IMPACT OF SOYA ENRICHED FOOD SUPPLEMENT ON THE NUTRITIONAL STATUS OF WOMEN BENEFICIARIES OF ICDS

By

C. NIRMMALA, M.Sc.

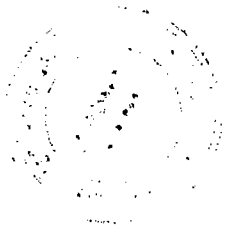
THESIS
SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENT FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY IN FOOD AND NUTRITION
FACULTY OF AGRICULTURE
KERALA AGRICULTURAL UNIVERSITY

DEPARTMENT OF HOME SCIENCE
COLLEGE OF AGRICULTURE
VELLAYANI, THIRUVANANTHAPURAM

2002

DECLARATION

I hereby declare that this thesis entitled **"Impact of soya enriched food supplement on the nutritional status of women beneficiaries of ICDS"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.



C. NIRMMALA

Vellayani,
8-5-2002.

CERTIFICATE

Certified that this thesis entitled **"Impact of soya enriched food supplement on the nutritional status of women beneficiaries of ICDS"** is a record of research work done independently by **Smt. C. Nirmmala** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

Vellayani,
8-5-2002.

Dr. (Mrs.) L. PREMA
(Chairman, Advisory Committee)
Professor and Head,
Department of Home Science,
College of Agriculture,
Vellayani, Thiruvananthapuram - 695 522..

Approved by

Chairman :

Dr. (Mrs.) L. PREMA
Professor and Head
Department of Home Science
College of Agriculture, Vellayani

8-5-02

Members :

1. **Smt. N. K. VIMALAKUMARI**
   Associate Professor
   Department of Home Science
   College of Agriculture, Vellayani

8/5/2002

2. **Dr. S. CHELLAMMAL**
   Associate Professor
   Department of Home Science
   College of Agriculture, Vellayani

8-5-02.

3. **Dr. VIJAYARAGHAVAKUMAR**
   Associate Professor
   Department of Agricultural Statistics
   College of Agriculture, Vellayani

23/11/02

4. **Dr. P. RAJENDRAN**
   Associate Professor
   Department of Soil Science and
   Agricultural Chemistry
   College of Agriculture, Vellayani

8-5-02

External Examiner

23.11.02

Dr S. PREMAKUMARI
Prof of Nutrition
Sri Avinashilingam Home Science
and Research Institute for Higher Education
for Women.
COIMBATORE

ACKNOWLEDGEMENT

It is my exuberant pleasure to express my deep sense of gratitude, indebtedness and sincere thanks to Dr. (Mrs.) L. Prema, Profesor and Head of the Department of Home Science, College of Agriculture, Vellayani and Chairperson of the Advisory Committee for her valuable guidance, expertise and constructive criticism and invaluable help, above all her patience and consideration that finally enabled me to convert the proposed hypothesis to concrete reality.

Let me express my gratitude to the members of my advisory committee. I place on record my sincere thanks to Smt. N.K.Vimalakumari, Associate Professor, Department of Home Science for her constant encouragement and valuable suggestions and expertise at all stage of this investigation.

I earnestly express my sincere thanks to Dr. S. Chellammal, Associate Professor, Department of Home Science for her periodic advice, valuable suggestions and expertise at all stages of this investigation.

My sincere thanks to Dr Vijayaraghavakumar, Associate Professor, Department of Agricultural Statistics, for his timely help and valuable advice for carrying out statistical analysis of the data and subsequent interpretation.

I am grateful to Dr. P. Rajendran, Associate Professor, Department of Soil Science and Agricultural Chemistry, for his help in carrying out the analytical work.

I acknowledge the patron of the Institution the Dean for all the necessary helps given to me during the whole course and study.

I place a word of thanks to Mr. Joy, Associate Professor and Bindu, Assistant Professor, College of Agriculture, Padanakkad for their help in carrying out the microbial study.

I am thankful to C.E.Ajithkumar, Programmer, College Agriculture, Vellayani for rendering his help in the computer analysis of the data.

I acknowledge the help rendered by M/s. Athira Computers, Devaswom Lane, Kesavadasapuram, Thiruvananthapuram for type setting the manuscript.

I greatly acknowledge the co-operation rendered by the CDPO Smt. M.A. Saraswathy, Athiyanoor ICDS Block and Smt. Remany and Smt. Syamala, ICDS supervisors, Venganoor and Thiruvallam Panchayath and Anganwadi workers and helpers for their sincere help in the data collection and conduct of feeding experiment. I also wish to record my deep sense of gratitude to all the respondents for their whole hearted co-operation which enabled for the generation of data and completion of my investigation. I also acknowledge with thanks the invaluable help rendered by Dr. Raveendran, Medical Officer, PHC, Vizhinjam, Smt. Meena, ANM, Smt. Ambili, Lab Technician in carrying out the clinical examination and collecting blood specimen for the study.

I record my sincere thanks to my colleagues, non-teaching staff and students of department of Home Science for their encouragement and timely help during the course of my research work. I place a word of thanks to my friends for their help in various stages of my research work.

I must also extend my deepest sense of gratitude to Dr. R.S. Aiyer for his encouragement and valuable advice during the course of the investigation.

I record my deep sense of gratitude to my husband Mr.K.S.Natesan and to my children, Nayana and Soonu and to my sister Smt. Jayakumari for their constant encouragement, sincere help, patience and sacrifice without which I would not have completed this research endeavor.

Above all I bow before God Almighty for leading me in the right path and for whatever He has taught to me.

Nirmmala. C.

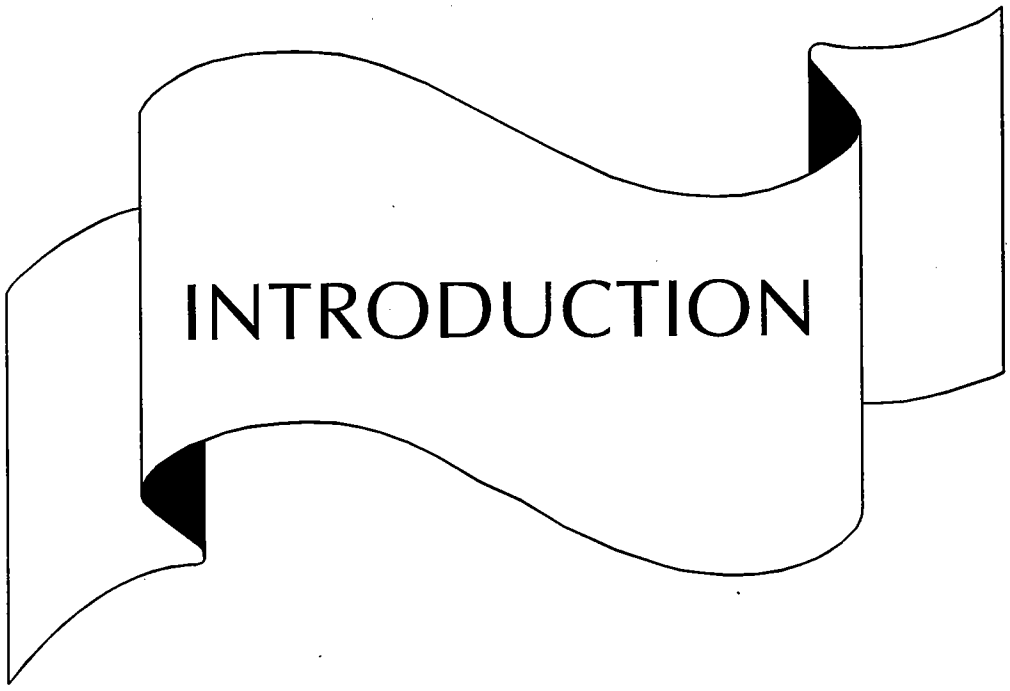
CONTENTS

Page No.

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES


INTRODUCTION

INTRODUCTION

Nutrition is a vibrant index of the quality of life and reflects the status of the economy and well being of the population. Nutritional adequacy is one of the key determinants of the quality of human resources.

High incidence of malnutrition and low health status of the vulnerable sections of the population calls special attention of policy makers on nutritional planning and organisation. Good nutrition and good health is a fundamental human right and should be the priority of all developmental schemes. Many intervention programmes in operation in our country is with the objective to take care of nutritionally unfit vulnerable section of the population namely children below six years of age, pregnant women and lactating mothers to grow up into robust citizens of physically fit, mentally alert, morally healthy endowed with skills and motivation needed by the society.

Integrated Child Development Services (ICDS) India's most comprehensive and ambitious programme is with multi dimensional approach for solving the problems of women and children, with creative, preventive and habitative inputs. Among the six package of services of ICDS, supplementary nutrition component is found to be ranked high in terms of awareness and coverage as indicated in earlier studies [Widge

and Aijaz (1986), Sharma and Chand (1989), Prema *et al.* (1990) and Ukkuru (1993)]. Through ICDS, imported food viz., Corn soya blend is distributed to the needy women and children in our country. Complementary feeding programmes like ICDS, that use donated imported food have been vigorously criticized in recent years both as dole programmes that create dependency and also ineffective nutrition intervention.

In recent years much importance have been advocated to develop food supplements with indigenous foods suitable for the vulnerable section of the population by national level institutions and Universities. While formulating such food supplements, plant proteins have recorded considerable attention by virtue of their availability, low cost as well as nutritional and functional attributes. Among different vegetable proteins available in our country soya bean is the cheapest source of protein with all the essential amino acids except methionine and capable of supplementing efficiently cereal proteins (Swaminathan, 1990).

The present study is also an attempt to evaluate the "Impact of soya enriched food supplement on the nutritional status of women beneficiaries of ICDS" with the following objectives:

1. To evaluate the existing supplementary nutrition component of ICDS.

2. To formulate a suitable food supplement using indigenous food materials specially with soya protein to replace the existing one.

3. To study the impact of the newly developed food supplement on the nutritional status of the lactating women beneficiaries of ICDS.


REVIEW OF
LITERATURE

REVIEW OF LITERATURE

This chapter describes the earlier research findings under the head "Impact of soya enriched food supplement on the nutritional status of women beneficiaries of ICDS" are furnished under the following headlines.

1. Need for the development of food supplement
2. Nutritional status of women with special reference to lactating mothers
3. Role of ICDS as an intervention programme

2.1. Need for the development of food supplement

Malnutrition is a consequence of the relation of people with food (UNICEF, 1984). According to Alexander (1985) it is a major health problem of our country and it is acute and wide spread. FAO (1992) states that malnutrition is an avoidable tragedy with enormous social and economic costs in wasted human potential. It affects growth and reproduction and undermines health, learning and working capacity and overall quality of life and well being. Singh *et al.* (1994) feel that protein energy malnutrition remains as the nutritional problem of most of the developing countries.

Protein malnutrition is a serious problem in India due to cereal based dietary pattern. It is well known that the nutritive value of legume

proteins can be significantly enhanced by complementation with cereal proteins due to mutual supplementary effect (Yadav and Leiner, 1978). The high lysine content of pulse protein has a beneficial complementary effect on cereal proteins and the methionine and cysteine content of cereal proteins complement the pulse proteins (Ashraf and Bwembya, 1988). Therefore, various preparations based on cereal pulse combinations are of paramount importance to improve the protein quality of Indian diet (Bhatnagar and Goyal, 2000). According to Udani (1990) protein rich ready to eat or cook mixes need to be developed for supplementary feeding.

Economically affluent elites meet the nutritional requirements by feeding commercial supplementary / complementary foods but the cost of these commercial products make them beyond the reach of common men (Chandrasekhar *et al.*, 1988). Dahiya and Kapoor (1993) state that there is an urgent need to develop low cost nutritious supplements which is possible by the judicious combination of less expensive foods available in a rural household. Malleshi *et al.* (1989) have felt the need for the development of nutritionally balanced, calorie dense, low dietary bulk and easily digestable supplementary foods adapting simple traditional technologies. Ahmed *et al.* (1993) have emphasised the effectiveness of supplementation of cereals and legumes in the diets of the people. According to Malleshi (1995) a supplementary food should be rich in calorie and adequate in protein, vitamins and minerals; protein of high biological value in adequate amounts, soft in consistency and easy to swallow, low in dietary bulk and viscosity, easy to prepare, easily digestible, free from anti nutritional factors, low in indigestable fibre and free from artificial colours and flavours.

2.1.1. Selection of ingredients for the deveopment of food supplement

According to UNICEF (1983) in the formulation of supplementary foods many factors have to be considered such as nutritive value, easy availability, suitable consistency, cultural acceptability, culinary feasibility, digestability, frequency, quantity and volume. According to Juliano (1985) 70 per cent of the world's dietary energy is reported to be obtained from the staple food, based on cereals (50-60 per cent). Usually rice or wheat is used as the cereal base for food supplements, as a source of energy. Wheat is the largest cereal grain crop of the world and the second largest in India (FAO, 1997). Wheat is a staple food, which is consumed along with the bran because of which it finds a special place in therapeutic diets (Kavitha *et al.*, 2001). Wheat is the second most important cereal crop in India after rice with an annual production of 69.27 million tonnes in 1997-98 (Directorate of Economics and Statistics, 1998). Among cereals wheat is known as the king of cereals because of its pre-eminent suitability for preparation of large number of palatable products.

Legumes are widely grown throughout the world and their dietary and economic importance is globally appreciated. Legumes not only add variety to human diet, but also save as an economical source of supplementary proteins for a large population in developing countries like India (Boshnam, 1991). Commonly consumed legumes in Indian diets are greengram, bengalgram, peas, blackgram, cowpea and soyabean. Legumes are rich sources of protein (20-40 per cent) and carbohydrates.

Pulses or legumes are consumed in a variety of ways in Indian diets depending on cultural and taste preference thus contributing different flavour to the diet (Jogyabathi *et al.*, 2001).

The percapita availability of legumes in the country had steadily declined over the years from 61g/day in 1951 to 33g/day in 1988 and the market prices have escalated to levels well beyond the reach of the poor (Easwaran *et al.,* 1998).

Green gram is reported to be an excellent source of protein with higher digestability (Adsule *et al.*, 1986). It is generally utilized in the form of whole, split, sprouted, boiled, roasted and fried gram in India (Gupta and Nanjappa, 2000).

Incorporatin of defatted soyaflour in diets will not only enhance the protein content of the diet but also raise its nutritive value, thereby helping in combating malnutrition (Anila *et al.*, 1994).

According to Jayalakshmi and Neelakantan (1988) soya bean and its products have become increasingly popular but a large section of the population in India are still not aware of the food value of the soyabean. According to Jimbu and Ige (1990) the quantity of vitamin A is low in soybean but the vitamin is present to a level of 1.4 mg/g which helps to prevent oxidation of fatty acids.

Rounet *et al.* (1992) have reported that soy flour contains 9.9 g fibre, 7.52g of ash and 5.54g of protein in 100g. Sinha and Nawab (1993)

reported that soya flour is a very good source of quality protein and supplement the lysine deficiency in cereal flour. Soya flour is most attractive in price, quality and quantity and has been extensively studied and generally recommended for fortifying purpose (Gupta and Sehgal, 1991). According to Karleskind *et al.* (1991) soy based food products can be manufactured with good physical and functional properties and at comparable or lower cost than some traditional food products. Studies have shown that addition of 15 per cent soya flour to corn and sorghum meal seperately increased the Protein Efficiency Ratio, (PER) of the meal (Jayalakshmi and Neelakantan, 1987).

Soya beans were introduced in India during mid sixties (Sandeep *et al.*, 1993). Soya beans are abundantly rich in lysine which is a limiting amino acid in most of the cereals (Meena and Usha, 1990). Soya bean has long been recognised mostly as a valuable source of edible oil and as an excellent source of protein for feeding both animals and man (Irvin, 1994). Soya bean has great promises to combat malnutrition in the third world countries owing to its very high content of quality protein (Aswathy *et al.*, 1991). Soya bean, occupies a premier position as a world crop because of its high unrivalled protein content (Weingarther *et al.*, 1989). On sprouting, the iron content of soya bean was found to be increased (Hanna and Hemeda, 1997).

Soya bean fats are consumed in significant amounts in Asian countries because of its inexpensive high quality protein and the anti carcinogenic effects (Wang and Murhpy, 1994).

Defatted soya flour with 50 per cent protein holds great promise to meet the present day nutritional requirement of various population groups (Devadas, 1993).

Extrusion cooking is a recent innovation in the food industry, the use of soya protein in extruded products offers a chewy texture, increases the absorption property and promotes firmness (Tamiguchi *et al.*, 1987). Sinha *et al.* (1991) found that at 18 per cent level of incorporation, the perceptible beany odour was more pronounced.

Supplementation of soya malt product for a period of 90 days brought about a reduction in the symptoms of anaemia (Anuradha and Sangeetha, 2001).

Unlike the pulses, soya bean is found to contain about 40 per cent good quality protein (Patel and Shukla, 1990 and Gandhi, 1991). Wolf (1969), Singh (1987), Synder and Kwon (1987) and Swaminathan (1990) have observed that soyabean proteins contain all the essential amino acids except methionine. Studies conducted at CFTRI (1992) on soya bean have revealed its nutritional supremacy with the protein content of common pulses.

By replacing the traditional legumes with soya bean or defatted soya flour, the nutritive value of various preparations can also be enhanced. Improvement in the protein quality and lysine content by incorporation of soya flour in a supplementary food has been reported

by Cheriyan and Tarur (1992). The successful incorporation of soya flour in the development of supplementary foods has been reported by Gupta and Kaur (1982) and Ashturkar (1992).

According to Jayalakshmi and Neelakantan (1988) soya bean and its products have become increasingly popular but a large section of the population in India are still not aware of the food value of the soya bean. Solanki (1986) feels that there is an urgent need to develop low cost ready to eat mixes to improve the nutritional status of people. Chellammal and Prema (1995) processed multi purpose food with cassava flour, soy flour and skim milk powder. Wheat flour, green gram dhal and soya bean were the ingredients used by Malleshi (1995) for the preparation of protein rich multi purpose food.

Spices are important ingredients of our daily diet although they are used in small quantities. Spices are used traditionally for aroma and as preservatives. There are several reports demonstrating the anti-oxygenic potential of spices on cooked and cured meat products (Khanum *et al.*, 2001). The spices can be added successfully to supplementary foods to improve its flavour and aroma.

Palmoil blends itself to a wide variety of foods and uses both in the domestic kitchen and the food industry. According to Berger (1992) and Wenxun and Xiaoshu (1994) palmoil, with its moderate linolenic acid content and very small linolenic acid content, has a worldwide use in most frying applications.

According to Indris (1995) cakes prepared with palmoil in combination with butter fat had better baking properties than those made with pure butter fat and at the same time had the desired buttery flavour.

Palm oil is the second largest oil produced in the world and is also imported in India. Palmolein is the refined palm oil. Palm oil has 50 per cent saturated fatty acids and is a rich source of carotene, tocopherols and tocotrienols (Tarat and Sharma, 1999).

India is a rich bio diversity hot spot in the world and home to over 45,000 species of plants, both agricultural and medicinal. Indians have traditionally believed that all plants possess therapeutic value and scientific research has so far revealed about 5000 to 7000 species of flora with medicinal properties that can be trapped (UNESCO, 2000). In a study conducted by Srihareni and Lakshmi (2001) among pregnant mothers found that changes in serum iron levels after supplementation with *Cynodon dactylon* (Arungampul) juice is 35 per cent more among experimental group than control (11.2 per cent). Gross *et al.*, (1997) recommends use of improved novel types of medicinal/herbs supplementation to overcome anaemia among pregnant and lactating mothers and adolescent girls, which is a cost effective method without any side effects.

2.2. Nutritional status of women with special reference to lactating mothers

Women's nutritional status affects not only pregnancy outcome and birth weight, but also fertility, lactation, productivity and morbidity (Sadik, 1991).

Lactation makes considerable nutritional demands on the mother. The success of lactation as well as the health status of the infant depends entirely on the type of diet consumed by women during pregnancy and lactation. The maternal diet is of significant importance during lactation. The quality and quantity of milk secreted also depend on maternal diet.

The diets consumed by many lactating mothers in our country are very poor and are mainly cereal based (Rawtani and Verma, 1989). Many Indian mothers in the low income group have been observed to loose weight while nursing a baby clearly indicates that their calories and possibly their protein needs are not met.

Studies undertaken in developing countries indicate that among poorer segments of the population dietary intake does not increase during lactation. The added stress of manual work and reduction in dietary intake were shown to be associated with weight loss in lactating women in Gambia (Prentice, 1992). Women in less developed countries experience repeated pregrancies followed by long periods of lactation (Popkin, 1992). Studies from India had shown that the added stress of pregnancy and continued lactation resulted in a reduction in maternal weight (Ramachandran, 1989).

