CHAPTER 3
RESEARCH DESIGN

Research Design pertaining to the study entitled *Nutritional and Pulmonary Health Status of Textile Women Workers of Tamil Nadu and the Impact of Micronutrient Fortified Food Supplement on Moderate Anaemic Cotton Ginners* is presented under the following headings:

3.1 Socio economic status of the selected textile women workers
3.2 Assessment of nutritional profile of the selected textile women workers
3.3 Screening of occupational health hazards prevailing among the selected textile women workers
3.4 Formulation and evaluation of micronutrient fortified soy biscuits
3.5 Conduct of intervention study
3.6 Evaluation of impact of micronutrient fortified food supplement on selected women working in ginning units
3.7 Imparting education to improve nutritional knowledge among the selected women working in textile units
3.8 Statistical analysis

**Baseline Survey to assess the health status of cotton textile adult women workers**

Occupational health is a branch of community medicine which deals with the effect of occupation (or) work place on human health (Park, 2001). Every occupation is associated with one or the other ill effects on health. One such occupational group is cotton textile workers. Cotton textile workers are susceptible to various morbid condition by virtue of the work place and their working condition.

Occupational disease reflect health hazard brought on by exposure within work environment. Due to lack of education, unaware of hazards of their
occupations general backwardness in the sanitation, poor nutrition and climatic proneness of the geographic region to epidemics aggravate their health hazards from work environment (Wang et al, 2003). Textile mills are the most important source of employment for industrial workers in India, and it has been estimated that nearly one half of the million workers are employed in these mills. Hence, in the present study women working in textile industries were included to conduct research.

3.1 Socioeconomic status of the selected textile women workers

Nutritional status of a community is associated with the socioeconomic and environmental factors of community (Kothari, 2005). The socioeconomic status and work pattern of selected textile women workers were assessed under the following heads.

3.1.1 Selection of locale
3.1.2 Selection of textile women workers
3.1.3 Socioeconomic status of the textile women workers
3.1.4 Work pattern of women workers

3.1.1 Selection of locale

Indian textile industry is one of the leading textile industries in the world (Lien et al, 2001). The investigation was carried out in the urban areas of Tirupur (250 units) and Erode (175 units) districts of Tamilnadu located around 300-500 Km South West of Chennai. Tirupur being a textile city is the major exporter of cotton garments and ranks second to Coimbatore city. Twenty percent of women in Tirupur and Ten percent of women in Erode are working cotton textile industries.

Basic reasons for selecting these districts are because the majority of women in these districts have been employed in textile based occupations. Additionally, the investigator was familiar with these areas and hence could establish good rapport with the women in the selected units (plate-1).
Plate 1: Selection of locale
3.1.2 Selection of textile women workers

Today is an era of women who have diverse role to play in society. Cotton industry workers are exposed to various hazards in the different departments of textile factories (Hafez et al., 1998). Especially in the spinning sections which play a role in the high incidence of industrial health hazard (Allan et al., 1981). Cotton ginners are exposed to cotton dust quite freely and frequently, which is a major threat to their pulmonary health (Haq, 1986). Considering this to elicit the information on health status of textile workers totally 300 non pregnant and non lactating women performing varied textile tasks and aged between 20-60 years were identified randomly from ginning and spinning industries located at Tirupur and Erode. Of the total, 150 women working in different sections of ginning factory (Srimurugan, Sudha, Venkateshwara and Bayyammal factories) namely, ginhouse, gutter, gutter and sorting
have been included for the study. Similarly, about 150 women employed in different sections of spinning factory (Annai, SripalaniMurugan, Aswin, Sulochana factories) namely carding, blowing and spindle are covered for the study.

3.1.3 Socioeconomic status of the textile women workers

Socioeconomic characteristics including age, education, family type and size, monthly income and expenditure pattern of the selected textile women workers were gathered through interview cum questionnaire method using a specially designed pretested proforma (Appendix – I).

3.1.4 Work pattern of women workers

In industrial nature of work, working posture play an important role, separately and combined with other strain factors (Erogol, 2001). Findings clearly indicates that health status is related to work pattern and economic as well as social resources.

