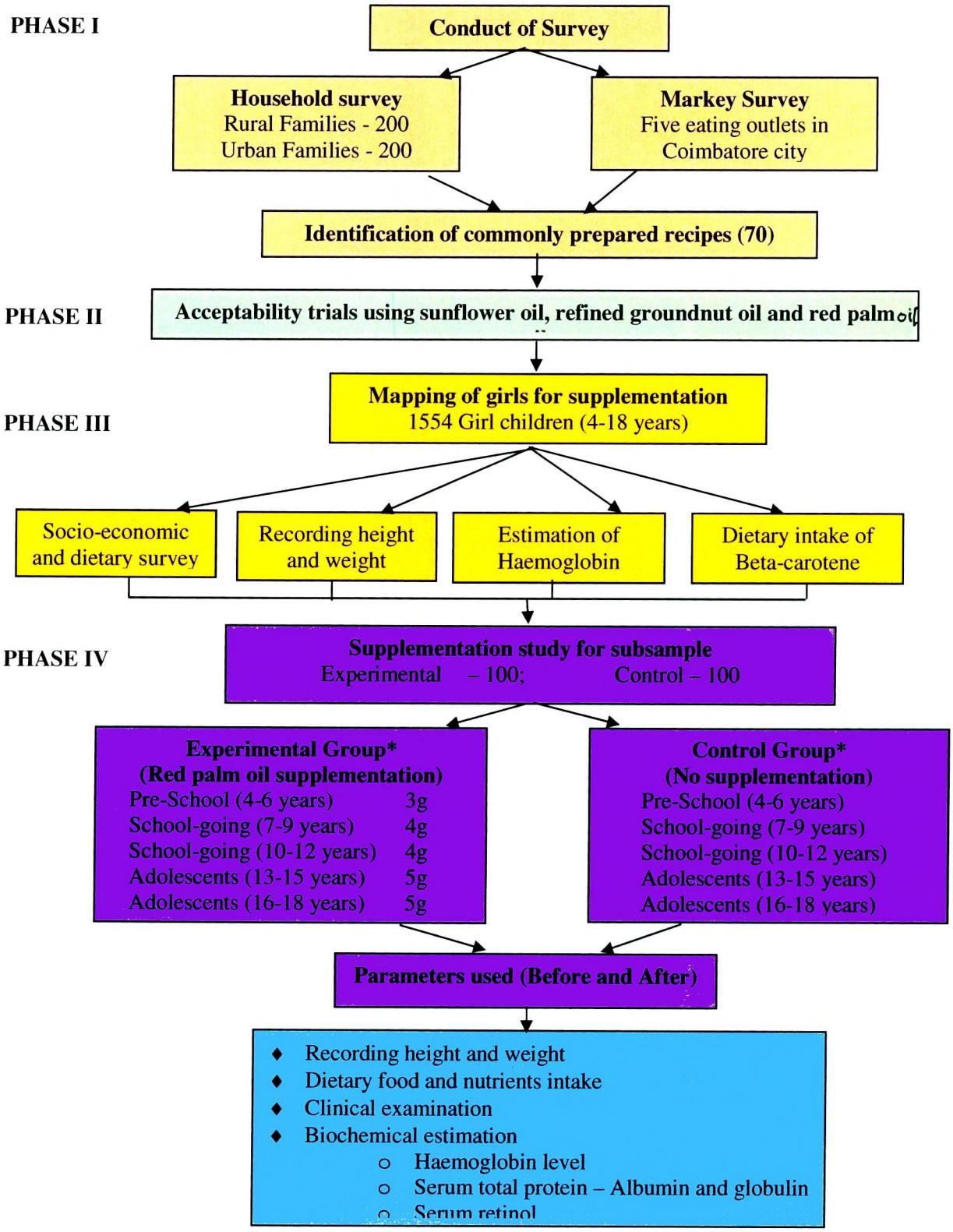




BIOCHEMICAL ESTIMATION

PLATE X

Research Design



* 20 girls in each age group

a) Haemoglobin estimation

Blood Haemoglobin of the target groups was estimated by Standard Cyanomethaemoglobin method as suggested by Varley (1998).

b) Serum total protein

Serum total protein - albumin and globulin were estimated for the selected target groups by Biuret method (NIN, 2004).

c) Serum retinol

It is a sensitive measure of vitamin A status of the body, that is, it reflects the amount of vitamin A in the body storage. It was estimated by Trichloro Acetic Acid method (NIN, 2004). Blood parameters analysed before and after supplementation were compared to assess the effect of supplementation on the selected target groups.

F. Analysis and interpretation of data

The data collected through interview schedule, clinical examination, biochemical estimation and food weighment survey were organized to obtain the desired results and interpreted scientifically (Kothari, 2004). The collected data was systematically analysed for arriving at the result of the effect of supplementation on health status of the selected target groups. For the analysis of the data, percentage was worked out wherever needed and statistically analysed and compared by using the students 't' test. The findings with the detailed discussions are presented in Chapter IV.