In a survey conducted among lactating labourers of Asian city regarding the food and nutrient intake, the mean cereal intake was shown to be 405 $\pm$ 10.6 g (63.8 per cent of RDA) against the requirement of 635g/day (Asha *et al.*, 1988). The pulse intake was only 20.5 per cent of

RDA. Intake of all types of vegetables was much below the RDA. They hardly consumed green leafy vegetables got free from the fields. Fruits, egg, nuts and meat consumption was almost nil.

Nath and Geervani (1998) found that intake of all the foods by lactating mothers from slums from Hyderabad including cereals was much below the recommended level. Lactating mothers residing in area of Jodhpur were also reported to consume milk, pulse, roots and tubers and other vegetables in small amounts. Where as consumption of green leafy vegetables and fruits was completely absent (Rawtani and Verma, 1989).

In a study conducted by Sinha and Pandey (1998) among 'Ho' tribe lactating women, showed that food taboos in lactation were practised out of fear that the child would be adversely affected through the breast milk if the mother consumed certain foods. In this study 85 per cent of respondents restricted non-vegetarian foods and vegetables like lady's finger, brinjal, green leafy vegetables, oil, spices and nuts as they believed that it would cause colic pain and diarrhoea in the child. It would also affect secretion of breast milk in mother.

Gopaldas (1989) observed that brinjal was considered to cause delay of the wound healing in mother and child. Eighty five per cent of lactating women were observed to include foods like mandi (rice cooked with lots of water) rash (top layer of rice beer), cooked rice fermented overnight with common salt, turmeric soup, dried onion seed, blackgram dhal, papaya and sathavari herb which are supposed to help in milk production (Sinha and Pandey, 1998).

Insufficiency of milk in the mothers can be treated by consuming nutritious diet and lactogogues (Subash and Arya, 1990) which are special foods to increase breast milk secretion. Ghosh (1993) recommends that to increase mother's milk secretion, eating of specially prepared foods from herbs and roots possessing the galactogogue properties, massage and hot fomentation of breast in addition to regular suckling of the infant are advisable.

Sathyapriya and Vijayalekshmi (1998) opined that supplementation of selected galactogogues like satevarex domestic leaves and garlic for a period of one month to the lactating mothers brought increased milk output.

There is a lot of evidence available from several studies reported in different parts of the world that belief concerning the importance of food restrictions of lactation are very common (Ferroluzzi, 1980, Pandey and Rohinidevi, 1990). In a study conducted by Meena *et al.* (2000) in urban and rural areas, Parbhani district, different types of food items such as fruits, curd, puffed bengal gram, ground nuts, fried foods, banana, potato and fish were reported, avoided or restricted in the diet of lactating mothers due to various food beliefs. Gupta (1994) reported that lactating mothers avoided various foods such as citrus fruits, sweet potato, pumpkin, green leafy vegetables, pulses, curd, butter milk, tamarind, pickles and spices due to varied reasons. Another study conducted among lactating mothers in Haryana by Jood *et al.* (1999) found that foods like pearlmillet, pulses, green leafy vegetables, vegetables like turnip, radish, carrot, bittergourd, curd, jaggery, garlic, pickle and spices were avoided by lactating mothers.

Restriction in different types of foods during lactation may lead to poor nutritional status of women and children, and hence a fully balanced diet is an unavoidable necessity of lactating mothers. Several studies have been carried out regarding the subject. In a study conducted among 200 lactating women in the urban and rural areas of Parbhani district, it was observed that the intake of pulses, other vegetables, roots and tubers, milk and milk products and fats and oils were significantly higher among the lactating women (Meena *et al.*, 2000). Jood *et al.* (1999) reported that mean daily intake of cereals among lactating women of Haryana were met 76-99 per cent of RDI requirement, but a lower intake of pulses was reported. Similarly lower intake of cereals and pulses has been reported by Gupta (1994), Kaur and Sehgal, 1991).

Daily mean energy intake among the lactating mothers were more than the recommended intake (Jood *et al.*, 1999). Butte *et al.* (1984) have reported adequate intake of energy where as others (Finley *et al.*, 1985; Rao, 1985; Geervani and Jayasree, 1988; Kaur and Sehgal, 1991) reported lower intake of energy during lactation. Energy intake of Punjabi women was low meeting only 60.5 to 74.8 per cent of the recommendations stipulated (Hira *et al.*, 1988). ACC/SCN report on Nutritional policy discussion (1992) showed that the calorie intake of 45 per cent of lactating women is below the required level and that 50 per cent of pregnant women are anaemic. Lactating women secrete about 500-800 ml milk a day and lactation involves energy loss of about 500-600 kcals a day. Nutritionists recommend an additional dietary intake up to 500 kcal, daily to meet the extra nutrient needs of lactating women (FAO/WHO/UNU, 1985).

Different studies have shown that the protein intake of nursing mothers (Pema *et al.*, 1981; Rosales, 1982; Chaudhary, 1985; Hira *et al.*, 1988; Kaur and Sehgal, 1991 and Jood *et al.*, 1999). Bhatia *et al.* (1988), Kaur and Sehgal (1991), Gupta (1994) and Jood *et al.* (1999) reported that the intake of riboflavin, thiamin and Vitamin C by the nursing mothers were below the RDA stipulated (ICMR, 1999).

In a study conducted by Meena *et al.* (2000) among 200 lactating women in rural and urban areas of Parbhani district it was found that the body weight of these lactating women were reported to be markedly less than the standard value of weight of adult reference woman. Bishnoi *et al.* (1999) had also conducted studies among the lactating mothers in three districts of Haryana was found that the body weight and height were below the standard weight and height of reference woman. The BMI values showed about one fourth of the respondents were under weight.

2.3. Role of ICDS as an intervention programme

Various nutrition programmes are introduced in our country in order to provide relief to the pressing problems of malnutrition and under nourishment giving top priority to the vulnerable groups viz., children, pregnant and lactating mothers. The important perspective for food supplementation in pregnancy and lactation may be the mother rather than the infant in utero or at the breast. Women in developing countries face major responsibility for the health and well being of the household. Pregnancy and lactation in the face of inadequate food intake have an unquestionable negative impact on the mother.

There are several studies that food distribution programmes directed towards pregnant women, can have beneficial effects on intrauterine growth as measured by birth weight of the baby (Adair and Pollitt, 1983; Lechting *et al.,* 1976; Mora *et al.*, 1978, 1979; Prentice *et al.*, 1983, 1987) and supplementation of lactating mothers' diet is also observed to carry benefit to the nursing infant (Stottingfus *et al.*, 1992).

Lutter *et al.* (1998) present the argument that targetting of food distribution should be based on the risk of malnutrition.

Food distribution programmes can serve as a vehicle for micronutrient supplementation (National Academy of Sciences, 1982).

Juditkatona (1993) opined that supplementary feeding for economically and nutritionally vulnerable groups in Bolivia and Peru helped to prevent deterioration of their nutritional situation.

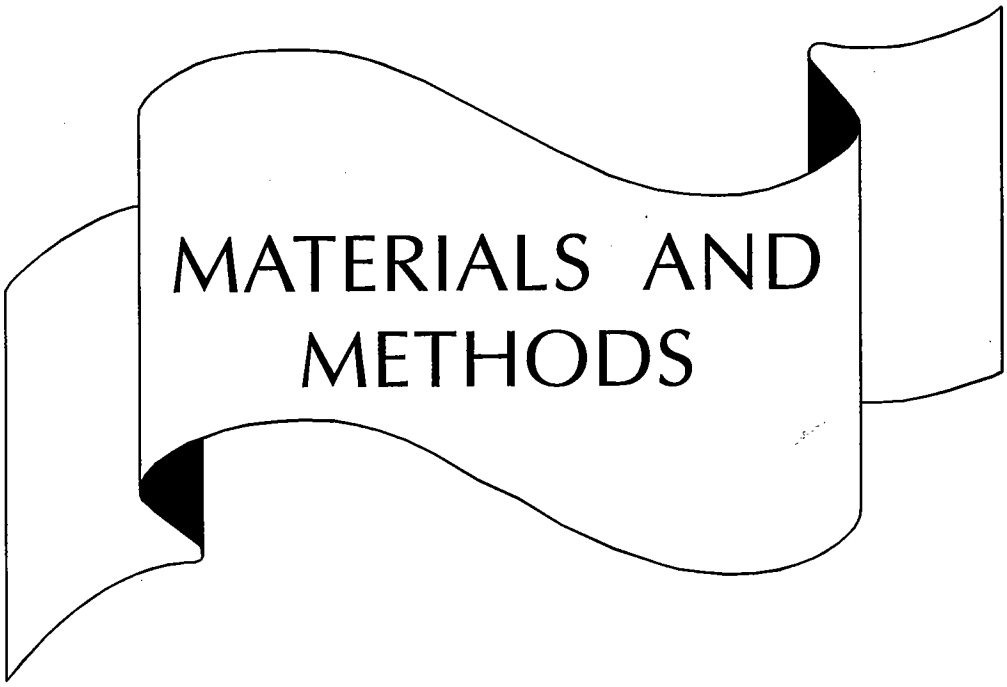
Beaton (1992) and Pelletier *et al.* (1991) opined that feeding interventions early in life during pregnancy prevent linear growth failure and improve learning capacity among children.

ICDS programe initiated in India in 1975 is a nutrition and health integrated programme for pre-school children, pregnant and lactating mothers. ICDS is one of the most important programmes among the several national programmes aimed at the development of women and children. The ICDS has expanded from an experimental scheme which was initiated in 1975 with 33 blocks, to the most comprehensive scheme

of the Government of India covering over 5614 projects in India (Indira, 1997). The ICDS programme is specifically designed to reach disadvantaged and low income groups for effective disparity reduction. The programme provides an integrated approach for converging basic services for improved child care, health and nutrition targeting young children, expectant and nursing mothers and adolescent girls (Jain *et al.*, 1999). Gupta and Srivastava (1989) and Thakar and Jyotsna (1990) had reported that nutritional status of the beneficiaries of the ICDS programme were relatively better than that of the non-beneficiaries due to the impact of the package of services provided to them. Bhatnagar *et al.* (1983) had reported that women receiving supplementary nutrition of 300 calories and 16 g protein in the last trimester of pregnancy in an urban ICDS programme had showed significantly higher weight gain as compared to the control group matched for age, weight, parity, social class and nutrient intake. Thakar and Patil (1990) had the opinion that community participation is essential for effective implementation of ICDS programme.

Ghosh (1986) stated that the main objective of ICDS is to promote health of children from birth to six years and look after pregnant and lactating mothers and cater to the under served segments of rural tribal and urban population.

Pawar (1988) roughly pointed out that ICDS is based on the conviction that community development programmes can become catalytic agents for social change and serve to improve the quality of life of present and future generations of the disadvantaged poor.


MATERIALS AND
METHODS

MATERIALS AND METHODS

The present investigation on "Impact of soya enriched food supplement on the nutritional status of women beneficiaries of Integrated Child Development Services (ICDS)", comprises of

1. Selection of ICDS centres and respondents
2. Evaluating the existing supplementary nutrition component of ICDS
3. Formulating a suitable food supplement to replace the existing one
4. Preference studies on the selected product
5. Reorientation of supplementary nutrition component of ICDS using selected food supplement.

3.1. Selection of ICDS centres and respondents

Thiruvananthapuram district was chosen as having maximum operational relevance to the study. As a second step, all available ICDS Blocks in the district were listed and Athiyannoor ICDS Block with an experience of 25 years of implementation of the programme was purposively selected. In the third stage from among the 125 ICDS anganwadi centres in the block, 20 centres within eight km radius of the College Campus were selected for the study.

All the lactating women beneficiaries (LWB) in the 20 centres were identified as respondents for the study and from among them, 120 respondents were selected at random. This group was further divided randomly in to two groups of 60 respondents each as Experimental Group (EG) and Control Group (CG).

3.2. Evaluating the existing supplementary nutrition component of ICDS

Inorder to evaluate the existing supplementary nutrition component of ICDS, data pertaining to the present food distribution system with reference to programme efficiency, efficiency of delivery of inputs with respect to quantity of food supplement prepared and distributed for consequent three months. Impact on rate of participation of beneficiaries were also assessed with reference to procurement of inputs and utilization of the same for consequent six months. Cost of implementation were collected from the records of the anganwadi centre and analysed. Health profile of the LWB in the existing ICDS programme were also assessed using suitable anthropometric and biochemical techniques (Jelliffe, 1966). Attitude of implementing staff at the centres (20) towards the programme was ascertained using suitably structured scale detailed in Appendix I.

The nutritional quality of the present ICDS food supplement with reference to protein (g/serving), energy (kcal/serving), protein energy ratio per serving and their percentage contribution to one day nutritional requirement of women beneficiaries were also ascertained.

3.3. Formulating a suitable food supplement to replace the existing one

Foods that are fed to an individual in addition to his/her regular daily diet is called as a food supplement. Food supplement distributed under ICDS is expected to supply 500 kcals of energy and 20-25 g protein per serving per day for women beneficiaries. This norm was followed in the formulation of the food supplement, in this study.

3.3.1. Selection of raw materials

Raw materials play a vital role in determining the nutritional and functional quality of the food supplement developed. Food articles selected were taken in different proportions and combinations, for the development of various formulations of the food supplement.

3.3.1.1. Energy supplement

Sinha and Nawab (1993) have reported that rice or wheat is usually used as the energy base for supplementary foods. In this experiment, rice and wheat being the major staple foods in the daily diets of Keralites were selected for the formulation of food supplement.

Nuts, oil seeds and oils are also very rich in energy. Groundnut, coconut and sesamum as nuts as well as oils were included in various proportions in different combinations. Oils like groundnut oil, coconut oil, gingelly oil and palm oil were tried out as an energy contributing factor in different combinations of the food supplements developed.

Roots and tubers popular in Kerala dietaries such as cassava, sweet potato and potato were also tried out as an energy constituent in different formulations.

3.3.1.2. Protein supplement

Legumes add variety and serve as economical source of protein. Different pulses like horse gram, green gram, bengal gram and cowpea were selected as the major source of protein in different combinations. Deoiled coconut meal was also tried in few combinations as protein supplement. But soyabean with 40 per cent good quality protein was included as an essential ingredient in different proportions in all the combinations worked out. For this, soya chunks an extruded processed product from soya bean, which has 53 per cent protein, high digestability coefficient and protein efficiency ratio and low in non nutritional factors was used.

3.3.1.3. Vitamin and mineral supplement

Spices like omum (*Trachyspermum ammi*), Jeera (*Cuminum cymimum*) and a medicinal leaf poovarasila (*Thespesia propulnea*) being rich in vitamin and mineral components were included in different formulations. They also contribute flavour and taste to the products.

3.3.2. Formulation and selection of different combinations

Food ingredients like cereals (50-60 per cent), pulses (10-15 per cent), soya (15 per cent), roots and tubers (10-15 per cent) nuts and oil

seeds (5-15 per cent) and oils (10 per cent) were used to compute 97 combinations of food supplements. Soya, palm oil, omum, jeera and poovarasila were included in all the combinations in equal amounts.

Amino acid score, chemical score, cost and energy protein concentration in each combination were computed and compared. From among these 97 combinations 15 combinations with high amino acid score, chemical score and nutrient density were selected as indicated in Appendix. II. From among the 15, five combinations were selected and processed for further indepth investigation. The five combinations of the food supplements selected were subjected to ascertain the nutritional and cooking qualities, acceptability, shelf life and economic feasibility. All the tests were administered on the currently distributed food supplement under ICDS.

3.3.2.1. Yield ratio of the five combinations

Yield ratio of the five combinations selected, was found out using the formula

$$\frac{\text{Cooked weight}}{\text{Weight before cooking}}$$

3.3.2.2. Processing loss in the five combinations

The weight of the food ingredients as purchased (Ap wt) minus that of the edible portion of the ingredients included in the formula (EP

wt) gives the preparation loss or processing loss and the ratio of processing loss was calculated using the formula

$$\text{Processing loss} = \frac{\text{Ap wt. - EP wt.}}{\text{Ap wt.}}$$

3.3.3. Composition of food supplement

Composition of food supplement was ascertained by determining the nutrients and the non-nutrient factors present in the formulations.

Nutritional quality of the developed food supplements and the food supplement distributed in the ICDS (green gram and rice gruel) were assessed by determining the nutrients listed (Table 1) below. Non nutrient factor such as phytin was computed using ICMR data (Gopalan *et al.*, 1991).

Table 1. Methods used to determine the nutrients

Nutrients	Methods used
Energy	Swaminathan, (1984)
Protein	ICMR, (1983)
Calcium	Jackson, (1973)
Iron	
Phorphorus	
Carbohydrate	Sadasivan and Manickam, (1992)
Fibre	
Fat	
Non nutrient factor	
Phytin	Gopalan *et al.* (1991)

3.3.4. Evaluation of protein quality through animal experiments

Protein quality and physiological tolerance are important parameters to be considered before introducing a new product. The physiological tolerance of the developed food supplement was assessed by determining PER (Protein Efficiency Ratio), BV (Biological Value), DC (Digestability Coefficient) and NPU (Net Protein Utilization).

Measuring the growth rate of experimental animals fed on a test food over a period of time offers the simplest method to evaluate the nutritive value of proteins (Ritchey and Harper, 1987). The PER is derived from the weight gain in the test animals.

Fourty two weanling albino rats of wistar strain of 20-30 days old with body weight ranging from 45 to 49 g were selected for the experiment. The rats were divided into seven groups of 6 rats each in a group. The first group served as control and was fed with the stock diet (Table 2) and group II to VII were fed on test food.

The experiment was conducted in CRD with six replications. The six treatments / food supplements were five soya enriched food supplements and the control casein diet. The VIIth treatment was ICDS food supplement. The experiment was carried out for a period of 28 days as per the procedure of Pellet and Young (1980).

Table 2. Composition of diets used for protein quality studies

Particulars	Stock diet	Experimental diets*						Non protein diet
	I	II	III	IV	V	VI	VII**	VIII
Food supplement	–	59	58	74.1	58	58.7	74	–
Starch	58.7	26	27	10.9	27	26.3	11	85
Skim milk powder	26.3	–	–	–	–	–	–	–
Oil	9	9	9	9	9	9	9	9
Vitamin mix	2	2	2	2	2	2	2	2
Mineral mix	4	4	4	4	4	4	4	4

* As indicated in the table, starch and casein were replaced by test food in the experimental group

** ICDS Food supplement (rice and green gram gruel)

The extent of utilization of protein in the food supplement was measured through nitrogen balance study. Groups of six male adult wistar rats each weighing approximately 65-75 g were used in the nitrogen balance experiment. Rats were housed individually in metabolic cages in the controlled environment. The whole experiment was divided into three phases. During the first phase of four days all the rats were fed with Diet VIII viz., non-protein diet to measure the endogenous nitrogen (Table 2). During the second phase of three days the rats were fed with stock diet (Table 2). During the third phase of four days, the different groups were fed with seven different experimental diets and one stock diet. Each animal received 15 g of diet and water was supplied adlibitum. Body weight and dietary intake of the animals were recorded. Samples of urine

and stools were collected separately during the period of the investigation. The stools were dried and ground into fine powder. The nitrogen in urine and stools were determined and NPU was calculated as per the procedure of Pellet and Young (1980).

3.3.5. Organoleptic qualities of food supplement developed

Beyond satisfying the nutritional needs, the foods chosen by people and the quantity consumed depend upon its acceptability. Hence evaluation of organoleptic qualities play an important role in acceptability study of a food product.

The panel members (20) were selected from the technical experts in the College of Agriculture, Vellayani through a triangle test (Watts *et al.*, 1989). A score card of 5 point hedonic scale was used for conducting the acceptability tests. The score card developed is given in Appendix III. The seven parameters included in the score card were appearance, colour, flavour, texture, taste, doneness and overall acceptability.

3.3.6. Shelf life studies of the food supplements developed

Glass bottles of 1 kg capacity were selected to store the food supplement as well as the regular ICDS supplement. After filling the bottles full, they were closed air tight and kept for storage study for a period of six months for evaluating the parameters listed below (Table 3).

Table 3. Different parameters used for shelf life studies

Parameters	Methods
Moisture	AOAC (1976)
Peroxide value	AOAC (1976)
Insect Infestation	Johnson and Curl (1972)
Microbial count	Martin (1950)

3.3.7. Economic feasibility

Cost of the developed food supplement was computed as input costs, output efficiency and programme cost/beneficiary/day.

3.3.8. Rate of participation of beneficiaries

Participation of an individual in a programme is defined as the sum total of his / her involvement in the various activities of the programme. In order to assess the total participation of beneficiaries in the programme, their involvement in each component of the programme are to be accounted. Participation index of a beneficiary is the weighted average of participation coefficient in each of the components in which they are involved, the weights being the frequency of involvement in each activity.