Ginning (gin house, gutter and sorting) spinning (cardroom, blowroom and spindle room) units were selected for the study. Different postures of women working in such units are standing, sitting and bending. Hence such information was collected.

The designation of work, the duration of work per day, type of work, years of exposure to cotton dust were collected from the selected women through pretested questionnaire (Appendix I) since the higher risk factor for developing respiratory disease include the length of employment and dust exposure level in the cotton textile industry etc., (Ghardashi, 2005).

3.2 Assessment of nutritional profile of the selected textile women workers

Direct indicators of nutritional study include anthropometry, dietary intake, clinical and bio-chemical assessment (Szoe Falk, 1984).

3.2.1 Anthropometry

3.2.2 Dietary intake

3.2.3 Clinical Examination
3.2.4 Bio-chemical Assessment

3.2.1 Anthropometry

Anthropometry deals with the measurement of body at various ages and level of nutritional status. It has been identified as a reliable tool in the identification of nutritional status (Geetha and Maheswari, 2002). The vital signs include the assessment like height, weight and Body Mass Index (BMI) reflect the nutritional status. While height is used to assess past nutritional status, weight helps to assess the present (Novorway et al, 1996). Height and weight of textile women labourers were measured using the standard procedure outlined by Jelliffee and Jelliffee(1989). Body Mass Index is frequently used as a popular and rapid clinical measure of relative obesity and malnutrition (Priyatomako,1991) and extreme Body Mass Index is associated with low productivity in women workers (Sathyanarayan, 1991). Therefore using height and weight measurements, Body Mass Index of the textile women workers was computed and categorized according to the Body Mass Index classification (WHO, 1999).

3.2.2 Dietary Intake

Dietary Intake covering food habits, availability, nutrient intake and meal preparation yield information on adequacy of existing diets (Swaminathan, 1988). Often dietary assessment studies for research purposes employ several methods simultaneously to increase accuracy. Human services Health and Nutrition Examination Survey recommended a 24 hour recall method and food frequency information (Gable, 1990).

Food consumption pattern of the selected textile women workers (n=300) was assessed by food frequency and 24 hour recall method. Differences in FFQ design characteristics, e.g. the number of food items, the inclusion of portion size questions, and mode of administration, can affect the validity of a FFQ( Molag et al 2007) Food and nutrient intake was computed using the food composition table (Goplan et al, 2004) and compared with the
Recommended Dietary Allowances (RDA) suggested for moderate active women (ICMR, 2004).

3.2.3 Clinical Examination

Clinical Examination is the most important part of nutritional assessment to obtain direct information of the signs and symptoms of the dietary deficiency prevalent among the people (Swaminathan, 1989). In the present study the selected women workers were examined by a physician to identify the presence of clinical symptoms of nutritional deficiency using modified ICMR Proforma. (Appendix – II)

3.2.4 Bio-chemical Assessment

Bio-chemical Assessment can reveal subclinical status of deficiency due to lowered intake of absorption or impaired transport and abnormal utilization of a nutrient (Swaminathan, 1974) Anaemia is defined as a Hb concentration below the reference range (specific for age,sex and gestation) for the laboratory performing the test. The WHO defines anaemia as a Hb level below 130 g/L in men, 120 g/L in women and 110 g/L in pregnant women and preschool children(WHO,2001). Hence the blood samples of the selected textile women workers (N=300) were collected and their haemoglobin level was estimated using Cynameth Haemoglobin method (Plate –2).

3.3 Screening of occupational health hazards prevailing among the selected textile women workers

Occupational health problems are important component of the total mobility disability and mortality among workers. Respiratory, musculoskeletal problems and morbidity pattern were examined to assess the health status of selected textile women workers.

Occupation is associated with one or the other ill effect on health and one such occupational group is cotton textile workers. Cotton textile workers are susceptible to various morbid conditions ranged from chronic respiratory disease due to inhalation of cotton dust (Ruthe, 2006).
PLATE - II
Cotton spinning industry is the most important industry with rapid industrialization and mechanization in textile industries. Occupational health hazards are becoming more prominent. Respiratory tract disease represent the most important group of occupational disease in these factories as a result of inhalation of cotton fibers and dust in work place. In addition excessive noise induced hearing impairment were present as an occupational health hazards too (Douglas,2007). Considering this, the morbidity pattern was assessed among cotton textile workers. Respiratory problems related to pulmonary disease were assessed using Medical Research Council Respiratory Questionnaire (Liarland Neukirch, 1986) (Appendix III) Further, musculoskeletal symptoms prevalent among these women workers were examined (Appendix IV).