In order to assess the participation coefficient of the respondents in supplementary nutrition, attendance of beneficiaries maintained in

anganwadies for the previous six months of survey period was taken into account.

3.4. Selection of best food supplement for further indepth investigation

Based on the above parameters (3.2 to 3.7) from the five selected combinations, one combination capable of supplying minimum 500 kcals of energy and 20 g protein was selected for further investigation.

3.4.1. Preference studies on the selected food supplement

Suitable recipes of the selected combinations were standardised and series of acceptability trials were conducted at institutional level to select one recipe. Recipes, standardised are detailed in Appendix IV. Demonstrations on selected recipe and hygienic measures of food preparation were conducted at the selected centres. Preference tests of the selected products were conducted at field level among 50 field workers and 100 beneficiaries using nine point and five point hedonic rating scales respectively (Appendix V and VI).

3.5. Re-orientation of supplementary nutrition component of ICDS using the selected food supplement

3.5.1. Large sample investigations

Impact of food supplement developed can be evaluated only through feeding trials among needy populations. Supplementary study

for six months period was conducted among 60 women beneficiaries (laclating mothers) at the selected centres in ICDS Block Athiyannoor. Equal number of regular beneficiaries (lactating women) of ICDS from other centres in Athiyannoor ICDS block were selected as control.

3.5.1.1. Socio economic and dietary profile

Socio economic and dietary profile of the women beneficiaries in the two groups were ascertained using a suitably structured schedule (Appendix VII) through interview. Nutritional contribution of food supplement, to the daily energy and protein requirement of these mothers were also assessed.

3.5.1.2. Influence of food supplement on health profile

Influence of food supplement was ascertained by monitoring the health condition of women beneficiaries with respect to changes in anthropometric measurements and clinical profile, for a period of six months.

Anthropometric indices are useful, sensitive, practical, accurate and reliable indicators of nutritional status of a community. In the present study details pertaining to the height, weight, Body Mass Index (BMI), skin fold thickness and waist hip measurements were the major indices elicited. The details of the procedures adopted are given in Appendix VIII.

Clinical assessment is the most important part of nutritional assessment which gives direct information of signs and symptoms of

dietary deficiencies in an individual. Clinical examination of 120 beneficiaries was conducted using the schedule presented in Appendix IX.

3.5.1.3. Attitude of the beneficiaries towards food supplement

Attitude of the beneficiaries towards the newly developed food supplement as against the regular ICDS supplement was assessed using standard procedure.

The objective measurement of attitude requires a scale developed for the purpose. An attitude scale contained statements, selected by different methods. Items and their scale value were decided by a panel of judges in equal appearing interval scales and successive interval scales. Item analysis was the basis for selection of items in Likert scales. Scalogram analysis of Guttan was followed in selecting items with unidimensionality.

An arbitary scale was developed for the present study for measuring the attitude of field functionaries towards ICDS programme. In developing attitude scale, a large number of statements each expressing some opinion about the ICDS programme were collected and edited according to the criteria suggested by Edwards (1957). These statements were then circulated among the specialists to assess the appropriateness of these statements for an attitude scale. In the light of the suggestions made by specialists the items were modified and selected.

The responses of each item were obtained on a five point continuum ranging from 'strongly agree' to 'strongly disagree'. The

scores assigned were for 'strongly agree' 4, 'Agree' 3, 'Undecided' 2, 'Disagree' 1 and 'Strongly disagree' 0. Negative statements were scored in the reverse manner. The attitude score of the beneficiaries were obtained by adding up the scores corresponding to their response pattern for each statement. Attitude scale thus developed is presented in Appendix X.

3.5.2. Investigations on sub sample

Influence of the food supplement on the nutritional status of women beneficiaries was ascertained on a sub sample of 20 beneficiaries from experimental and 20 from control group for eliciting information on actual food intake and blood profile.

3.5.2.1. Actual food intake

Information regarding actual food intake of 20 beneficiaries each from experimental and control groups for one day was conducted through weighment method. The schedule used for evolving such information is given in Appendix XI. The nutrients available from the food consumed was computed using food composition table (Gopalan *et al.*, 1991).

3.5.2.2. Blood profile

Variations in the intake of different nutrients in the diet are reflected by changes in the concentrations of the corresponding nutrients in blood, tissues and urine.

Following biochemical investigations were carried out among women beneficiaries of ICDS (Table 4).

Table 4. Methods used to study blood profile

Parameters studied	Methods	Sample size	
		Experimental group	Control group
Haemoglobin Cyanmethaemoglobin method	NIN, 1983	60	60
Serum protein Biurette method	NIN, 1983	20	20
Serum albumin Bromocresol green method	NIN, 1983	20	20
Serum iron Wong's method	NIN, 1983	20	20
Total Iron Binding Capacity	Good Hart and Shills, 1980	20	20

3.5.2.3. Nutritional Status Index (NSI) of respondents

Suppose x_{ij} be observation corresponding to j^{th} variable for the i^{th} sample, $wj = 1/\sigma_j^2$, the weight assigned to the observation corresponding to j^{th} variable, the nutritional status of i^{th} individual is defined as

$$N_i = \frac{\sum_{j=1}^{k} w_i x_{ij}}{K} \qquad i = 1, 2 .... N$$

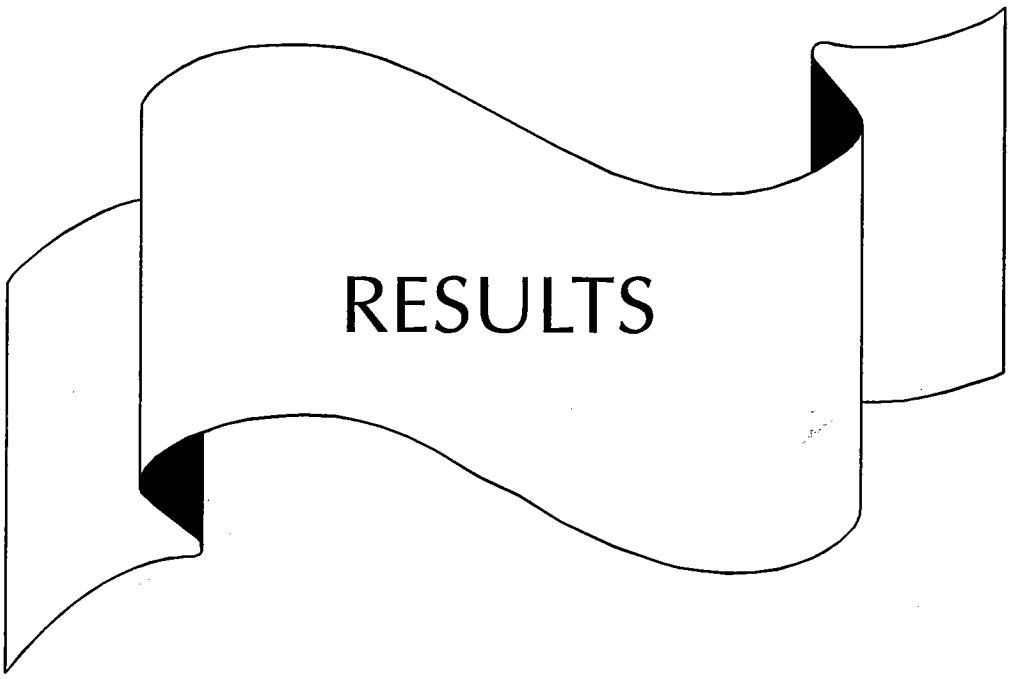
N = number of respondents

K = number of variables

The NSI of lactating women beneficiaries were defined in terms of characters such as weight, height, Body Mass Index, clinical score and haemoglobin levels.

3.6. Statistical analysis

The data collected were tabulated and analysed using suitable statistical methods. Percentage calculation, test of significance, chi-square test, paired 't' test and test for proportion were the statistical methods used for the analysis of data (Arora and Malhan, 1998).


RESULTS

RESULTS

Results of the present investigation entitled "Impact of soya enriched food supplement on the nutritional status of women beneficiaries of ICDS", comprises of:

1. Selection of ICDS Centres and respondents
2. Evaluating the existing supplementary nutrition component of ICDS
3. Formulation and selection of suitable food supplement to replace the existing one in ICDS project
4. Selection of best food supplement for further indepth investigation
5. Socio economic and demographic profile of lactating women beneficiaries
6. Reorientation of supplementary nutrition component of ICDS using selected food supplement

4.1. Selection of ICDS Centres and respondents

Eleven centres from Thiruvallam panchayath and nine centres from Venganoor panchayat in Athiyannoor ICDS Block, Thiruvananthapuram

district were selected (Fig. 1) for the study, being most relevant to the operational evaluation of the supplementary nutrition component of ICDS. From among the two categories of women beneficiaries of ICDS viz. pregnant and lactating women beneficiaries, lactating women beneficiaries were selected for the study. The selected beneficiaries were classified in to two groups of 60 beneficiaries each, constituting Experimental Group (EG) and Control Group (CG).

4.2. Evaluating the existing supplementary nutrition component of ICDS

One of the major components of ICDS is supplementary nutrition, which acts as nodal agent for disseminating the simple nutrition messages. To evaluate this component, informations regarding the present food distribution system with reference to delivery of inputs to anganwadi centre as well as to beneficiaries, efficiency of delivery of inputs for the consequent three months, the rate of participation of beneficiaries for consequent six months, attitude of anganwadi staff towards ICDS with reference to supplementary nutrition component and economic viability of the programme were elicited.

4.2.1 ICDS Food supplement

As per the implementation procedure, panchayath is responsible for procurement, transportation and delivery of inputs to the anganwadi centres. The food ingredients distributed was stored in the anganwadi centre and daily ration was drawn from this stock for use. Lack of proper storage facilities in the centre, especially during rainy season

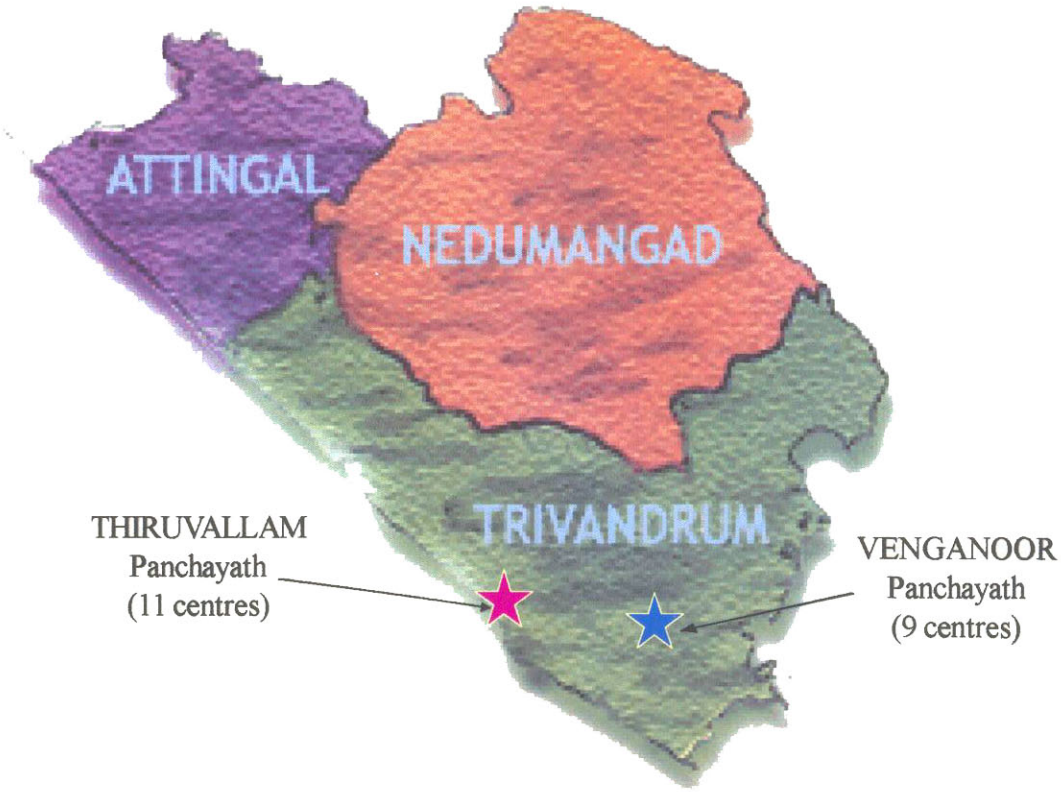


Fig. 1. Location of the study

was observed to have a negative impact on the shelf life qualities of the stored food supplements. Details pertaining to the storage facilities available in the centres studied, revealed that 25 per cent of the anganwadi centres had their own pucca buildings with store rooms and 15 per cent had same facilities in rented buildings. And fifty per cent of the centres were observed to be functioning in rented thatched buildings with inadequate storage facilities and 10 per cent in their own thatched buildings without facilities. This basic facility of ensuring proper storage is also observed to have direct or indirect effect on the proper functioning and efficiency of the supplementary nutrition programme with reference to distribution of food supplements and rate of participation of the beneficiaries.

Daily ration of the food supplement for a woman beneficiary was 100g rice and 30g green gram while food supplements distributed under ICDS are expected to supply 500 kcals of energy and 20g protein per serving/day for a woman beneficiary. This food supplement was prepared as a gruel at the centre and distributed to the beneficiaries. As per plan of action of ICDS, "on the spot feeding system" as well as "take home system" were observed to be recommended and the latter was found to be popular among 86.66 per cent of the beneficiaries studied.

Constant observation of feeding programme in the centres studied, revealed that food supplement per average serving was found to be 130g with 12.61 g of protein and 446 kcals of energy. Protein Energy ratio of the food supplement worked out was found to be 11.30 per cent. The food supplement was also observed to supply 17 per cent calorie and 19

per cent of protein needed for a lactating woman in a day as specified in recommended daily allowances of nutrients by ICMR (1999).

4.2.2 Collection rates of the ICDS food supplement

Efficiency of delivery of inputs was also assessed by monitoring the total quantity of the food supplement, distributed during the period of 3 months in the existing programme. Informations collected in this context were total quantity of food supplement procured at the centre, number of feeding days in three months (74 days from May 2001 to July 2001) and number of days on which feeding was actually conducted in various centres during this period (Table 5).

Out of 20 centres selected, only nine centres were observed to conduct the supplementary feeding for women beneficiaries more or less regularly during the three months period. Reasons given by the functionaries at the remaining 11 centres for not conducting feeding were delay in the delivery of inputs to the centre from the source of supply, and delay in the reimbursement of contingent grant to the field functionaries of the centre.

Out of 74 feeding days during the three months observation period, only 20 to 60 days feeding was conducted at different centres. In these nine centres, none of the centres had reported 100 per cent feeding. Four centres were observed to have conducted feeding for 75 to 78 per cent of the feeding days scheduled and two centres 64 to 68 per cent. Remaining three centres were found to conduct feeding only for 28 to

Table 5. Efficiency of delivery of inputs under supplementary nutrition component of ICDS during the three months period

Sl. No. of centres	No. of days feeding conducted		Quantity of of food procured (kg)	Quantity of food needed (kg)	Deficit amount of food (kg)	Per cent deficit
	No.	Per cent				
1	56	75.68	43.68	57.72	14.04	24.33
2	58	78.38	15.08	19.24	4.16	21.62
3	58	78.38	15.08	19.24	4.16	21.62
4	51	68.92	13.26	19.24	5.98	31.08
5	48	64.86	31.20	48.10	16.90	35.13
6	21	28.38	13.65	48.10	34.45	71.62
7	26	35.14	30.42	86.58	56.16	64.86
8	24	32.43	28.08	86.58	71.50	82.58
9	58	78.38	15.08	19.24	4.16	21.60

35 per cent of the days scheduled. These lapses were also observed to be directly associated with the quantity of food supplement procured by each centre. The quantity of food procured, quantity to be fed and per cent deficit in food supply were worked out. The defecit was observed to be 21 to 82 per cent in different centres.

The delivery system operated under ICDS was comprised of receipt of inputs, participation and utilisation of inputs by target population. The criteria adopted for assessing the efficiency of these components, in this study were by eliciting information on the proportion of targeted quantity of inputs actually delivered to a centre, and participation rate by the lactating women beneficiaries (LWB). A programme efficiency index which is a product of the proportion of inputs (food) reaching each anganwadi centre and the participation rate for each input by the lactating women beneficiaries was aggregated, and indices developed for each centre are presented in Table 6.

Programme efficiency indices developed for various centres were found to have direct association with the availability of food supplements and rate of participation of the women beneficiaries.

4.2.3 Rate of participation of the women beneficiaries in the existing ICDS programme

Inorder to assess the participation rate of the women beneficiaries in supplementary nutrition, attendance of the beneficiaries in the selected 20 anganwadi centres for subsequent six months were taken into account. Table 7 furnishes these details.

Table 6. Programme Efficiency Indices of various anganawadi centres

Sl. No. of Centres	P_f	Q_f	I_f
1	86.15	0.566	48.80
2	90.00	0.902	81.18
3	91.47	0.706	64.58
4	90.76	0.622	55.45
5	88.20	0.510	45.31
6	74.51	0.469	34.94
7	87.51	0.482	42.22
8	132.00	0.175	23.10
9	112.79	0.706	79.63

P_f - Proportion of actual food intake

Q_f - Rate of participation of beneficiaries for the input food

I_f - Food index

Table 7. Participation of women beneficiaries in the existing supplementary nutrition component of ICDS

Particulars	Per cent
Duration of participation	
< 5 months	18.33
5 - 10 months	36.67
10 months - 1½ year	45.00
Distance of anganwadi centre from the location of residence of women beneficiaries	
5-10 minutes walk	38.33
10 - 15 minutes walk	61.67
Attendance in supplementary feeding	
Regularly	53.33
Occasionally	46.67
Reasons for becoming beneficiary	
Free feeding	45.00
Medical aid	35.00
Interest in education classes	38.33
Persuation by anganwadi staff	91.67

From the table it is clear that 45 per cent of the women beneficiaries were participating in the supplementary nutrition programme of ICDS for the last 10 months to 1½ years. Among the beneficiaries 18.33 per cent were participating for the last 5 months while 36.67 per cent of them were attending the programme for the last 5 to 10 months.

The distance between the anganwadi centre and location of residence of the women beneficiaries varied widely, since 61.67 per cent of the beneficiaries were observed to take 10-15 minutes to reach the centre, and remaining 38.33 per cent of the women beneficiaries were to take only 5 to 10 minutes for the same purpose.

Among the women beneficiaries only 53.33 per cent were found to attend the supplementary nutrition programme regularly while remaining beneficiaries utilised this facility occassionally (46.67 per cent).

Reasons putforth by the women beneficiaries to enrol as beneficiaries in the programme were the pursuation of the field functionaries of anganwadi centre (91.17 per cent), availability of free food (45.00 per cent), free medical aid (35.00 per cent) and genuine interest in attending education classes conducted in the centre (38.33 per cent).

4.2.4 Health profile of the lactating women beneficiaries in the existing ICDS programme

Regular participation in the supplementary nutrition programme may influence the health profile of the beneficiaries. Hence general

health status of all women beneficiaries (120) were assessed by ascertaining BMI (Body Mass Index), haemoglobin level and general clinical profile of the women beneficiaries. BMI indicates ratio of weight (in kg)/Height^2 (in m) and provides a reasonable indication of nutritional status. BMI is also observed to have direct association with fatness and indicates health risk. Among the 120 lactating women beneficiaries, 10.00 per cent were observed to have mild energy deficiency, 5.00 per cent moderate energy deficiency and 1.67 per cent severe energy deficiency, indicating that more than 16.00 per cent of the respondents were undernourished.

Waist Hip Ratio (WHR) worked out for the women beneficiaries also revealed that 23.33 per cent of the respondents were found to be in a ratio of 0.91 to 0.99 and 66.67 per cent of the respondents were in a ratio of 0.80 to 0.90 indicating the prevalence of gluteus obesity which may be due to the physiological condition in which the women were placed. Ten per cent of them were in the ratio of 0.71 to 0.80.

Assessment of triceps skinfold thickness of women beneficiaries, revealed that 55.83 per cent were below the normal level of fat fold thickness and 41.67 per cent of the respondents were above the normal level and 2.50 per cent of the women beneficiaries belong to the normal group.

Haemoglobin level is an important tool in diagnosing anaemia. Analysis of blood samples collected from these respondents revealed that 70.00 per cent had values below 12 g/dl indicating anaemia of mild to severe cases.

General clinical profile of the respondents also revealed that 11.66 per cent belong to poor health status depicting nutritional deficiency symptoms.

4.2.5 Attitude of existing staff of the anganwadi centre towards ongoing ICDS programme

Attitude of the existing staff (40) towards the ICDS programme was assessed by administering a scale with 20 statements on various aspects of implementation of major components of ICDS selected after pretesting in the field.

Maximum score for the twenty statements selected was 80. All the field functionaries were observed to respond very favourably to the statements, related to ICDS food supplement, and need for increasing their remunerations. Favourable responses were also observed for the statements related to ICDS components like supplementary nutrition, health status and medical services. Lesser number of field functionaries were found to have favourable approach to health check up components, physical facilities of ICDS centres and need for effective implementation of the programme.

Table 8 depicts the distribution of the staff based on the scores obtained. Scores in the range of 60 to 69 were obtained for 11 field functionaries constituting 27.50 per cent of the total personnel to whom the scale was administered. Sixty seven point five per cent of the respondents scored 50-59 scores constituting 27 personnel, and scores in the range of 40-49 by 5 per cent of the personnel.

Table 8. Distribution of respondents based on the attitude scores obtained

Details of scores	Details of Respondents	
	No. of respondents	Per cent
70-80	–	–
60 - 69	11	27.50
50 - 59	27	67.50
40 - 49	2	5.00

Table 9. Attitude of implementing staff towards the supplementary nutrition component of ICDS

Statements related to supplementary nutrition component of ICDS	Total scores obtained	Per cent
1. Anganwadi centre promotes the nutrition status of beneficiaries through supplementary feeding	160	100
2. The food supplied through anganwadi is nutritious	125	78.13
3. Variety in supplementary food is needed	120	75.00
4. The quantity of food supplied through anganwadi is inadequate	150	93.75
5. Ready to serve nutritious supplementary food is needed	158	98.75

Attitude of ICDS personnel towards supplementary nutrition component of ICDS was further tested by analysing the response to the selected five statements on this component (Table 9). It was observed that among the different statements, statements related to supplementary nutrition had favourable responses.

Higher responses were observed to statements related to the impact of supplementary nutrition, inadequacy of food supplement distributed and difficulties in preparing the food supplement prior to serving. Compared to these statements less response was observed for the nutritional quality and monotony in the food supplement distributed.

4.2.6 Cost analysis of the ICDS food supplement

Cost of implementation of the programme/woman/day was calculated from the cost of food supplement, processing charges for the food supplement and cost of salaries of implementing staff.

The scheduled working hours in anganwadi programme is 9.30 am to 3.30 pm. An anganwadi teacher was found to spend 30 minutes every day in connection with the supervision of supplementary feeding to the lactating women beneficiaries. In the case of anganwadi helper, on an average, she was observed to spend 30 minutes for preparation of supplementary food and 30 minutes for distribution of the food to beneficiaries. Hence the total time spent for supplementary feeding by the helper was accounted as one hour/day and teacher 30 minutes per day.

The remuneration for anganwadi teacher and helper were taken into consideration (Rs.800/- month for the teacher and Rs.500/- month for the helper).

Cost of logistical transportation of food materials, from the source to the centre and cost expended for storage of the food materials were not taken into account for calculating the cost of ICDS food supply.

As detailed in Table 10 an amount of Rs.6.87/day/beneficiary was spent for implementing the supplementary nutrition component

4.3. Formulation and selection of suitable food supplement to replace the existing one in ICDS programme

ICDS norms stipulated for the supply of calories and proteins were followed for fomulating the food supplement which is to replace the existing ICDS food supplement. Care was also taken to introduce variety, locally available cheaper indigenous foods of superior quality and plant foods like soya beans ideal for women in special condition.

4.3.1 Selection and preliminary processing of different food articles

Raw materials selected were food articles rich in energy, proteins, minerals and vitamins. Rice and wheat were selected as the basic ingredient for the development of the food supplement. Raw rice was purchased from co-operative store, cleaned, washed, sundried and powdered in the flour mill. The flour was stored in air tight containers and used for the preparation of the food supplement.

Table 10. Cost of delivering ICDS food supplement/woman beneficiary/day

Items in the cost break down	Amount Rs. Ps.
1. Cost of food supplement/day/beneficiary	0.80
Rice @ Rs.8/kg and greengram @ Rs.29/kg	0.87
2. Cost of fuel and processing expense/day/beneficiary	0.10
3. Cost of food accessories/beneficiary/day	0.10
4. Salary of Anganwadi teacher @ Rs.800/month apportioned to the time spent in a day for supervising the supplementary nutrition	2.22
5. Salary of Anganwadi helpers @ Rs.500/month apportioned to the time spent in a day for preparation and feeding food supplement	2.78
Total cost/woman beneficiary/day	6.87

Whole grain wheat, purchased from the co-operative store/ provision shop, was cleaned, washed, sundried and powdered in the flour mill and the flour was stored in air tight containers. This whole grain flour was used for preparation of the food supplement.

Energy and protein rich sources of nuts and oil seeds like groundnut, coconut and gingelly seeds were also considered for the formulation of food supplement. Roasted groundnut was purchased from co-operative store and stored in air tight containers for use. Sesamum was purchased, cleaned, washed and sundried before use.

Cooking oils like groundnut oil, coconut oil, gingelly oil and palm oil were tried out as energy contributing ingredients in different combinations of the food supplement.

Roots and tubers popular in Kerala dietaries such as cassava, sweet potato and potato were also tried out as energy constituents in different formulations.

Different pulses like horse gram, green gram, bengal gram and cow pea were selected as major sources of protein supplement in different combinations. These pulses were purchased from co-operative store, cleaned, washed, sundried and powdered. The flour was stored in air tight containers for use. Bengal gram flour was purchased and stored in air tight containers for use. Deoiled coconut meal was also tried in few combinations as a source of protein. Soya chunks, an extruded processed product of soyabean, was included as an essential ingredient in all the combinations. The soya chunk was purchased from commercial stores,

sundried and powdered. The flour was stored in air tight containers for further use.

Spices like omum (*Trachyspermumammi*) jeera (*Cuminum cyminum*) and a medicinal leaf poovarsila (*Thespesia propulnea*) being rich in vitamin and mineral components and also with medicinal properties were included in different formulations. They also contribute flavour and taste to the products. Omum and jeera were purchased from co-operative store, cleaned, washed, sundried and stored in air tight container till use.

Fresh poovarasila was collected after removing unwanted portions, washed and dried in hot air oven at 60 to 70°C for 2-4 hrs and powdered and kept in air tight containers till use. Nutritional composition of the above food articles available in standard Food Composition Table published by ICMR (1991) was used for computing the nutritive value of the products formulated. Since the nutritive value of poovarasila powder was not available in the food composition tables, it was analysed in the laboratory and as detailed in Table 11. 100 g of poovarasila was found to contain energy 82.00 kcals, 4.90 g protein, 6.53 mg iron and 542.14 mg calcium. This was also observed to be rich in phytic acid and fibre.

3.2 Criteria observed for formulating and selecting combinations of food supplement

Ninety seven combinations of the food supplement were computed using the ingredients rice, wheat, soya and different types of legumes, nuts and oil seeds, roots and tubers and oils and miscellaneous articles like omum, jeera and poovarasila in varying proportions.

Table 11. Nutritional quality of *Thespesia propulnea* leaves

Nutrients	Quantity/100g
Protein (g)	4.90
Calcium (mg)	542.12
Iron (mg)	6.53
Phosphorus (mg)	176.32
Energy (kcals)	82.00
Moisture (g)	54.72
Fibre (g)	4.32
Phytic acid (mg)	218.40

Amino acid score, chemical score, cost and nutritional composition of these combinations were worked out and the details are presented in Appendix II. From these, fifteen combinations were selected based on their superiority for the above parameters, for further indepth investigation. Table 12 depicts the composition, amino acid score, chemical score, cost, protein and energy concentration of 15 selected combinations.

The selected 15 combinations were found to be rich in protein (15 g per cent and above); maximum protein concentration being observed in combination 14. Energy value range was computed to be 400 to 430 kcals, except in three combinations numbered as 4, 12 and 13. Calcium concentration was also observed to be very high in all the combinations (above 400 mg/100 g) and iron content in different combinations were found to vary from 4 to 8 mg/100 g. It was observed that though the protein concentration was high in the combinations 12, 13 and 14, the

Table 12. Nutritional composition of fifteen selected combinations (100g)

Sl. No.	Composition	Protein (g)	Energy (Kcals)	Fat (g)	Calcium (g)	Iron (g)	Amino Acid score	Chemical Score	Cost/kg
1.	A_2 50 B_1 15 B_2 15 G_1 5 F 5 E10	16.68	409.00	14.56	462.00	5.27	96.30	95	25.40
2.	A_2 50 B_1 15 B_2 15 G_2 5 F 5 E 10	16.68	407.55	14.18	469.50	7.20	96.30	95	25.40
**3.	A_2 50 B_1 15 B_2 15 G_3 5 F 5 E 10	16.94	429.55	14.30	484.25	5.30	96.30	95	25.40
4.	A_2 50 B_1 15 B_3 10 D 15 G_3 5 F 5 E10	16.54	386.30	14.57	468.00	5.55	88.30	91	27.20
**5.	A_2 50 B_1 15 B_3 10 D_2 5 G_3 5 F 5 E 10	16.62	405.00	14.41	490.25	5.57	88.30	91	27.20
**6.	A_2 50 B_1 15 B_2 10 D_2 5 G_1 5 F 5 E 10	17.23	419.35	16.67	430.90	5.60	95.14	96	27.70
7.	A_2 50 B_1 15 B_2 10 D_2 25 G_2 5 F 5 E 10	17.03	418.50	16.31	451.15	8.37	95.14	96	27.70
**8.	A_2 50 B_1 15 B_2 10 D_2 5 G_3 5 F 5 E 10	17.31	420.80	17.23	456.55	5.42	95.14	96	27.70
9.	A_2 50 B_1 15 B_2 10 D_1 5 G_1 5 F 5 E 10	16.92	420.80	16.84	467.70	5.58	91.87	92	29.60
10.	A_2 50 B_1 15 B_2 10 D_1 5 G_2 5 F 5 E 10	16.54	418.50	16.04	460.20	8.11	91.87	92	29.60
**11.	A_2 50 B_1 15 B_2 10 D_1 5 G_3 5 F 5 E 10	16.99	439.55	17.01	450.90	4.42	91.87	92	29.60
12.	A_2 50 B_1 15 D_1 15 G_1 5 F 5 E 10	17.45	384.41	20.02	463.00	5.42	78.90	84	28.00
13.	A_2 50 B_1 15 D_1 15 G_2 5 F 5 E 10	16.91	382.11	19.39	444.05	7.93	78.90	84	28.00
14.	A_2 50 B_1 15 D_1 15 G_3 5 F 5 E 10	17.53	402.96	20.36	477.75	5.45	78.90	84	28.00
15.	A_2 25 A_1 25 B_1 15 B_2 15 G_3 5 F 5 E 10	17.06	422.70	16.21	450.90	4.42	88.55	92	28.00

A_1 Rice A_2 Wheat B_1 Soya B_2 Green gram B_3 - Bengal gram D_1 Ground nut D_2 Gingelly
E oil F Poovarasila G_1 Jeera G_2 pipalli G_3 Omum

** Selected 5 combinations for further in depth investigation

amino acid score and chemical score were less, probably due to the absence of pulses. Cost calculated for 1 kg of food mix was found to be in the range of Rs.25 to Rs.30 for different combinations.

From the selected 15 combinations, five combinations were selected based on amino acid score, chemical score and protein concentration and subjected to nutritional quality evaluation, acceptability studies, shelf life quality evaluation and economic feasibility studies. The selected five combinations are presented in Table 13.

The selected five combinations detail the type and quantity of ingredients used in the combinations. In all the combinations, cereals, soya, pulses, spices, oils and poovarasila were common ingredients while nuts and oil seeds were absent in combination one.

4.3.3 Nutritional composition of food supplements selected

Composition of food supplements and the ICDS food supplement was estimated in the laboratory. Table 14 depicts the nutritional quality factors as well as non-nutritional factors present in the food supplements (1 to V) evolved as well as in ICDS food supplement (V1).

Analysis of protein content of different combinations showed that 17.86 g/100g the highest amount was present in combinations 'IV and V' followed by combinations II (17.51), I (16.81) and III (13.31). Calorific value of the five food supplements were analysed and they were found to be in the order of I (398 kcals/100g), II (418 kcals/100g), III (422 kcals/ 100g), IV (440 kcals/100g), V (420 kcals/100g) and VI (343 kcals/100g).

Table 13. Food combinations selected for indepth study

Combinations	Cereals (g)	Soya (g)	Pulse (g)	Nuts and oil seeds (g)	Spice (g)	Poovarasila (g)	Oil (g)
1	A_2 50	B_1 15	B_2 15	-	G_3 5	F5	E10
2	A_2 50	B_1 15	B_2 10	D_2 5	G_1 5	F5	E10
3	A_2 50	B_1 15	B_3 10	D_1 5	G_3 5	F5	E10
4	A_2 50	B_1 15	B_2 10	D_2 5	G_3 5	F5	E10
5	A_2 50	B_1 15	B_2 10	D_1 5	G_3 5	F5	E10

A_2 Wheat B_1 Soya B_2 Green gram B_3 Bengal gram G_1 Jeera

G_3 Omum D_1 Ground nut D_2 Sesamum (gingelly) F Poovarasila E Oil

Table 14. Composition of the selected food supplements (100g)

Particulars	Food supplements						
	I	II	III	IV	V	VI	CD Value
Nutrients							
Protein (g)	16.81	17.51	13.31	17.86	17.86	10.00	0.863**
Energy (Kcals)	398.00	418.00	422.00	440.00	420.00	343.00	33.430NS
Carbohydrate (g)	52.37	54.32	35.68	54.05	53.82	73.85	–
Calcium (mg)	421.14	456.38	439.63	462.80	452.85	35.53	–
Iron (mg)	4.52	4.80	3.60	5.32	3.98	4.37	0.477**
Phosphorus (mg)	371.88	348.73	274.03	370.08	332.40	185.23	9.137**
Fat (g)	14.56	16.31	14.12	17.32	17.01	0.60	–
Non nutrient components							
Phytic acid (mg)	136.82	139.64	68.38	131.05	98.32	90.76	–
Fibre (g)	3.16	2.50	1.83	1.66	1.66	1.10	0.420**

** Significant at 1 per cent level NS Not significant

Calcium content was found to be the highest in combination IV (462.80 mg/100g) followed by II (456.38 mg/100g), V (452.85 mg/100g), III (439.63 mg/100g), and I (421.14 mg/100g). Calcium content in ICDS food supplement was comparatively low with 35.53 mg/100g. Iron, the trace mineral element was present in varying amount, in the range of 3.60 mg (III), 3.98 mg (V), 4.53 mg (I), 4.80 mg (II) and 5.32 mg (IV) in 100g samples. Comparatively, ICDS food supplement was also rich in iron content (4.38 mg/100g). The fat present in different combinations of food supplement were in the range of 17.23g to 14.12g, highest level observed in combination IV (17.32 g) followed by V (17.01 g), II (16.31 g), I (14.56 g) and III (14.12 g) in 100 g samples. ICDS food supplement was observed to contain only 0.6g per cent of fat.

Besides the above constituents fibre and phytic acid were the two non-nutritional factors estimated in the food supplements. Fibre was in the range of 1.10 g to 3.17 g, highest in I (3.17 g), followed by II (2.50 g), III (1.83 g) and IV and V (1.66 g) in 100 g. Similarly phytic acid was found to be in the range of 68.38 mg/100g to 139.64 mg/100g. The highest phytic acid content in 100 g sample was found in II (139.64 mg) followed by I (136.82 mg), IV (131.05 mg), V (98.32 mg) and VI (90.76 mg).

4.3.4 Evaluation of the protein quality of the food supplements formulated

The most reliable way is to assess the nutritional quality of the proteins through animal experiments in which Protien Efficiency Ratio (PER) and Nitrogen Balance (NB) were ascertained.

The PER of developed supplementary foods and ICDS food supplement were worked out and compared with the standard diet, composed of casein. Experimental diets were composed of developed food supplements and existing ICDS food supplement. The details of composition of standard and experimental diets are presented in Table 2 under Materials and Methods. Each test diet was fed to six rats for 28 days.

Table 15 depicts the details of mean protein intake and gain in body weight by the animals on completion of the feeding experiment. With the data generated, PER of food supplements and standard diet were worked out.

From the Table it is clear that the mean food intake varied from 140.00 g to 184.80 g and mean gain in weight for different groups were observed to be 36.16g (G.II) to 48.33 g (G.VII). The PER for food supplements were found to be the lowest for G.III (2.12) followed by G.II (2.14), G.VI (2.39), G.I (2.66), G.V (2.82), G.IV (2.98) and G.VII (3.39).

Statistical analysis of the data observed that intake of food by G.VI, III and II were significantly higher than G.VII (standard diet) but on par with G.V, IV and I. Significant difference was observed in weight gain of animals in standard and test groups.

Biological value (BV) of protein is the fraction of its nitrogen retained in the body for growth and maintenance of cell synthesis.

Table 15. Protein Efficiency Ratio of Experimental and standard diet

Groups	Mean food intake (g)	Mean protein intake in test food (g)	Mean gain in weight (g)	PER
I	140.00	14.00	37.25** (R_6)	2.66** (R_5)
II	169.00	16.90	36.16 (R_7)	2.14 (R_6)
III	184.80	18.48	39.17 (R_5)	2.12 (R_7)
IV	146.10	14.61	43.53 (R_2)	2.98 (R_2)
V	142.60	14.26	40.21 (R_4)	2.82 (R_3)
VI[a]	173.00	17.30	41.35 (R_3)	2.39 (R_4)
VII[b]	142.60	14.26	48.33 (R_1)	3.39 (R_1)
	9.87*	NS	4.38*	0.685

* - Significant at 5 per cent level
NS - Not significant
** R_1 ..... R_6 - Rank
a - ICDS Food supplement
b - Standard diet

The biological value of the food supplements developed and standard diet were tested in groups of adult male albino rats. In this experiment the biological value of the standard diet was higher when compared with the experimental diets. Table 16 furnishes the BV of developed food supplements and standard casein diet. The BV of standard diet was found to be 78.87. Among test foods, lowest value was observed for G.III (74.84) followed by G.VI (75.40), G.II (75.45), G.I (77.32), G.IV (78.41) G.V (79.75) and G.VII (78.87). Food supplement fed to G.III was found to have lower value than ICDS food supplement.

Digestability coefficient of a protein is defined as the ratio of food nitrogen intake to food nitrogen absorbed. The digestability coefficient of developed food supplements were noted as 89.21 (G.I), 80.96 (G.II), 90.71 (G.III), 90.92 (G.IV) and 88.76 (G.V) for five supplements while for the standard diet digestability coefficient was 90.85. The DC worked out for ICDS food supplement was found to be 80.14 (Table 16), which was less than the DC for five food supplements evolved.

Net protein utilisation (NPU) is the ratio of nitrogen retained to the total nitrogen intake and determined from BV and DC and the data are presented in Table 16.

The NPU developed for food supplements were observed to be comparable with that of standard diet (71.65). The NPU of developed food supplements were 68.97 (G.I) 61.08 (G.II), 67.88 (G.III), 70.92 (G.IV), 70.79 (G.V), and 60.88 (G.VI). The lowest value was found assigned to ICDS food supplement.

Table 16. Biological value (BV), Digestability coefficient (DC) and Net protein utilisation (NPU) of Experimental and control diet

Groups	Mean nitrogen intake per rat per day (g)	BV (Rank)	DC (Rank)	NPU (Rank)
I	0.62	77.32 (R_4)	89.21 (R_4)	68.97 (R_4)
II	0.63	75.45 (R_5)	80.96 (R_6)	61.08 (R_6)
III	0.61	74.84 (R_7)	90.71 (R_3)	67.88 (R_5)
IV	0.64	78.41 (R_3)	90.92 (R_1)	70.92 (R_2)
V	0.62	79.75 (R_1)	88.76 (R_5)	70.79 (R_3)
VI[a]	0.62	75.40 (R_6)	80.74 (R_7)	60.88 (R_7)
VII[b]	0.65	78.87 (R_2)	90.85 (R_2)	71.65 (R_1)

BV Biological value DC Digestability Coefficient NPU Net protein utilisation

a ICDS Food Supplement b Standard diet

4.3.5 Organoleptic qualities of developed food supplement

Organoleptic investigation was carried out with the help of 20 panel members selected from the academic personnel in the College of Agriculture, Vellayani through a triangle test. In the triangle test three sets of sugar solutions of different concentrations were used. Of the three samples, two were of identical concentration and the subjects were asked to identify the third sample which is of different concentration. On the basis of the test, 20 panel members were selected for conducting organoleptic evaluation of the developed food supplements.

The test samples were evaluated by the panel members using a score card of 5 point scale and the results are presented in Table 17.