3.4 Formulation and evaluation of micronutrient fortified soy biscuits

Iron deficiency anemia is one of the most prevalent micronutrient and malnutrition in India, and more than 50 per cent of women suffer from anemia (Gopalan and Kaur, 1989). A suitable approach is through food supplementation as it has the dual advantage of not only improving the hematological picture but also providing complementary nutrients for iron utilization. Bagriansky (1996) has stated that micronutrient and malnutrition could be eliminated by increasing the availability of certain foods in natural, processed or fortified status to target population.

Considering this, supplementary food in the form of biscuits fortified with iron and folic acid were formulated for correcting micronutrient deficiency prevailing among the textile workers. Cookies are ready to eat convenient snacks and the nutritional quality can be improved by replacing wheat flour partially with pulse flour to provide complementary nutrients like protein. To furnish enough protein, pulse flour namely toasted defatted soy flour (enzyme inactive), untoasted defatted soy flour (enzyme active), Rajma (Phaseolus vulgaris) and moth bean (Vigna aconitifolia) were used.
Initially 18 formulations were worked out. Out of these, the following 8 formulations were identified for organoleptic trial test.

| Standard | refined wheat flour | 100WF |
| Variation I | refined wheat flour : toasted defatted soy flour | 70WF:30TDSF |
| Variation II | refined wheat flour : un toasted defatted soy flour | 70WF:30UTDSF |
| Variation III | refined wheat flour : rajma | 70WF:30RAJMA |
| Variation IV | refined wheat flour : moth bean | 70WF:30MOTH BEAN |
| Variation V | refined wheat flour : untoasted defatted soy flour : rajma : moth bean | 70WF:15UTDSF:15RAJMA:15MOTHBEAN |
| Variation VI | refined wheat flour : untoasted defatted soy flour : moth bean | 70WF:15UTDSF:15MOTHBEAN |
| Variation VII | refined wheat flour : untoasted defatted soy flour : moth bean | 70WF:10UTDSF:10RAJMA:10MOTHBEAN |

The quality attributes were organoleptically evaluated by 20 semi-trained panel members using five point hedonic scale (Appendix - V). Based on the mean sensory scores variation I with refined wheat flour and toasted defatted soy flour (70:30), variation II with refined wheat flour, untoasted defatted soy flour (70:30), variation V with refined wheat flour, untoasted defatted soy flour and rajma (70:15:15) and variation VI with refined wheat flour, untoasted defatted soyflour, and moth bean (70:15:15) were selected for further study.

The selected four combinations were further subjected to physio–chemical, nutrient and micro analysis to select the best and suitable combination for micronutrient fortification and were compared with standard.

Considering the different criteria combination II with refined wheat flour and untoasted defatted soyflour (70:30) identified to be the suitable for
intervention was fortified with optimum level of folic acid (175 µg) and at different levels of ferrous fumarate (6,8,10mg). The prepared fortified cookies (T₁,T₂ and T₃) were compared with sample control for sensory characteristics. Subsequently, the most suitable micronutrient fortified soy cookies with 8 mg of ferrous fumarate and 175µg of folic acid of fortificants was studied further to understand the keeping quality of the product. Quality characteristics of the selected micronutrient fortified soy biscuit including sensory, nutrient (moisture, ash, energy, carbohydrate, protein, fat, iron, folic acid and fiber) and microbial load were tested initially and on storage (after 120 days).

3.4.1 Selection of raw materials
3.4.2 Preparation of cookies
3.4.3 Micronutrient for fortification
3.4.4 Quality characteristic of cookies

3.4.1 Selection of raw materials

Soy has gained global recognition as a food source of immense importance to the health. It is a complete reservoir of protein, all essential aminoacids, and omega 3 fatty acid. Soya possess excellent nutritional and prophylactic profile (Venkatachalam et al, 2004). The soya product like toasted defatted soya flour and untoasted defatted soya flour were selected for the preparation of cookies. It was procured in bulk quantity from Sakthi Sugars Limited (Soya Division) Pollachi, Tamilnadu.