A comparison among different combinations of the food supplements revealed that combination 'IV' obtained highest score for colour, texture, flavour, taste, doneness and overall acceptability, while for appearance, combination 'V' was found to be ranked as 'I'. The lowest score for appearance, colour, doneness and overall acceptability were observed for combination 'III' while for texture, combination 'II' and for flavour and taste combination 'I' was found to have the lowest score. When the mode values were verified among the food supplements, highest values were obtained for food supplement IV.

4.3.6 Shelf life studies of developed food supplement

Shelf life studies of six months duration was conducted for the five food supplements as well as for ICDS supplement. Qualities of the selected food samples were periodically ascertained through organoleptic evaluation of the stored food samples.

Table 17. Organoleptic qualities study of the food supplements (mean scores)

Parameters	Food supplements											
	I		II		III		IV		V		VI	
	(i)	(ii)	(i)	(ii)	(i)	(ii)	(i)	(ii)	(i)	(ii)	(i)	(ii)
Appearance	3.95	4.00	3.95	4.00	3.65	3.50	4.60	4.00	4.75	5.00	4.25	4.00
Colour	3.80	4.00	3.95	4.00	3.40	3.00	4.40	5.00	4.35	5.00	3.70	4.00
Texture	3.95	4.00	3.85	3.50	4.10	5.00	4.65	5.00	4.50	5.00	4.20	4.00
Flavour	3.45	4.00	3.85	3.00	3.65	4.00	4.60	5.00	3.80	4.00	4.70	5.00
Taste	3.15	3.50	4.20	4.00	3.65	3.50	4.45	5.00	3.80	4.00	4.40	4.00
Doneness	4.50	4.00	4.45	4.00	4.40	4.00	4.80	5.00	4.70	4.00	4.50	4.00
Overall acceptability	4.00	4.00	4.75	4.00	3.70	4.00	4.85	5.00	4.10	4.00	4.20	4.00

(i) Mean score (ii) Mode values

4.3.6.1. Organoleptic quality evaluation of stored food supplements

Acceptability of the stored food supplements were tested every month for organoleptic qualities using a score card by selected panel of judges. The parameters studied were appearance, colour, texture, flavour, taste and overall acceptability of the stored food supplements.

Appearance

Table 18 denotes the change in the appearance of the food supplements in subsequent six months of storage. A gradual decrease in the scores for appearance was observed in all the products (Fig. 2). A decrease in the mean scores from -0.10 to -0.80 was noted in the case of the food supplement (I), while this variation for other food supplements during storage period were from -0.30 to -0.80 (Food supplement II), -0.30 to -0.50 (Food supplement III), -0.10 to -0.70 (Food supplement IV), -0.20 to -0.85 (food supplement V), and -0.05 to -0.50 (ICDS food supplement VI).

Colour

Colour is one of the important visual attributes and may influence other sensory characteristics and in turn, food acceptability, choice and preferences. The initial mean score of the different food supplements were observed to range from 3.80 (Food supplement 1) to 4.35 (Food supplement V). As the storage period increased, it was observed that there was a decrease in the mean scores (Fig. 3), awarded for 'colour' in all the stored food supplements (Table 19).

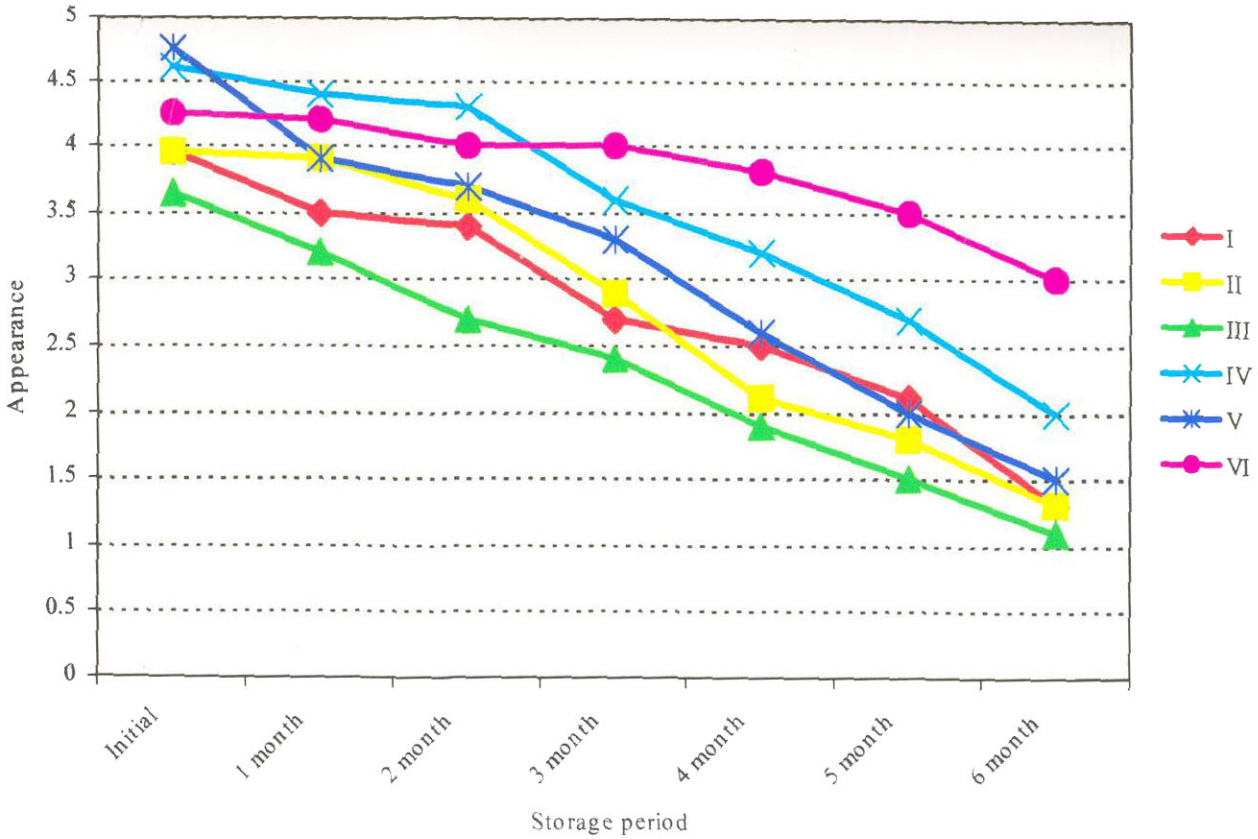


Fig. 2. Influence of storage on the appearance of the food supplements

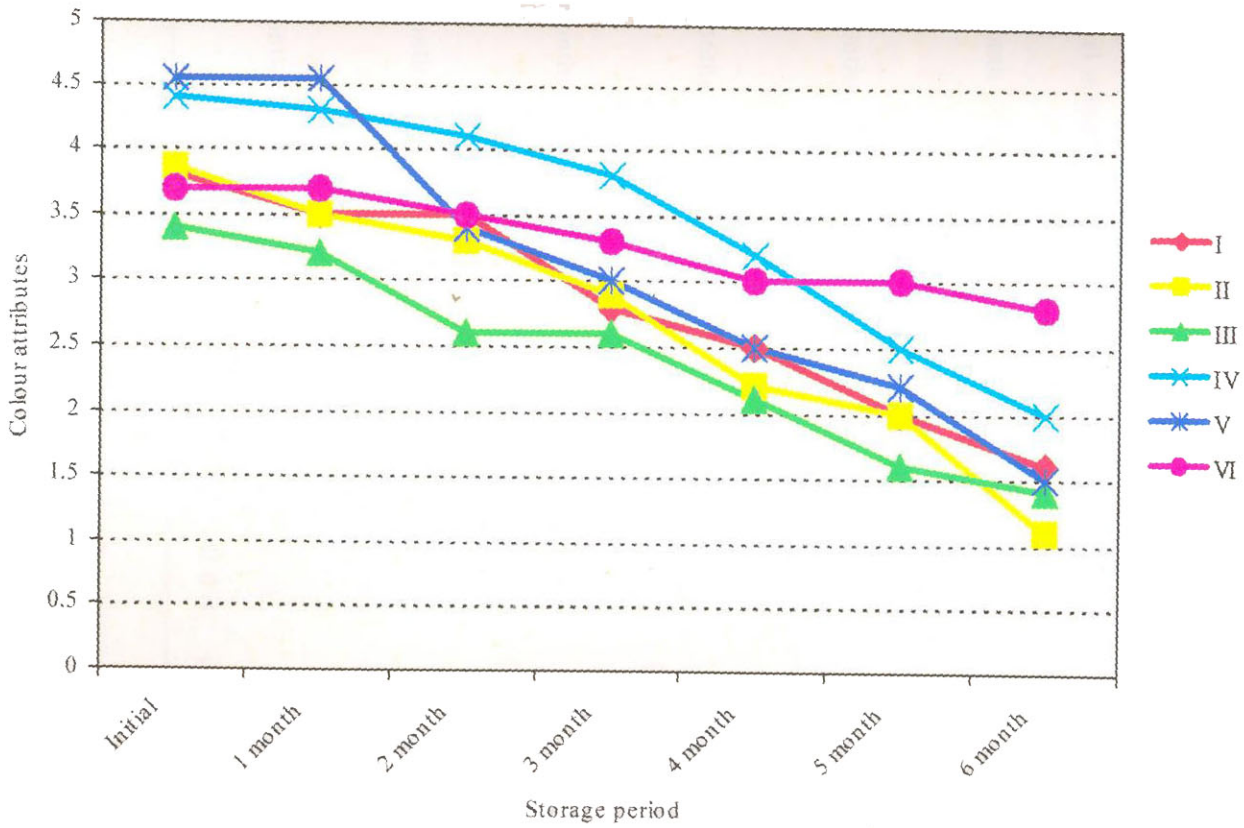


Fig. 3. Influence of storage on the colour attributes of the food supplements

Table 18. Influence of storage on the appearance of the food supplements

Storage period	Food supplements					
	I	II	III	IV	V	VI
Initial mean score	3.95	3.95	3.65	4.60	4.75	4.25
1 month	3.50	3.90	3.20	4.40	3.90	4.20
	(-0.45)	(-0.05)	(-0.45)	(-0.20)	(-0.85)	(-0.05)
2 months	3.40	3.60	2.70	4.30	3.70	4.00
	(-0.10)	(-0.30)	(-0.50)	(-0.10)	(-0.20)	(-0.20)
3 months	2.70	2.90	2.40	3.60	3.30	4.00
	(-0.70)	(-0.70)	(-0.30)	(-0.70)	(-0.40)	(-0.00)
4 months	2.50	2.10	1.90	3.20	2.60	3.80
	(-0.20)	(-0.80)	(-0.5)	(-0.40)	(-0.70)	(-0.20)
5 months	2.10	1.80	1.50	2.70	2.00	3.50
	(-0.40)	(-0.30)	(-0.40)	(-0.50)	(-0.60)	(-0.30)
6 months	1.30	1.30	1.10	2.00	1.50	3.00
	(-0.80)	(-0.50)	(-0.40)	(-0.70)	(-0.50)	(-0.50)

Figures in paranthesis shows the monthly change in quality parameter

Table 19. Influence of storage on the colour attribute of the food supplements

Storage period	Food supplements					
	I	II	III	IV	V	VI
Initial mean score	3.80	3.95	3.40	4.40	4.35	3.70
1 month	3.50 (-0.30)	3.50 (-0.45)	3.20 (-0.20)	4.30 (-0.10)	4.00 (-0.35)	3.50 (-0.20)
2 months	3.50 (-0.00)	3.30 (-0.20)	2.60 (-0.60)	4.10 (-0.20)	3.40 (-0.60)	3.50 (-0.00)
3 months	2.80 (-0.70)	2.90 (-0.40)	2.60 (-0.00)	3.80 (-0.30)	3.00 (-0.40)	3.30 (-0.20)
4 months	2.50 (-0.30)	2.20 (-0.70)	2.10 (-0.50)	3.20 (-0.50)	2.50 (-0.50)	3.00 (-0.30)
5 months	2.00 (-0.50)	2.00 (-0.20)	1.60 (-0.50)	2.50 (-0.70)	2.20 (-0.30)	3.00 (-0.00)
6 months	1.60 (-0.40)	1.10 (-0.90)	1.40 (-0.20)	2.00 (-0.50)	1.50 (-0.70)	2.80 (-0.20)

Figures in paranthesis shows the monthly change in quality parameter

Minimum change noted in the case of the food supplement (1) was from -0.00 to -0.70 and another observation made in this context was that during the first and second months, there was no change in the scores obtained for this parameter for food supplement I. Scores for colour awarded for other food supplements were from -0.20 to -0.90 (Food supplement II), -0.20 to -0.60 (Food supplement III), -0.10 to -0.70 (Food supplement IV), -0.30 to -0.70 (Food supplement V) and -0.20 to -0.30 (Food supplement VI). Minimum change was observed for this parameter in the ICDS food supplement.

Flavour

Flavour is an unique character along with colour and taste and it is perceived by the sense of basic smell. A decrease in the scores of flavour was observed as the storage life progressed (Table 20). Minimum decrease in the scores was observed in various food supplements from -0.10 to -0.90 in food supplement (I), -0.10 to -0.80 (Food supplement II), -0.10 to -0.70 (Food supplement III), -0.10 to -0.90 (Food supplement IV), -0.10 to -0.70 (Food supplement V) and -0.10 to -0.50 (Food supplement VI) (Fig. 4). It was noted that there was no change in the character 'flavour' until second month of storage for food supplement (III), and until third month of storage for ICDS food supplement (VI).

Texture

Texture constitutes the physical property of food stuffs, associated with the sense of feel or touch experienced by the fingers or the mouth. The mean scores obtained for texture is presented in Table 21

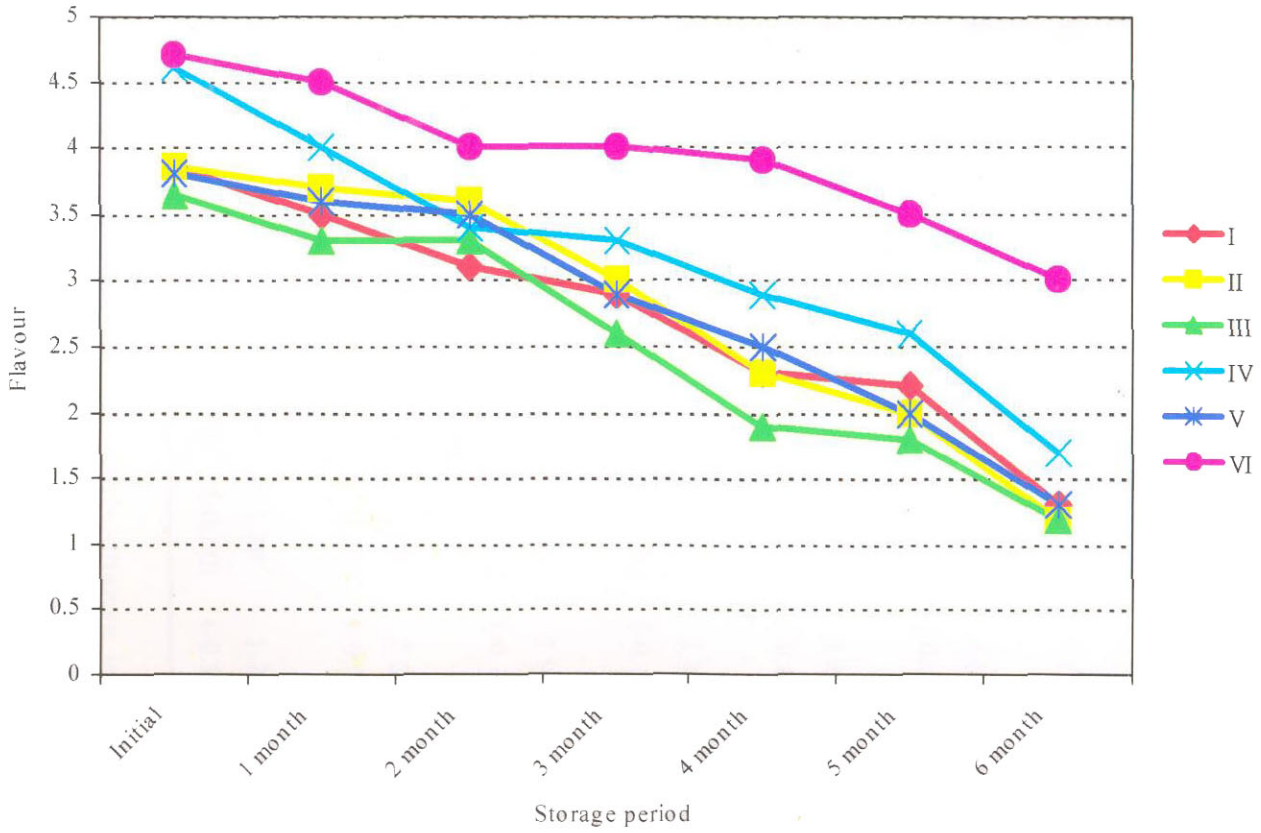


Fig. 4. Influence of storage on the flavour of the food supplements

Table 20. Influence of storage on the flavour of the food supplements

Storage period	Food supplements					
	I	II	III	IV	V	VI
Initial mean score	3.85	3.85	3.65	4.60	3.80	4.70
1 month	3.50 (-0.35)	3.70 (-0.15)	3.30 (-0.35)	4.00 (-0.60)	3.60 (-0.20)	4.50 (-0.20)
2 months	3.10 (-0.40)	3.60 (-0.10)	3.30 (-0.00)	3.40 (-0.60)	3.50 (-0.10)	4.00 (-0.50)
3 months	2.90 (-0.20)	3.00 (-0.50)	2.60 (-0.70)	3.30 (-0.10)	2.90 (-0.60)	4.00 (-0.00)
4 months	2.30 (-0.60)	2.30 (-0.70)	1.90 (-0.70)	2.90 (-0.40)	2.50 (-0.40)	3.90 (-0.10)
5 months	2.20 (-0.10)	2.00 (-0.30)	1.80 (-0.10)	2.60 (-0.30)	2.00 (-0.50)	3.50 (-0.40)
6 months	1.30 (-0.90)	1.20 (-0.80)	1.20 (-0.60)	1.70 (-0.90)	1.30 (-0.70)	3.00 (-0.50)

Figures in paranthesis shows the monthly change in quality parameter

Table 21. Influence of storage on the texture of the food supplements

Storage period	Food supplements					
	I	II	III	IV	V	VI
Initial score	3.95	3.85	4.10	4.65	4.50	4.20
1 month	3.30 (-0.65)	3.50 (-0.35)	3.10 (-1.00)	3.90 (-0.75)	3.80 (-0.70)	4.10 (-0.10)
2 months	3.20 (-0.10)	3.20 (-0.30)	2.70 (-0.40)	3.80 (-0.10)	3.50 (-0.30)	4.00 (-0.10)
3 months	3.00 (-0.20)	2.70 (-0.50)	2.40 (-0.30)	3.30 (-0.50)	3.00 (-0.50)	3.80 (-0.20)
4 months	2.30 (-0.70)	2.30 (-0.50)	1.90 (-0.50)	2.90 (-0.40)	2.50 (-0.50)	3.70 (-0.10)
5 months	2.10 (-0.20)	2.00 (-0.30)	1.80 (-0.10)	2.60 (-0.30)	2.00 (-0.50)	3.50 (-0.20)
6 months	2.10 (-0.00)	1.20 (-0.80)	1.00 (-0.80)	1.50 (-0.60)	1.50 (-0.50)	3.00 (-0.50)

Figures in paranthesis shows the monthly change in quality parameter

for various food supplements during six months period of storage. A gradual decrease in the scores was observed for different food supplements (Fig. 5). The scores awarded for food supplement (I) showed that a difference in decrease in scores ranged from -0.10 to -0.70 [for food supplement (1)] -0.30 to -0.80 [food supplement (II)] -0.10 to -1.00 [for food supplement (III)] -0.10 to -0.75 [for food supplement (IV)] -0.30 to -0.70 for food supplement (V) and -0.10 to -0.50 [for food supplement (VI)].

Taste

Taste is the major attribute which determines acceptability of the food materials. Table 22 denotes the acceptability scores awarded for the attribute "taste" for six months. There was a decrease in the total mean score as the storage life progressed (Fig. 6). Food supplement I obtained a total mean score of 3.75 as the initial score and at the end of six months period the score was 1.30. The change in score range was from -0.10 to -0.90. The total mean score obtained for the food supplement II initially was 4.20 and at the end of six months it was 1.40. The decrease was observed to be from -0.10 to -0.70. The mean score obtained for food supplement III was 3.65 initially and at the end of six months storage it was 1.20. The observed change in the score was -0.15 to -0.70. The decrease in score for the food supplement IV, was 4.45 to 1.90, for food supplement V, it was 4.30 to 1.30, and for food supplement VI it was 4.40 to 3.00. Change in score of -0.30 to -0.90 was observed for food supplement IV, while this was from -0.30 to -0.90 for food supplement V and from -0.20 to -0.50 for food supplement VI.