Refined wheat flour, rajma (Phaseolus vulgaris) and moth bean (Vigna aconitifolia) procured from the local departmental stores were cleaned and hammer milled to obtain flour. Likewise the necessary ingredients required for preparation of cookies such as butter, sugar and baking powder were procured.
3.4.2 Preparation of cookies

In India biscuit manufacturing industry is growing to meet the increasing demand of biscuits which have gained popularity in Indian diet because of its availability at reasonably cheaper rate (shirsagar et al, 2004). The details of different cookies are presented in Table –I

Table - I
Proportion of different ingredients in cookies

<table>
<thead>
<tr>
<th>Ingredients (g)</th>
<th>Std</th>
<th>V -I</th>
<th>V -II</th>
<th>V - III</th>
<th>V - IV</th>
<th>V - V</th>
<th>V -VI</th>
<th>V - VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refined Wheat flour</td>
<td>100</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Toasted defatted soya flour</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Un toasted defatted soya flour</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>15</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Rajma</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>15</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Moth bean</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Butter</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Sugar</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Baking powder</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Vanilla essence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 drops</td>
</tr>
</tbody>
</table>

Procedure

- Sieve refined wheat flour and pulse flour with baking powder.
- Rub butter in flour, add sugar and mix it into a smooth workable dough.
- Roll into ½ thick sheet, on dusted board and cut into uniform rounds, using a small round cutter.
- Place on greased tray and prick the top with the fork.
- Bake at 120°C for 10 minutes

3.4.3 Micronutrient for fortification

Food fortification is important food based approaches which satisfy the nutritional needs of people in developing as well as developed countries. Lack of iron may lead to decrease in physical performance and folic acid deficiency may result in anemia. The most effective technological approach to combat iron and folic acid deficiency in developing countries include supplementation
targeted to high risk groups combined with program of food fortification (Beard, 2001).

The micronutrient mix was purchased from the CELRICH PRODUCTS ISO 9001, 2000 certified (Certified No. 0611281j) and HACCP approved Company Hyderabad. An optimum level of folic acid (175 µg) with different levels of ferrous fumarate (6, 8, 10 mg) were added to fortify the biscuits.

3.4.4 Quality characteristics of cookies

3.4.4.1 Sensory evaluation

The formulated cookie (Plate – 3) was intended for feeding selected women labourers to improve their micronutrient status. Consumer expectations and awareness regarding quality has reached heights, and for quality assurance several steps are broken, out of which organoleptic evaluation holds an important place (Moskowitz, 1997).

Organoleptic evaluation is the composite characteristic which determines the degree of acceptability of specific product by the consumer. The quality attributes of the food are broken down into components characteristic like appearance, texture, flavour and taste etc., (Chandrasekar, 2002). The cookies were evaluated for sensory attributes by the panel of 20 semitrained panel members using 5 points hedonic scale (Appendix – V).

3.4.4.2 Physico chemical characteristics

The bakery goods such as biscuits, cake and bread are aerated starch structure vulnerable to dehydration. To retard water loss high moisture barriers such as polyethylene film bags are used for packing (Catherine, 2002). The cookies were packed in aluminum foil and tested for the storage stability (60 days).
Inadequate or excess moisture would affect the shelf life and texture of the product. So the physico-chemical characteristics such as moisture, ash and acid insoluble ash were analyzed initially and on storage to understand the keeping quality of the formulated cookies. The detailed procedure is appended in Appendix V.

3.4.4.3 Nutrient content

Nutrient analysis is essential to know about the nutritional composition of the bakery products such as cookies and bread (Kumari and Grewal, 2007). The prepared cookies were analyzed for carbohydrate, protein, fat and fiber. The standard procedures used for analyzing the nutrients are given in Appendix VII.