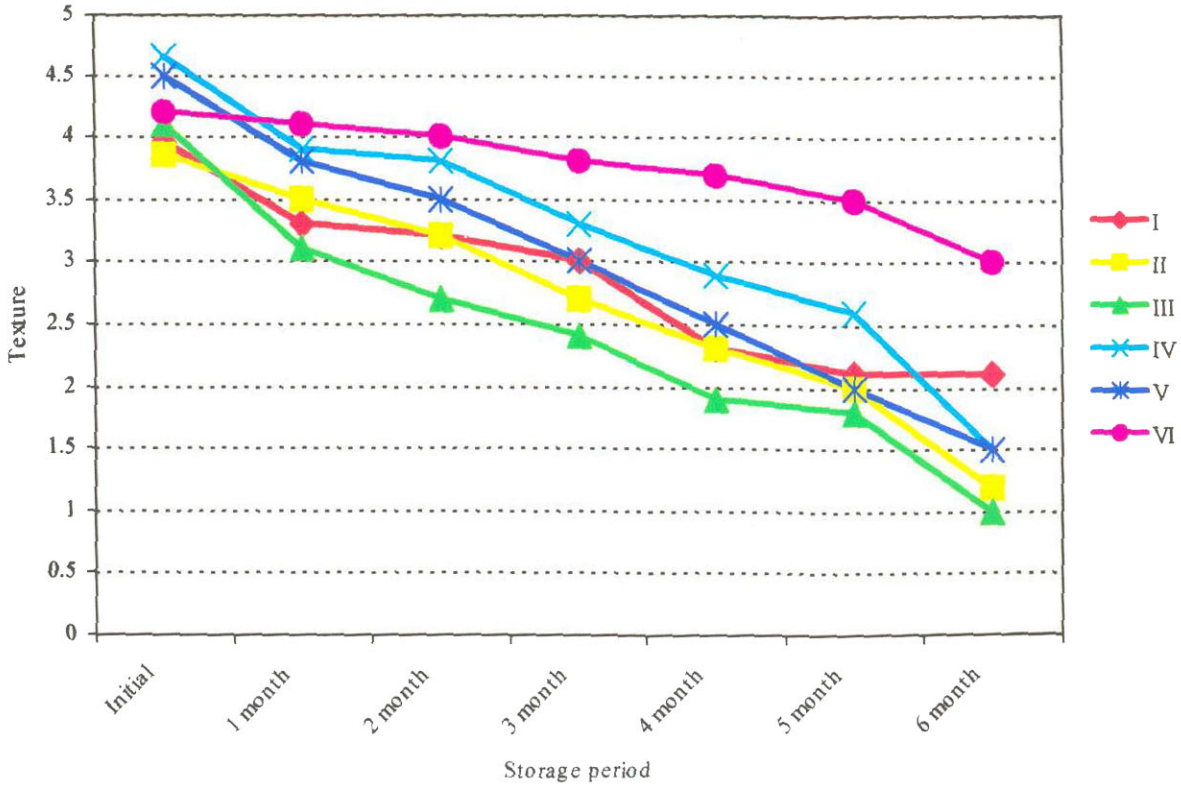


Fig. 5. Influence of storage on the texture of the food supplements

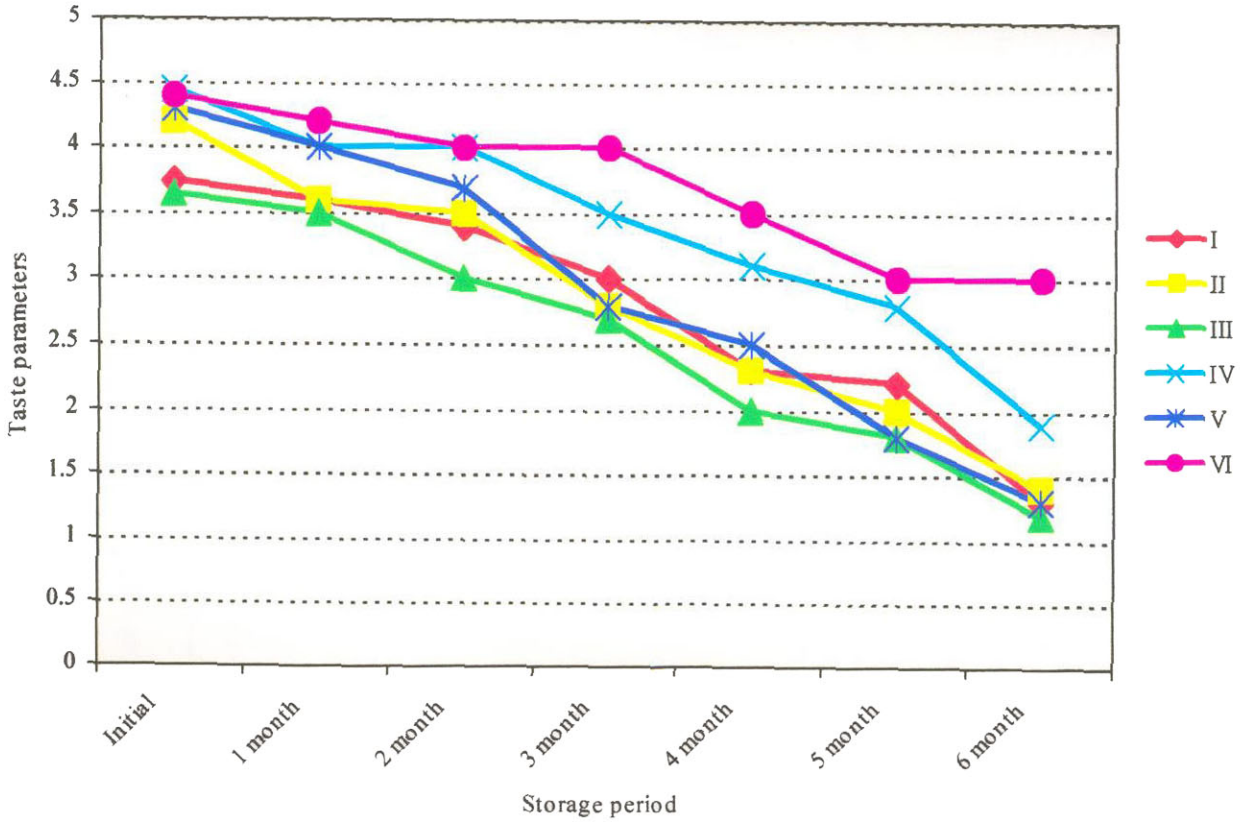


Fig. 6. Influence of storage on the taste parameter of the food supplements

Table 22. Influence of storage on the taste parameter of the food supplements

Storage period	Food supplements					
	I	II	III	IV	V	VI
Initial score	3.75	4.20	3.65	4.45	4.30	4.40
1 month	3.60 (-0.15)	3.60 (-0.60)	3.50 (-0.15)	4.00 (-0.45)	4.00 (-0.30)	4.20 (-0.20)
2 months	3.40 (-0.20)	3.50 (-0.10)	3.00 (-0.50)	4.00 (-0.00)	3.70 (-0.30)	4.00 (-0.20)
3 months	3.00 (-0.40)	2.80 (-0.70)	2.70 (-0.30)	3.50 (-0.50)	2.80 (-0.90)	4.00 (-0.00)
4 months	2.30 (-0.70)	2.30 (-0.50)	2.00 (-0.70)	3.10 (-0.40)	2.50 (-0.30)	3.50 (-0.50)
5 months	2.20 (-0.10)	2.00 (-0.30)	1.80 (-0.20)	2.80 (-0.30)	1.80 (-0.70)	3.00 (-0.50)
6 months	1.30 (-0.90)	1.40 (-0.70)	1.20 (-0.60)	1.90 (-0.90)	1.30 (-0.50)	3.00 (-0.00)

Figures in paranthesis shows the monthly change in quality parameter

Overall acceptability

The overall acceptability scores awarded for different food suppplements are presented in Table 23 for six different supplements for six months period. Overall acceptability score obtained for food supplement I was 4.00 and at the end of six months it was 1.30 and the change in score range was from -0.10 to -0.90 (Fig. 7). The mean score obtained for food supplement II initially was 4.25 and at the end of six months it was 1.40. The decrease in score was observed to be from -0.20 to -0.70. The mean score obtained for food supplement III was 3.70 and at the end of six months storage it was 1.20. The observed change in score was -0.10 to -0.95. Food supplement IV, had a shift in score from 4.85 to 1.90, food supplement V, from 4.70 to 1.40, and food supplement VI, from 4.20 to 3.00. Change in score of -0.10 to -0.90 was observed for food supplement IV, while this was from -0.20 to -0.80 for food supplement V and from -0.10 to -0.50 for food supplement VI.

4.3.6.2 Chemical analysis of the stored samples

Laboratory analysis of moisture content, and peroxide value of the stored samples were estimated initially, after three months and at the end of six months of storage period. Table 24 details the data generated.

Moisture is one of the important parameters which determine the shelf life of any food product and it is an important parameter influencing storage period. An increase in moisture levels was observed in all the stored food supplements.

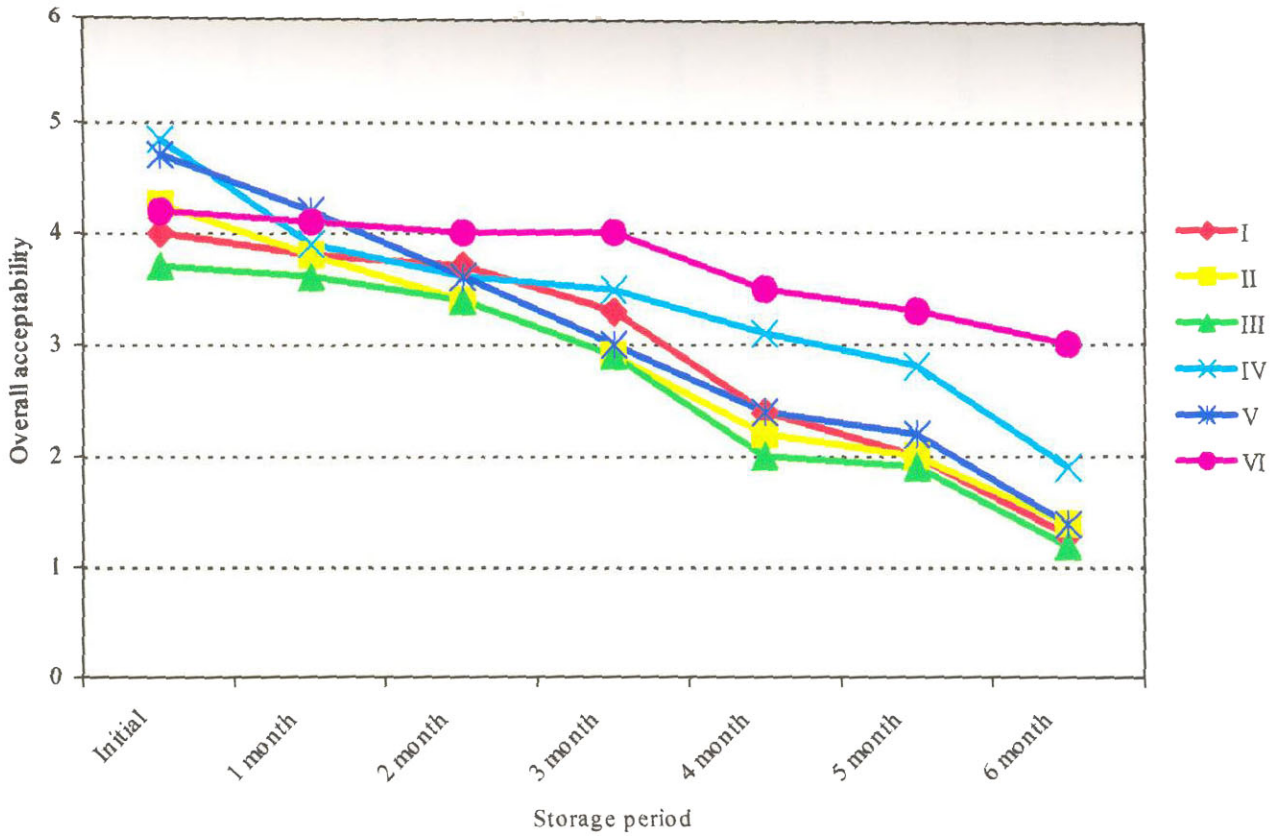


Fig. 7. Influence of storage on the overall acceptability of the food supplements

Table 23. Influence of storage on the overall acceptability of the food supplements

Storage period	Food supplements					
	I	II	III	IV	V	VI
Initial mean score	4.00	4.25	3.70	4.85	4.70	4.20
1 month	3.80 (-0.20)	3.80 (-0.45)	3.60 (-0.10)	3.90 (-0.95)	4.20 (-0.50)	4.10 (-0.10)
2 months	3.70 (-0.10)	3.40 (-0.40)	3.40 (-0.20)	3.60 (-0.30)	3.60 (-0.60)	4.00 (-0.10)
3 months	3.30 (-0.40)	2.90 (-0.60)	2.90 (-0.60)	3.50 (-0.10)	3.00 (-0.60)	4.00 (-0.00)
4 months	2.40 (-0.90)	2.20 (-0.70)	2.00 (-0.90)	3.10 (-0.40)	2.40 (-0.60)	3.50 (-0.50)
5 months	2.00 (-0.40)	2.00 (-0.20)	1.90 (-0.10)	2.80 (-0.30)	2.20 (-0.20)	3.30 (-0.20)
6 months	1.30 (-0.70)	1.40 (-0.60)	1.20 (-0.70)	1.90 (-0.90)	1.40 (-0.80)	3.00 (-0.30)

Figures in paranthesis shows the monthly change in quality parameter

Table 24. Infuence of storage on the moisture and peroxide content of the food supplements

Parameters	Food supplements					
	I	II	III	IV	V	VI
Moisture (g)						
Inital	9.53	6.21	13.73	6.13	7.73	16.20
3 months	9.59	6.42	13.78	6.17	7.79	16.23
6 months	9.62	6.51	13.83	6.20	7.82	16.28
Peroxide value (meq/kg)						
3 months	3.42	1.57	5.80	1.42	2.35	Negligible
6 months	5.51	3.45	7.20	2.78	5.45	Negligible

No loss in the quantity of the food supplements was observed during storage period. Quantitative changes were not observed in the stored samples.

Peroxide content of stored samples

Peroxides are the compounds formed when fat oxidises during storage. Presence of peroxide was observed in all the food supplements from third month of storage. Peroxide values ranged from 1.20 meq/kg

7.02 meq/kg of different food supplements. Highest concentration of peroxide was observed after six months storage in food supplement (III) as 7.02 meq/kg, followed by food supplement I (5.51 meq/kg), V (5.45 meq/kg), II (3.45 meq/kg) and lowest value was observed in food supplement IV (2.78 meq/kg).

4.3.6.4 Assessment of insect infestation in stored food supplements

The incidence of insects attack in stored food supplements was observed once in three months of storage. The stored food supplements, except ICDS food supplement even after six months storage, were found free of insects and pests. Insect *Sitophilus oryzae* was identified in ICDS food supplement after five months of storage.

43.6.5 Assessment of microbial quality of developed food supplements after the storage period

Few microbial tests are generally recommended to ensure quality and safety of processed products. Many organisms are also reported to cause food born illness when grown above the safe limits.

The population of fungi and bacteria in the developed food supplements stored for a period of three months and six months were assessed following the serial dilution plate technique (Johnson and Curl, 1972), peptone dextrose agar with rose bengal and streptomycin (Martin, 1950) and nutrient agar were used for plating fungi and bacteria respectively. The assessment of microbial quality revealed that there

was no fungal growth in any of the stored food supplements. Bacteria was observed only in food supplement III. The bacterial count was 40,000/gram.

4.3.7 Economic feasibility

Economic benefit is an important factor in any new product. The cost of developed food supplements were assessed through input cost, output cost and programme cost per beneficiary per year. Input cost was calculated from the cost of the food ingredients. Out put cost is the total of input cost and added 10 per cent as overhead charges for fuel and labour. The cost of production of one kg food supplement worked out in this order, is presented in Table 25. Table presents the average cost for food supplement IV as Rs.29.92, followed by Rs.30.47 for supplement II and Rs.29.37 for supplement V, and for the supplement I it was Rs.27.83 and for food supplement, III the cost was observed to be Rs.30.25.

Yield ratio

Yield ratio is an important factor which may influence the economic feasibility of a product.

Yield ratio of selected five combinations of the food supplements was calculated and presented in Table 26. Among the five food supplements, yield ratio as 0.88 was the highest for food supplements I and IV followed by V (0.87), II (0.86) and III (0.83).

Table 25. Cost of production of 1 kg of food supplements

Particulars	Amount (g)	Cost of food supplements				
		I	II	III	IV	V
Input cost						
Wheat flour	500	6.00	6.00	6.00	6.00	6.00
Soya	150	7.50	7.50	7.50	7.50	7.50
Green gram	100	4.80	3.20	-	3.20	3.20
Bengal gram	100	-	-	4.00	-	-
Ground nut	50	-	-	3.50	-	3.50
Sesamum	50	-	4.00	-	4.00	-
Jeera	50	3.50	3.50	-	-	-
Omum	50	-	-	3.00	3.00	3.00
Palm oil	100	3.50	3.50	3.50	3.50	3.50
Povarasila	50	-	-	-	-	-
Total input cost	-	25.30	27.70	27.50	27.20	26.70
Overhead charge (10%)	-	2.53	2.77	2.75	2.72	2.67
Output cost	-	27.83	30.47	30.25	29.92	29.37

Table 26. Yield ratio of the food supplements

Particulars	Food supplements				
	I	II	III	IV	V
Weight before cooking (g)	540.00	520.00	525.00	530.00	525.00
Cooked weight (g)	480.00	450.00	440.00	470.00	460.00
Yield ratio	0.88	0.86	0.83	0.88	0.87

Processing loss

Processing loss is another factor which can influence the economic feasibility of a product.

Processing loss for various food supplements were worked out by determining the difference between purchased weight of the ingredients and their edible portion. Details regarding the processing loss is presented in Table 27.

The processing loss was observed to have wide variations depending upon the type of ingredients. The loss accounted was mainly due to the removal of unwanted portions of the ingredients. Processing loss was determined for preparation of 500 g of the food supplement. Processing loss for the food supplements III and IV were found to be 23.36 and 23.44 per cent respectively. The loss was highest for food

Table 27. Processing loss (per cent) in the food supplements

Ingredients	Food supplements				
	I	II	III	IV	V
Wheat (A_2)	16.80	16.80	16.80	16.80	16.80
Soya (B_1)	5.00	5.00	5.00	5.00	5.00
Green gram (B_2)	5.40	5.40	-	5.40	5.40
Bengal gram (B_3)	-	-	2.00	-	-
Ground nut (D_1)	-	-	23.00	-	23.00
Sesamum (D_2)	-	20.00	-	20.00	-
Jeera (G_1)	-	5.00	-	-	-
Omum (G_3)	20.00	-	20.00	20.00	20.00
Poovarsila (F)	50.00	50.00	50.00	50.00	50.00
Oil (E)	000	00	00	00	00
Total loss	97.20	102.20	116.80	117.20	120.20
Per cent	19.44	20.44	23.36	23.44	24.04
Ratio of processing loss	0.194	0.204	0.234	0.234	0.240

supplement V (24.04%), followed by II (20.44 %) and I (19.44 %). Ratio of loss was also noted. It was observed that the ratio of loss for food supplement 1 as the lowest (0.19), followed by II (0.20), III (0.23), IV (0.23) and V (0.24).

4.4. Selection of best food supplement for further indepth investigation

Nutritional, organoleptic and shelf life studies on five selected food supplements conducted revealed that the combination IV with proportion of wheat (50 per cent) soya (15 per cent) green gram (10 per cent) gingelly seeds (5 per cent) omum (5 per cent) palm oil (10 per cent) and poovarasila (5 per cent) was ranked the highest in all the quality parameters. Table 28 indicates a comprehensive picture of the selected quality parameters of the five food supplements for comparison.

Protein and energy content in food supplement IV were found to be higher compared to other food supplements. Similarly, based on PER, BV, DC and NPU values, food supplement IV was ranked as I. The overall acceptability mean score in fresh as well as in stored samples after three months and six months storage period were also observed to be high in food supplement IV compared to others. On the other hand, moisture and peroxide values were lowest indicating suitability of the food supplement IV for large scale production and storage.