3.4.4.4. Microbial count

To determine the storage stability of the cookies microbial analysis was done at initial, 30 days and 60 days for the presence of total viable bacteria, yeast and mold. The detailed procedure is given in Appendix - VIII.

3.5 Conduct of intervention study

Haemoglobin estimation was carried out for all the 300 selected textile women workers. The prevalence picture showed moderate degree of anaemia ranged between 7 to 9.9 g/dl among the selected women. Further, the mean haemoglobin level of women working in ginning units (7.89±0.19 g/dl) was low when compared to the level in women working in spinning units (8.81±0.66 g/dl).

In addition they are susceptible to various morbid conditions by virtue of work place and working condition. This was supported by the studies of Raffle (2005) and Saadia (2006) who mentioned that cotton ginners are exposed to cotton dust quite frequently and they have high prevalence of respiratory symptoms, morbid pattern, clinical deficiency for anaemia and poor health status. Considering these references and the obtained data, for
further study, women working in ginning units were selected for intervention programme. Hence based on their haemoglobin values and willingness to participate in the food supplementation study women who were classified under moderate anaemia category having haemoglobin level between 7 to 9.9 g/dl and a total of 40 women were included for the study. They were grouped into control (n=20) and experimental (n=20).

Control group did not receive any supplements. Based on acceptability trails, nutrient contribution and feasibility for feeding, 100g of micronutrient fortified soy biscuit containing 13.5g of protein, 8.4mg of iron (ferrous fumarate) and 120µg of folic acid was supplemented to experimental group of women as a midmorning and midevening snack for a period of four months (Plate-4).

The intervention period of 120 days was chosen, because only minimum dosage of iron (ACC/SCN new 1990) was considered in this study as the selected sample of women for intervention were moderately anaemia. They were monitored and consumption of biscuit by the members was ensured throughout the supplementation study. Control of hook worms is significant strategy for reducing anaemia. Hence before starting the intervention, the selected groups of women were given deworming tablets (Albendazole 400mg) twice (once in 15 days).

3.6 Evaluation of impact of micronutrient fortified food supplement on selected women working in ginning units

Impact of the micronutrient fortified soy biscuits on moderate anaemic women were assessed through changes in their anthropometric measurement, clinical examination, respiratory symptoms, morbid conditions, haematological picture and pulmonary function test.

3.6.1 Anthropometry
3.6.2 Health status
3.6.3 Haematological picture
3.6.4 Pulmonary function test
PLATE - IV
3.6.1 Anthropometry

Anthropometry has been recognized as a reliable tool in the identification of nutritionally vulnerable groups, monitoring changes in the extent of malnutrition, selection of beneficiaries for intervention programme and evaluating the impact of interventions (Rao and Vijaya Raghavan 1998). Anthropometric measurements such as height and weight were recorded for the selected control and experimental group of women before and after the intervention period.

3.6.2 Health status

Changes in clinical examination, morbid conditions and respiratory symptoms prevailing among selected women were assessed by a physician before and after supplementation period.

3.6.3 Haematological picture

Haematological indices such as blood haemoglobin, serum iron, serum ferritin, transferrin, folic acid, serum albumin, globulin and total protein, ESR, WBC count and differential count were estimated at the beginning and at the end of the intervention period for control(n=20) and experimental(n=20) group of women working in ginning factory. The procedures adopted for estimation by using the selected parameters are presented in Appendix IX.

1. Blood haemoglobin method
   - Cyanamet haemoglobin

2. Serum iron, ferritin Transferrin and folic acid
   - Laboratory Method
     Radio immuno assay and microbiological assay

3. Serum albumin and globulin
   - Salt precipitation method

4. Total serum protein
   - Biuret method

5. WBC and Differential count
   - Haemocytometer and Leishman stain.
6. ESR (Erythochyte Sedimentation Rate)- Wester Gren’s method

3.6.4 Pulmonary Function Test

Workers exposed to cotton dust suffer from occupational diseases which lead to respiratory problem characterized by chest tightness and airway obstruction (Botarwi, 2007) In the diagnosis of air way obstruction functional grading using Forced Expiratory Volume in one second (FEVI) and Forced Vital Capacity (FVC) be routinely used in India. Spirometric results were obtained primarily from the 18 years of age (Sveger et al, 1995). Standard spirometric tests were performed at the pulmonary function test room of the LOTUS hospital Erode. Hence in the present study lung volume and capacities of air breathed in and out of lung by the selected women was measured by a trained technician using a multipurpose spirometer. The spirometer was calibrated for volume, time and flow before each testing, care was taken to ensure that the instrument (Plate –2) was horizontally placed and none of the air venting slots were obscured. Measurements were taken on the subjects sitting upright with the nose clipped (Cherniack and Raber, 2000). The predicted values for all functional parameters were compared before and after supplementation period. The formal procedure is given in Appendix X.

3.7 Imparting education to improve the nutritional Knowledge among the selected women working in textile units

Observations made from screening test revealed that the selected women followed poor dietary practices, included less serving of protective foods such as cereals, pulses, fruits and vegetable attributed to the lack of knowledge. Considering this, followed by the dietary supplementation (intervention study) an awareness campaign on health specially on nutrition education was planned to conduct among the selected ginning workers.

Nutrition education involves teaching the client about the importance of nutrition provision, educational material that reinforces message about health, eating essentials for making dietary change etc. Information gathered
During nutritional screening (or) assessment will provide necessary information on which nutrition issues needs to be addressed during nutrition education and counselling session (Croll, 2010).

Ginning factory discharge large amount of cotton dust leads to both acute and chronic pulmonary abnormalities were visualised, which indicates both short-term and long-term effect of cotton dust on lungs. The prevalence of significantly more number of pulmonary impaired were working in ginning section (Jannet and Jeyanthi 2006). Considering this, an attempt has been made to provide educational programme as complement package to the selected women working in ginning units (N = 150). This additional input apart from dietary supplementation would facilitate sustainable development in their health status. Initially basic knowledge on nutrition and related concepts were assessed from the participants by administering a questionnaire (Appendix XI).

Nutrition education programme including lung function, importance of antioxidant, protein, iron, folic acid rich foods and yoga on improving the health status was prepared. The suitability of the prepared educational tool was tested preliminary among 25 women working in ginning section of textile industry. Further the developed education programme was imparted through lecture power point presentation and display (Plate –5 and 6). Further to follow and practice good dietary practices a booklet in the regional language was distributed to selected women (N=150) Plate -7. Subsequently, the impact of diet counselling was assessed after 30 days in order to understand the retention of knowledge and change in practices by administering the questionnaire.

### 3.8 Data Analysis

The collected data were compiled and analyzed statistically using Test of Significance at 0.05 (P<0.05) and 0.01 (P<0.01>) level to draw conclusion.

The research design pertaining to the present study is presented in figure –1
3.8.1. Formulation of Hypothesis

**Hypothesis-I**

Development micronutrient fortified soy biscuits are acceptable organoleptically and provide appreciable amount of nutrients.

**Hypothesis - II**

Micronutrient fortified soy biscuits have a efficacy on anthropometric, health status, Haematological picture and pulmonary function test of moderate anemic cotton ginners.

**Hypothesis testing variables**

<table>
<thead>
<tr>
<th>Anthropometric measures</th>
<th>Height, Weight, &amp; B.M.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory attributes</td>
<td>Appearance, colour</td>
</tr>
<tr>
<td></td>
<td>Flavour texture taste and overall acceptability</td>
</tr>
<tr>
<td>Biochemical parameters</td>
<td>Haemoglobin, Serum iron, ferritin</td>
</tr>
<tr>
<td></td>
<td>Transferrin and folic acid,</td>
</tr>
<tr>
<td>Haematological</td>
<td>Serum albumin and globulin</td>
</tr>
<tr>
<td></td>
<td>Total serum protein, ESR</td>
</tr>
<tr>
<td></td>
<td>WBC and Differential count</td>
</tr>
<tr>
<td>Pulmonary function Test</td>
<td>Forced Expiratory Volume in one second (FEVI) and Forced Vital Capacity (FVC)</td>
</tr>
</tbody>
</table>

Hypothesis framed were tested on a predetermined level of significant at 1 and 5 per cent level by applying statistical measures.
Plate V
Figure