Considering all these factors food supplement IV was chosen as the best one among the five food supplements and is selected for further indepth studies.

Table 28. Quality parameters of five selected food supplements

Samples	Composition	Protein g/100g	Energy Kcals/ 100g	PER	BV	DC	NPU	Overall acceptability scores	Storage 3 months	Acceptability 6 months	Moisture level	Peroxide value	Fungi	Bacteria
		1	2	3	4	5	6	7	8	9	10	11	12	13
I	A_2 50 B_1 15 B_2 15 G_3 5 F_5 E10	16.94	398.00	2.66	77.32	89.21	68.97	4.00	3.30	1.30	9.53	3.42	Nil	Nil
II	A_2 50 B_1 15 B_2 10 D_2 5 G_1 5 F_5 E 10	17.23	418.00	2.14	75.45	80.96	61.08	4.25	2.90	1.40	6.21	1.57	Nil	Nil
III	A_2 50 B_1 15 B_3 10 D_1 5 G_3 5 F_5 E 10	16.62	422.00	2.12	72.84	90.71	67.88	3.70	2.90	1.20	13.73	5.80	Nil	40000/-
IV	A_2 50 B_1 15 B_2 10 D_1 5 G_3 5 F_5 E10	17.86	440.00	2.98	78.41	90.92	70.92	4.85	3.50	1.90	6.13	1.42	Nil	Nil
V	A_2 50 B_1 15 B_2 10 D_1 5 G_3 5 F_5 G 10	17.86	420.00	2.82	79.75	88.70	70.79	4.10	3.00	1.40	7.73	2.78	Nil	Nil

4.4.1 Preference studies of the selected food supplement

Using the selected food supplement (IV), four recipes were standardised at the laboratory level as detailed in Appendix IV with two variations in sweetening agent and acceptability tests were conducted at the institutional level (Tables 29, 30) using nine point and five point hedonic rating scales.

Variations in the four recipes standardised were the difference in sweetening agent (either sugar or jaggery) used and the form in which these sweetening agents (either as powder or syrup) were used.

Recipe 1 Food supplement + jaggery syrup

Recipe 2 Food supplement + sugar syrup

Recipe 3 Food supplement + powdered sugar

Recipe 4 Food supplement + powdered jaggery

Preference studies conducted among the institutional staff revealed that 30 per cent of the experts graded recipe 4 as "like extremely". This was followed by recipe 1 (20 per cent), recipe 2 (8 per cent) and recipe 3 (4 per cent) with less number of experts awarding same grades. Grading as "like very much", was awarded by 40 per cent of the respondents for recipe 1 and for recipe 2. Similar grading was awarded by 44 per cent of the experts. Equal grades were awarded for recipe 3 by 48 per cent and for recipe 4 by 42 per cent of the experts. Grading as "moderate likeness" was awarded by 22 per cent of the experts for recipe one, 26 per cent of the experts for recipe 2, 32 per cent of the experts for recipe 3 and 20

Table 29. Distribution of experts based on the rate of preference for recipes developed

Rating scale	Recipe 1	Recipe 2	Recipe 3	Recipe 4
Like extremely	20.00 (10)	8.00 (4)	4.00 (2)	30.00 (15)
Like very much	40.00 (20)	44.00 (22)	48.00 (24)	42.00 (21)
Like moderately	22.00 (11)	26.00 (13)	32.00 (16)	20.00 (10)
Like slightly	18.00 (9)	22.00 (11)	16.00 (8)	8.00 (4)

Figures in parenthesis denotes number (50) of respondents

Table 30. Preference scores of recipes by the Institutional staff (50)

Recipes	Mean preference score*	Total score	Per cent score
Recipe 1	7.62	381	84.66
Recipe 2	7.38	369	82.00
Recipe 3	7.64	382	84.88
Recipe 4	7.94	397	88.22

* Maximum score 9

per cent for recipe 4. The recipes developed were graded as "slightly liked" by 18 per cent judges, for recipe 1; by 22 per cent, for recipe 2; by 16 per cent for recipe 3 and by 8 per cent for recipe 4.

Preference scores obtained for different recipes and percentage scores are shown in Table 30. Highest total score obtained for recipe 4 was 397 with per cent score "88.22", followed by recipe 3 with a total score of 382 and per cent score of 84.88; recipe 1 with a total score of 381 and per cent score of 84.66 and recipe 2 with a total score of 369 and per cent score of 82. From the Table it is observed that all the four recipes scored more than 80 per cent and "recipe 4" with highest score was selected and taken to field for further preference studies.

Demonstrations on the "recipe 4" were conducted in the selected 20 centres. The preference rates of the recipes among 50 anganwadi workers and 100 women beneficiaries were tested with a 5 point hedonic rating scale and the result of the preference study is presented in Table 31.

Preference study among 50 anganwadi workers revealed that 82 per cent graded the recipe as "liked very much" with a total score of 205.

Preference study of selected recipe among 100 women beneficiaries showed that 89 per cent of them "liked very much" the recipe and the total score obtained was 445 (Table 31). Eighteen per cent of the anganwadi workers and eleven per cent of the women beneficiaries "liked moderately" the recipe and the total scores obtained

Table 31. Distribution of anganwadi workers (AW = 50) and women beneficiaries (WB = 100) based on their preference for the selected recipe

Rating	Maximum score	Total score		Mean score		Percent score	
		AW	WB	AW	WB	AW	WB
Like very much	5	205 (41)	445 (89)	4.10	4.45	82	89
Like moderately	4	36 (9)	44 (11)	0.72	0.44	18	11

Figures in parenthesis denotes number of respondents

were 36 and 44 respectively. Based on the above observations recipe 4 was selected for the field experiment conducted among 60 women beneficiaries in selected centres for six months.

4.5. Socio economic and dietary profile of lactating women beneficiaries

Socio economic and dietary profile of lactating women beneficiaries were assessed by eliciting information on their demographic and dietary profile of the families.

4.5.1 Demographic profile of the families

Beneficiaries of the field experiment were lactating women beneficiaries identified under Experimental (EG) and Control Groups

(CG). Before detailed comparisons were undertaken between these two groups, it was first established that sampling differences did not exist between these two groups, with respect to certain key socio economic dietary factors.

A socio economic survey was conducted among the 120 respondents selected for the study. Information generated on the socio economic profile of the respondents were about their religion, type and size of the family, marital status, their economic, educational and employment status, details of household aspects and basic facilities. Hindu community was observed to predominate (86.67 per cent) in the EG and (76.67 per cent) in the CG. Christians constituted 10 per cent and 8.33 per cent respectively, of the households studied in the EG and CG and 3.33 per cent of the women beneficiaries in the EG and 15 per cent in the CG were found to be from muslim community.

Table 32 represents the details of type, size and composition of the family, and of the respondents.

Nuclear type families were common in the EG (80.33 per cent) and CG (68.33 per cent) while extended families constituted 11.67 per cent in the EG and 26.67 per cent in the CG. Comparatively joint families were not common in both the groups.

Families with 3 members were found among 46.67 per cent of the families in the EG and 38.33 per cent in the CG studied while in 36.67 per cent in the EG and 35.00 per cent in the CG were found to

Table 32. Distribution of respondents based on the type, size and composition of their families

Particulars	Experimental group		Control group		X^2 values
	Number	Per cent	Number	Per cent	
Type of family					
Nuclear	(50)	80.33	(41)	68.33	
Joint	(3)	5.00	(3)	5.00	4.412^{NS}
Extended	(7)	11.67	(16)	26.67	
Size of family					
3 members	(28)	46.67	(23)	38.33	
4 members	(22)	36.67	(21)	35.00	1.898^{NS}
5 members	(6)	10.00	(10)	16.67	
6 members	(4)	6.66	(6)	10.00	
Adult males					
1 member	(55)	91.67	(45)	75.00	
2 members	(4)	6.67	(12)	20.00	4.170^{*}
3 members	(1)	1.66	(2)	3.33	
Adult females					
1 member	(53)	88.33	(44)	73.33	
2 members	(7)	11.67	(14)	23.33	0.513^{NS}
3 members	(6)	00	(2)	3.34	
Male children					
1 member	(31)	51.67	(38)	63.33	
2 members	(7)	11.67	(35)	8.33	–
3 members	(2)	3.33	(0)	00	
Female children					
1 member	(34)	56.67	(32)	53.33	
2 members	(4)	6.67	(4)	6.67	–
3 members	(1)	1.66	(0)	00	

* - Significant at 5 per cent level Ns - Not significant

have four members. Average size of the family was observed to be 4. Ten per cent and 16.67 per cent of the families studied in the two groups were found to have 5 members, while 6.66 per cent and 10 per cent of the families in the EG and CG were having 6 members.

Composition of families were also found varying with the type of the families. In the EG, single adult male was observed in 91.67 per cent of the families, while two adult male members in 6.67 per cent of the families and 3 members in 1.67 per cent of the families were found. Similarly in the EG, single adult male member was found in 75 per cent of the families, 2 members in 20 per cent and 3 members in 3.33 per cent of families were also observed.

In 83.33 per cent families of the EG and 73.33 per cent in CG, single adult female member (house wife) was observed. In 11.67 per cent of families in the EG and 23.33 per cent in the CG, two adult female members were found and in 3.34 per cent of families in CG, there were three female adult members.

Among child population, similar sex ratio was not observed. Either one male child or one female child was found respectively in 51.67 per cent and 56.67 per cent families in the EG. In 63.33 per cent of families and 53.33 per cent of families in the CG single child either male or female was observed. Two male children were found in 11.67 per cent of EG and 8.33 per cent in CG while in both the groups 6.67 per cent were found to have two female children. Three male children and three female children were found in 3.33 per cent and 1.67 per cent of the families respectively in the EG.

Total population in the 60 households of the EG were 224, composed of 64 adult men, 64 adult female, 51 male children and 45 female children. Average family size was 3.73. In the CG of 60 households, the total population was 241, composed of 75 adult males, 78 adult females, 48 male children and 40 female children. Average family size was 4.01. When the data was statistically treated by administering the chisquare test, significant difference was observed in number of male members and children in the households.

Table 33 details the family assets, with reference to land holding and infrastructure facilities of the house. 98.34 per cent of the families in the EG and 100 per cent in the CG were found to possess land of 5 to 15 cents. Only 1.67 per cent in the EG and 10 per cent in CG possessed land above 15 cents. The data when statistically tested, no significant difference was observed.

With regard to ownership of house, 83.33 per cent of the families in the EG and 66.67 per cent of the families in CG owned houses. Rented houses were occupied by 5 per cent of families in both EG and CG. Joint occupation of a single house along with relatives, but with seperate establishment were observed among 11.67 per cent of families in EG and 28.33 per cent of families in CG.

Majority of the houses were observed to be electrified and common water connection was available in the area. Well was also a source of water. 46.67 per cent of the families in the EG as well as 46.67 per cent in CG, had electricity, water and toilet facilities at the

Table 33. Distribution of respondents based on the possession of household assets and basic facilities

Particulars	Experimental group		Control group		X^2 values
	Number	Per cent	Number	Per cent	
Land holding					
Below 5 cents	(16)	26.67	(10)	16.67	
5.1 - 10 cents	(34)	56.67	(36)	60.00	
10.1 - 15 cents	(8)	13.33	(8)	13.33	2.108^{NS}
Above 15 cents	(1)	1.67	(6)	10.00	
Landless	(1)	1.66	(0)	00	
Facilities					
Electricity + Water + Toilet	(28)	46.67	(28)	46.67	
Electricity + Water	(17)	28.33	(16)	26.66	
Electricity + Toilet	(5)	8.33	(7)	11.67	0.475^{NS}
Water + Toilet	(5)	8.33	(4)	6.67	
Nothing	(5)	8.33	(5)	8.33	

NS - Not significant

household level while among 28.33 per cent families in EG and 26.66 per cent in CG were observed to have electricity and water but no toilet facility. 8.33 per cent of families in EG and 11.67 per cent in CG were observed to have electricity and toilet facility in their houses but they were depending on public tap or well, to meet water requirements. 8.33 per cent of families in EG and 6.67 per cent in CG were found to have water and toilet facilities without electricity. Among 8.33 per cent families each in EG and CG, these facilities, were absent. The data was tested statistically and found not significant.

Employment and income are interrelated and living status of the family depends directly on the income of the families. In this study, 66.67 per cent of families in EG and 56.67 per cent in CG were labourers

in the unorganised sectors like agriculture and house construction (Table 34). Few house holds were observed to be benefited by better jobs like running small petty shops, employment in workshops or drivers of autorikshaw or lorry. These type constituted 23.33 per cent of households in EG and 41.66 per cent in CG. Heads of families of 8.33 per cent households in EG and 1.67 per cent of households in CG were found employed in private sector. Among the households surveyed, government employment as occupation was observed only among 1.67 per cent in EG.

Table 34 depicts the monthly income of the families studied. 38.33 per cent of the households in EG and 36.67 per cent in CG were

Table 34. Distribution of respondents based on the occupational status of the head of the family and monthly income

Particulars	Experimental group		Control group		X^2 values
	Number	Per cent	Number	Per cent	
Occupation					
Government employee	(1)	1.67	(0)	00	
Private employee	(5)	8.33	(1)	1.67	
Coolie	(40)	66.67	(34)	56.67	--
Small business/petty shops/ Driver/Workshop women	(14)	23.33	(25)	41.66	
Monthly Income range					
Below Rs.1000/-	(2)	3.33	(0)	00	
1001 - 1500	(10)	16.67	(4)	6.67	
1501 - 2000	(23)	38.33	(22)	36.67	5.520^{NS}
2001 - 2500	(18)	30.00	(23)	38.33	
2501 - 3000	(2)	3.33	(7)	11.67	
3001 and above (5)	(5)	8.33	(4)	6.66	

NS - Not significant

found to have a monthly income of Rs.1501-2000 while 30 per cent of the households in EG and 38.33 per cent in CG were identified under an income range of Rs.2001-2500/month. 16.67 per cent of households in EG and 6.67 per cent in CG were observed to earn Rs.1000 to 1500/ month, while 3.33 per cent of the house holds in EG had a monthly income below Rs.1000/- while 8.33 per cent of households in EG and 6.66 per cent in CG had a monthly income above Rs.3000/-. Statistical treatment of the data revealed no significant variation between the two groups.

An analysis of the age wise distribution of the respondents showed that 10 per cent of the respondents in EG and 18.33 per cent in CG belonged to the age group of 18 to 20 years (Table 35). In the age group of 20 to 25 years of age, 41.67 per cent of the respondents in EG and 55 per cent in CG were found located. The respondents in the age group of 25 to 30 years contributed 43.33 per cent in the EG and 23.33 per cent in the CG. Only 5 per cent of the respondents in the EG and 3.34 per cent in the CG belonged to the age above 30 years. Statistical treatment of the data revealed significant variation between the two groups.

Educational status of the respondents revealed that 3.33 per cent in the EG and 5.00 per cent in the CG had education up to primary level. Five per cent in EG and 18.33 per cent in the CG were found educated upto upper primary level. Majority of the respondents 75.00 per cent in EG and 56.67 per cent in CG were observed to have high school education; while 16.67 per cent in the EG and 20 per cent in the CG, were found to have college level education either upto PDC or Degree. Statistical treatment of the data revealed no significant variation between the two groups.

Table 35. Distribution of respondents based on selected personal characteristics

Particulars	Experimental group		Control group		X^2 values
	Number	Per cent	Number	Per cent	
Age in years					
18 - 20	6	10.00	11	18.33	
20 - 25	25	41.67	33	55.00	6.320*
25 - 30	26	43.33	14	23.33	
30 and above	3	5.00	2	3.34	
Education - Illiterate					
Primary	2	3.33	3	5.00	
Upper primary	3	5.00	11	18.33	5.977NS
High School	45	75.00	34	56.67	
College	10	16.67	12	20.00	
Marital status					
1 year	19	31.67	17	28.33	
2 years	11	18.33	20	33.33	
3 years	15	25.00	11	18.33	3.673NS
4 years	7	11.67	8	13.33	
5 years	8	13.33	4	6.67	

* - Significant at 5 per cent level NS - Not significant

Among the respondents 31.67 per cent in the EG and 28.33 per cent in the CG had completed one year of marital life while 18.33 per cent and 33.33 per cent of the respondents in the experimental and control groups respectively were found completed two years of marital life and 25.00 per cent and 18.33 per cent respectively in the EG and CG had completed 3 years of marital life. Four years of marital life was found completed by 11.67 per cent in the EG and 13.33 per cent in the CG. 13.33 per cent in EG and 6.67 per cent in the CG had completed five years of marital life. No significant variation was observed between the two groups.

4.5.2 Dietary profile of the families

Food consumption surveys provide an insight into the dietary habits, food buying practices and pattern of food consumption of subjects under study. Such informations are useful in interpreting and analysing the dietary profile of families.

High lights of the analysis of the data on food expenditure pattern of the subjects are presented in Table 36.

Rice which is the most important staple cereal of Keralites was purchased by 100 per cent of the families in both the groups and 28.33 per cent of EG and 61.67 per cent CG were observed to spend Rs.300/ month for purchasing rice and wheat. Higher amount in the range of Rs.301-400 per month was found to be spent by 61.67 per cent of EG and 36.60 per cent of CG to buy the same food articles. Rs.401-500 was spent for purchasing similar food items by 10.00 per cent of the households in the EG and 1.66 per cent in the CG.

Regarding the purchase of pulses different types of pulses, frequently purchased, were green gram, black gram, cow pea, red gram dal and bengal gram. 46.67 per cent households in the EG and 40.00 per cent in the CG were observed to spend Rs.50/month to purchase these pulses. While 53.33 per cent and 60.00 per cent of the households in the EG and CG respectively were observed to spend Rs.51 to Rs.100/ month to purchase these pulses.

Table 36. Monthly food expenditure pattern of the families (in per cent)

Items and Expenditure	Experimental group		Control group	
	Number	Per cent	Number	Per cent
Cereals				
Below Rs.300	17	28.33	37	61.67
301 - 400	37	61.67	22	36.67
401 - 500	6	10.00	1	1.66
Pulses				
Below Rs.50	28	46.67	24	40.00
51 - 100	32	53.33	86	60.00
Roots and Tubers				
Below Rs.25	60	100.00	60	100.00
Vegetables				
Below Rs.50	10	16.67	32	53.33
51-100	50	83.33	28	46.67
Green leafy vegetables (GLV)				
Below Rs.25	60	100.00	60	100.00
Oils and fats				
Below Rs.50	42	70.00	45	75.00
51 - 100	18	30.00	15	25.00
Milk and milk products				
Below Rs.100	0	0	8	13.33
101 - 200	24	40.00	25	41.67
201 - 300	27	45.00	24	40.00
301 - 400	9	15.00	3	5.00
Nuts and oil seeds				
Below Rs.100	60	100.00	60	100.00
Sugar				
Below Rs.50	47	78.33	49	81.67
51 - 100	13	21.67	11	18.33
Fish				
Below Rs.200	17	28.33	8	13.33
201 - 300	23	38.33	37	61.67
301 - 400	17	28.33	14	23.33
401 - 500	3	5.00	1	1.67
Meat/Egg				
Below Rs.100	38	63.33	46	76.67
101 - 200	22	36.67	14	23.33
Jaggery				
Below Rs.50	60	100.00	60	100.00
Fruits				
Below Rs.50	22	36.67	28	46.67
51 - 100	38	63.33	32	53.33

Roots and tubers, the second staple food of Keralites were observed to be purchased by all the households and on an average Rs.25/ month was found to be spent to effect the purchase.

Purchase of GLV (Green Leafy Vegetables) was limited among the study groups and an amount of Rs.25/month was spent by the respondents in both the groups. Sixteen point six seven per cent of households in the EG and 53.33 per cent in the CG found to spend Rs.50/ month for the purchase of other vegetables while 83.33 per cent of the respondents in the EG and 46.46 per cent of respondents in the CG were found to spend Rs.51-100/month for getting vegetables other than GLV and root vegetables.

Coconut is the major oil seed used by Keralites and in this study 100 per cent of the households in the two groups were in the habit of buying coconut and spending more than Rs.100/month for effecting the purchase.

Oils and fats, mainly coconut oil were used by the respondents. Next to coconut oil, palm oil was also found used. 70.00 per cent of respondents in the CG were observed to spend Rs.50/month for this purpose. The rest of the respondents, ie. 30.00 per cent in the EG and 25.00 per cent in the CG was found to spend Rs.51-100/month for the purchase of buying fats and oils for household utilization.

Milk was purchased daily by all the respondents either from milk vender or milk society and 13.33 per cent of the respondents in the CG were found to spend Rs.100/month to purchase milk. Forty per cent of

the respondents in the EG and 41.67 per cent of the respondents in the CG were found to spend Rs.101-200/month for milk purchase. Forty five per cent of the respondents in the EG and 40.00 per cent of the respondents in the CG were found to spend Rs.201-300/month. The remaining 15.00 per cent of the respondents in the EG and 5.00 per cent of the respondents in the CG was observed to spend Rs.301-400/month for effecting milk purchase.

Sugar was used daily by all the households and 78.33 per cent of the respondents in the EG and 81.67 per cent of the respondents in the CG were found to spend Rs.50.00/month for sugar, while 21.67 per cent in EG and 18.33 per cent of CG were observed to spend Rs.51-100/month for similar purchase. Jaggery was used occasionally by all the families and an amount of Rs.50/month was found to be spent for the purchase of jaggery.

Fish was purchased daily by all the respondents, since all the 120 families were habituated to eat non-vegetarian foods. Among the families 28.33 per cent of the families in the EG and 13.33 per cent in the CG were found to spend Rs.200/month or less and 38.33 per cent of the families in the EG and 61.67 per cent in the CG were spending Rs.201-300; and 28.33 per cent in EG and 23.33 in CG were found to spend Rs.301-400/month. Five per cent of the families in the EG and 1.67 per cent in the CG were spending Rs.401-500/month to purchase fish.

Information on meat purchase and use, revealed that 63.33 per cent of the respondents in EG and 76.67 per cent in the CG were spending

Rs.100/month, while 36.67 per cent in the EG and 23.33 per cent in the CG were spending Rs.101-200/month for purchasing meat.

Fruits were purchased for Rs.50/month by 36.67 per cent of respondents in the EG and 46.67 per cent in the CG while 63.33 per cent of the respondents in the EG and 53.33 per cent in the CG were spending Rs.51-100/month for fruits.

Purchase of snacks bakery items and processed foods was found widely varying among the groups. They were observed to spend Rs.50-100/month to buy these items.

4.5.3 Food use frequency of the families

Table 37 details the food use frequency of the families. Cereals like rice and wheat, oils and fats, mainly coconut oil, nuts and oil seeds mainly coconuts, vegetables, milk, fish and sugar were found used "daily" by all the (100 per cent) respondents in the two groups. The use of pulses were limited to "weekly once" in 11.67 per cent of the households in EG and 26.67 per cent in CG while many households in EG (88.33 per cent) and CG (73.33 per cent) were observed to be using pulses twice a week. Inclusion of roots and tubers in the dietaries by the households in the two groups were also found varying; "weekly once" by 55.00 per cent of households in EG and 41.67 per cent households in CG, while "weekly twice" consumption of roots and tubers were seen among 23.33 per cent of households in EG and 58.33 per cent of house holds in CG. Among 21.66 per cent of households in EG, consumption of roots and tubers was less frequent since these food articles were used "once in a week".

Table 37. Food use frequency pattern of the families (in per cent)

Frequency		Cereals,fish milk,oils,sugars vegetables		Pulses		Roots & tubers		GLV		Fruits		Meat/Egg		Jaggery	
Daily	EG	(60)	100.00	-	-	-	-	-	-	-	-	-	-	-	-
	CG	(60)	100.00	-	-	-	-	-	-	-	-	-	-	-	-
Weekly once	EG	-	-	(7)	11.67	(33)	55.00	(31)	51.67	(11)	18.33	(1)	1.67	-	-
	CG	-	-	(16)	26.67	(25)	41.67	(17)	28.33	-	-	(3)	5.00	-	-
Weekly twice	EG	-	-	(53)	88.33	(14)	23.33	(9)	15.00	-	-	-	-	-	-
	CG	-	-	(44)	73.33	(35)	58.33	(6)	10.00	-	-	-	-	-	-
Weekly thrice	EG	-	-	-	-	(13)	21.66	(4)	6.67	-	-	-	-	-	-
	CG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fortnightly	EG	-	-	-	-	-	-	-	-	(6)	10.00	(16)	26.47	-	-
	CG	-	-	-	-	-	-	-	-	(42)	70.00	(11)	18.33	-	-
Monthly once	EG	-	-	-	-	-	-	-	-	(16)	26.47	(35)	58.33	-	-
	CG	-	-	-	-	-	-	-	-	(32)	53.33	-	-	-	-
Occasionally	EG	-	-	-	-	-	-	-	-	(27)	45.00	(8)	13.33	(35)	58.33
	CG	-	-	-	-	-	-	-	-	(18)	30.00	(14)	23.33	(30)	50.00

Figures in paranthesis indicates number of respondents EG - Experimental group CG - Control group

Use of green leafy vegetables was limited to "weekly once" among 51.67 per cent of households in EG and 28.33 per cent in CG. However green leafy vegetables was used "weekly twice" by 15 per cent of households in EG and 10 per cent in CG. Consumption of green leafy vegetables in a higher rate, *viz.,* "thrice a week" was observed among 6.67 per cent of households in EG.

Consumption of fruits was found to be poor since 18.33 per cent of households in EG were in the habit of eating fruits "once in a week". Ten per cent of households in EG and 70 per cent in CG were in the habit of using "fruits fortnightly" and 26.47 per cent of households in EG 53.33 per cent were eating fruits "once in a month". While frequency of consumption was lower among 45.00 per cent of households in EG and 30.00 per cent of households in CG.

Compared to sugar, jaggery was less popular and was used occasionally by 58.33 per cent of households in EG and 50 per cent in CG.

Based on the summation of the scores obtained for individual food groups by households in the two groups, total scores were worked out for each food article. From this, mean scores were worked out and the results are presented in Table 38. Foods most frequently used were the ones with a mean score of 100 and cereals, fish, fats and oils, nuts (coconuts), milk, vegetables and sugar were identified under this group. While food items like roots and tubers, pulses, green leafy vegetables, fruits and meat did not find a place in the daily dietary regimen of the two groups. Based on the frequency of inclusion of various food groups in the dietaries the foods were classified into four groups (Table 39) as most frequently used foods, medium frequently used foods, less frequently used foods.

Table 38. Food use frequency scores obtained for different food items (Percentage)

Food items	Mean scores	
	EG	CG
Cereals	100.00	100.00
Fish	100.00	100.00
Milk	100.00	100.00
Vegetables	100.00	100.00
Fats and oils	100.00	100.00
Sugar	100.00	100.00
Nuts (Coconuts)	100.00	100.00
Roots and tubers	40.00	39.29
Pulses	41.86	40.57
Green leafy vegetables	29.26	18.71
Fruits	17.29	7.71
Meat/Egg	18.57	17.57
Jaggery	5.00	4.29

Table 39. Classification of foods based on food use frequency scores

Frequency of use	EG	CG
Most frequently used foods (scores 75-100)	Cereals, fish, nuts, milk, vegetables, oils and sugar	Cereals, fish, nuts, milk, vegetables, oils and sugar
Moderately used foods (Scores 61-75)	Nil	Nil
Less frequently used foods (scores 20-50)	Pulses, green leafy vegetables, meat, roots and tubers, fruits	Pulses, green leafy vegetables, meat roots and tubers
Least frequently used foods (Score $\leq$ 20)	Jaggery	Jaggery and fruits

4.5.4 Special foods prepared by the families

Habit of preparing special foods during occasions like birthdays, marriages, festivals, religious occasions and death ceremonies were assessed and the details are presented in Table 40.

Majority of the families in the two groups prepared special foods during birth days, marriages, festivals and other special occasions. All the households in the two groups were in the habit of preparing sweet items, fried items and a complete festival meal or purchasing ready to eat processed foods. During birth days 93.33 per cent of households in EG used to prepare sweet preparations, while 63.33 per cent of households in EG prepared non-vegetarian preparation and 91.67 per cent of the households in EG were in the habit of purchasing processed food items during these occasions. While households in the control group were in the habit of preparing sweet items (83.33 per cent) non-vegetarian items (58.33 per cent), a complete festival meal (50.00 per cent) and purchasing ready to eat bakery and other processed foods (70.00 per cent).

Celebrations and special food preparation with all four categories were also observed in marriages, among two groups, (100 per cent). Non vegetarian items were prepared among 5.00 per cent of EG and 11.67 per cent of CG during these occassions. Religious festivals were observed as auspicious occasions by them and hence different types of special foods such as sweet preparations, (86.67 per cent among EG and 83.33 per cent among CG) fried items, (80.00 per cent of EG and

Table 40. Percentage distribution of the households based on the preparation of special foods

Special foods	Birthdays		Marriage		Religious festival		Death ceremonies	
	EG	CG	EG	CG	EG	CG	EG	CG
No special foods prepared	5.00 (3)	8.00 (5)	-	-	-	-	-	-
Sweet preparations	93.33 (56)	83.33 (50)	100.00 (60)	100 (60)	86.67 (52)	83.33 (50)	-	-
Fried items	-	-	100 (60)	100 (60)	80.00 (48)	65.00 (39)	-	-
A complete festival meal	48.33 (29)	50.00 (30)	100 (60)	100 (60)	-	-	70.00 (42)	78.33 (47)
Non-vegetarian items	63.33 (38)	58.33 (35)	5.00 (3)	11.67 (7)	8.33 (5)	11.67 (7)	-	-
Processed ready to eat items purchased	91.67 (55)	70.00 (42)	100 (60)	100 (60)	5.00 (3)	11.67 (7)	-	-

Figures in paranthesis denotes number of families EG - Experimental Groups CG - Congrol group

65.00 per cent of CG) and non vegetarian items (8.33 per cent of EG and 11.67 per cent of CG) were found prepared. For death ceremonies also, special food preparations were common. 70.00 per cent of EG and 78.33 per cent of CG were found to prepare festival meals during those occasions.

4.5.5 Intra family distribution of foods in the families

Intra family distribution of foods is reflected in the practice followed in taking meals within the family. As indicated in Table 41 it was observed that in majority of the households (75.00 per cent in EG and 71.67 per cent in CG) meals were found served first to male members in the family and, to children and other family members later.

Table 41. Intra family food distribution pattern in the households surveyed

Preference given in food distribution	EG	CG	X^2 value
Male members first followed by children and other members	75.00 (45)	71.67 (43)	1.579^{NS}
Male members and children together and then others	18.33 (11)	15.00 (9)	–
All members together	6.67 (4)	13.33 (8)	–

Figures in paranthesis denotes number of respondents

About 6.67 per cent of households in the EG and 13.33 per cent of households in CG were observed to have a common meal time for all the members of the family when everybody was expected to be present. In all the households surveyed in both the groups, no preference was given to vulnerable people especially pregnant and lactating mothers in the distribution of foods during meals.

Many households in the two groups were observed to be in the habit of giving special foods to infants and both the groups (66.67 per cent each) were also found to provide snack food items, egg and milk to pre-school children over and above the normal meals (Table 42). However less number of house holds, (53.33 per cent in EG and 55.00 per cent in CG) were in the habit of giving extra dietary care in the form of egg and milk to school going children. Special attention was also found to be given to adolescent girls by including egg, gingelly oil, kurukku (a rice based sweet preparation like porridge but little thicker with rice, turmeric and jaggery) were specially given to the girl for one week with the onset of menarche. She was expected to be in complete rest during this period. This is a custom followed in 90.00 per cent of households in EG and 93.33 per cent in CG. The special dietary care during pregnancy was much better compared to the condition of nursing mothers. All the households in both the groups in one way or other had given special care to pregnant mothers providing extra foods like egg, fruits and milk. Ninety five per cent of the families in the EG and 91.67 per cent in the CG were found to give special foods like milk, egg, fruits and fish in extra amounts during the postnatal care period.

Table 42. Percentage distribution of households based on dietary care given to different groups

Age groups	Special foods given	EG	CG
Infants	Porridge/milk/fruit juice/egg	91.67 (55)	75.00 (45)
Pre-school children	Snack/biscuits/egg/milk	66.67 (40)	66.67 (40)
School going children	Snacks/milk/egg	53.33 (32)	55.00 (33)
Adolescent girls (Menarche)	Egg/gingelly oil, porridge	90.00 (54)	93.33 (56)
Pregnant mother	Milk/egg/fruits	100.00 (60)	100.00 (60)
Lactating mother	Milk/egg/fish	95.00 (57)	91.67 (55)
Aged members	Soft, less spicy foods	21.67 (13)	15.00 (9)
Sick people	Soft foods/kanji/ Tea/Liquid foods	23.33 (14)	16.67 (10)

Figures in paranthesis denotes number of respondents

Aged people were usually provided only with normal adult food prepared at home. Over and above this they were provided with soft liquid or semi solid easily digestible foods by 21.67 per cent of the households in the EG and 15.00 per cent in the CG. Depending upon the type of sickness certain changes were made in the diets of sick persons during fever and diarrhoea. Soft, less spicy and easily digestible foods were found provided by 23.33 per cent of households in EG and 16.67 per cent in CG.

Informations elicited on the restrictions of certain foods were taken during special conditions (Table 43). Forty five per cent of the households in the EG and thirty per cent of households in the CG were observed to restrict cow's milk, fish and egg in the diets of infants due to religious customs and beliefs and because of fear of worm infestation and digestive complaints.

In the case of adolescent girls 90.00 per cent of households in EG and 86.67 per cent in CG were observed to restrict foods like fish, brinjal and raw plantain after the onset of menarche. Similarly papaya and pineapple consumption were found restricted by pregnant women due to the fear of abortion by 96.67 per cent of households in EG and in all the households in the CG. Jackfruit and prawn were not consumed by lactating mothers in 11.67 per cent of households in EG and 20.00 per cent households in CG since it might cause flatulence complaints to mother and child. Spicy foods, fatty foods and fried foods were the foods restricted to old people since it might cause stomach upset and digestive complaints by 8.33 per cent households in EG and 10.00 per cent households in CG.

Table 43. Percentage distribution of households according to dietary restrictions at different stages of life cycle

Age groups	Foods restricted	EG	CG
Infants	Cows milk/fish/egg	45.00 (27)	30.00 (18)
Adolescent girls during menarche	Fish/brinjal/raw plantain	90.00 (54)	86.67 (52)
Pregnancy	Papaya/pine apple	96.67 (58)	100 (60)
Lactating mother	Jack fruit/prawn	11.67 (7)	20.00 (12)
Aged persons	Spicy foods/fried foods/fatty foods	8.33 (5)	10.00 (6)

Figures in paranthesis denotes number of respondents

4.6 Reorientation of supplementary nutrition component of ICDS using selected food supplement

An assessment of the existing ICDS programme provided the necessary experience and direction to study the operational and replication aspects of the supplementary nutrition programme. With this experience, an attempt was made to introduce an experimental nutrition programme, substituting the existing ICDS food supplement with the food supplement IV. This nutrition programme was implemented from 2.7.2001 to 28.12.2001. Only minimal precautions were taken to introduce efficiency controls.

4.6.1. Impact of supplementary studies

With the selected food supplement composed of wheat (50); soya (15); green gram (10); gingelly (5); Omum (5); poovarsila (5) and oil (10) one recipe sweetened with jaggery was administered to 60 women beneficiaries of EG. The mean intervention period for this study was 24 weeks but in actual implementation, more than one year was spent in the field as commencement of the programme in the 20 study centres was staggered. Supplementary food packets containing 110g of food supplement was distributed daily on feeding days (150) to 60 lactating women beneficiaries through anganwadis for a period of six months. Before starting the feeding programme, in the presence of Child Development Project Officers supervisiors and field functionaries of the anganwadi centres, the new supplementary feeding programme was explained to the beneficiaries. The new food supplement was demonstrated and food acceptability trials were conducted to win their confidence. The beneficiaries were directed to consume the food supplement every day.

The food packets required for one week (7 packets each for 60 lactating women beneficiaries) were entrusted to the field functionaries of the anganwadi centre and were instructed to hand over one packet to one beneficiary on every feeding day. Take home system of feeding was followed in the reoriented supplementary feeding experiment. The field functionaries of the centres were requested to maintain minimum records, like attendance registers to ensure physical presence of beneficiaries and food stock register which included collection and distribution of the food

supplement to the beneficiaries. These registers were checked by the investigator every week.

The influence of food supplement intake on the nutritional status of the lactating women beneficiaries, were ascertained through anthropometric, clinical and biochemical parameters.

4.6.2. Assessment of anthropometric measurements

Anthropometric measurements are considered as the best tool for detecting the various degrees of growth ratardation among the population and also to ascertain the impact of various supplementary feeding programme (Jelliffe, 1966).

In this study anthropometric measurements viz. height (cm) weight (kg) mid upper arm circumference (cm), chest circumference (cm) waist circumference (cm), hip circumference (cm) and skin fold triceps (mm) were accounted every month, during the experimental period. Mean weight and height profile of lactating women beneficiaries in the EG and CG, before and after the experiment, are presented in Table 44 and the details are presented in Appendix XII.

Anthropometric data of the EG and CG were analysed to find out difference in the mean final anthropometric measurements of EG and CG. The mean weight of lactating women beneficiaries in the experimental group was 49.27 kg against 48.52 kg which is the mean weight of the lactating women beneficiaries of CG. Weight profile of all the lactating women beneficiaries in the two groups were below the Indian standards.

Table 44. Mean anthropometric measurements of the lactating women beneficiaries

Parameters	EG		CG		Standard
	Initial	Final	Initial	Final	
Weight (kg)	49.27	50.75	48.53	48.44	50*
Height (cms)	152.37	152.37	152.68	152.68	155*
MUAC (cm)	24.48	24.95	24.31	24.35	24**
Chest circumference (cm)	80.44	80.60	79.66	79.67	-
Hip circumference (cm)	86.40	86.67	88.32	88.17	-
Waist circumference (cms)	79.88	80.40	80.13	80.05	-
Skinfold triceps (mm)	14.32	-	12.97	-	13**

* ICMR (1994) ** NNMB (1991)

The range in weight indicates that women beneficiaries in the CG had lesser weight than their counter parts in the EG. Average increase in the weight during the experimental period is also found to be less than the initial value, among the women beneficiaries in the CG.

In the case of lactating women beneficiaries the mean height for EG was 152.68 cms and 152.87 cms for CG. The standard height for Reference Indian woman is 155 cms (ICMR, 1994) and the observed height profile of the lactating women beneficiaries in the EG and CG were found to be below the standard height specified for Indian women.

Initial values for mean Mid Upper Arm Circumference of lactating women beneficiaries in EG were 24.48 and of CG group it was 24.31

cms. It was observed that the values were comparable with standard values of 24.00 cms. The range among EG was 18.00 cms - 32.00 cms and for CG it was 20.00 cms - 30.00 cms.

The mean value for chest circumference in EG was 80.44 cms and 79.66 cms for CG. The range of values were found to vary among lactating women beneficiaries of EG (68.00 cms - 102.00 cms) and CG (66.00 cms - 92.00 cms).

Mean Waist Circumference (WC) of lactating women beneficiaries in EG were 79.88 cm and in CG, it was 80.13 cms. The range of the values for WC observed, were found to be 50.00 cm to 98.00 cm in EG and 54.00 cm to 110.00 cm in EG.

Mean values for Hip Circumference (HC) among CG it was 88.32 cms and for EG 86.40. The range for HC was observed to vary from 58.00 cms to 106.00 cms for lactating women beneficiaries in EG and for CG it was observed to be 58.00 cms to 102.00 cms.

Mean Values for skinfold triceps (ST) were 14.32 mm for the lactating women beneficiaries in EG and 12.97 mm for lactating women beneficiaries in CG. The range of values for ST was from 5.00 mm to 33.00 mm for EG and for CG it was 8.00 mm to 25.00 mm.

Existing ICDS and reoriented ICDS were found to have positive influence on the above anthropometric measurements like weight, mid upper arm circumference, chest circumference, arm circumference, waist circumference and triceps skinfold thickness.

Details pertaining to Waist Hip Ratio (WHR) are presented in Table 45.

It was observed that all the lactating women beneficiaries in the two groups were above the Waist Hip Ratio (WHR) of 0.7. Majority of the lactating women beneficiaries in the EG (68.00 to 70.00 per cent) and CG (65.00 to 68.00 per cent) were in the WHR range of 0.81 - 0.90.

Table 45. Waist Hip Ratio of lactating women beneficaries

	EG		CG	
Range	Initial	Final	Initial	Final
< 0.7	Nil	-	-	-
0.71 - 0.80	6.6 (4)	6.6 (4)	13.33 (8)	13.33 (8)
0.81 - 0.90	68.33 (41)	70.00 (42)	65.00 (39)	68.33 (41)
> 0.90	25.00 (15)	23.33 (14)	21.66 (13)	18.34 (11)

Figures in parenthesis denotes number of respondents

Body Mass Index (BMI)

BMI is used as a good parameter to grade Chronic Energy Deficiency (CED) and to ascertain the nutritional status in adults (Nutrition News, 1991). BMI of the lactating women beneficiaries worked out is presented in Table 46.

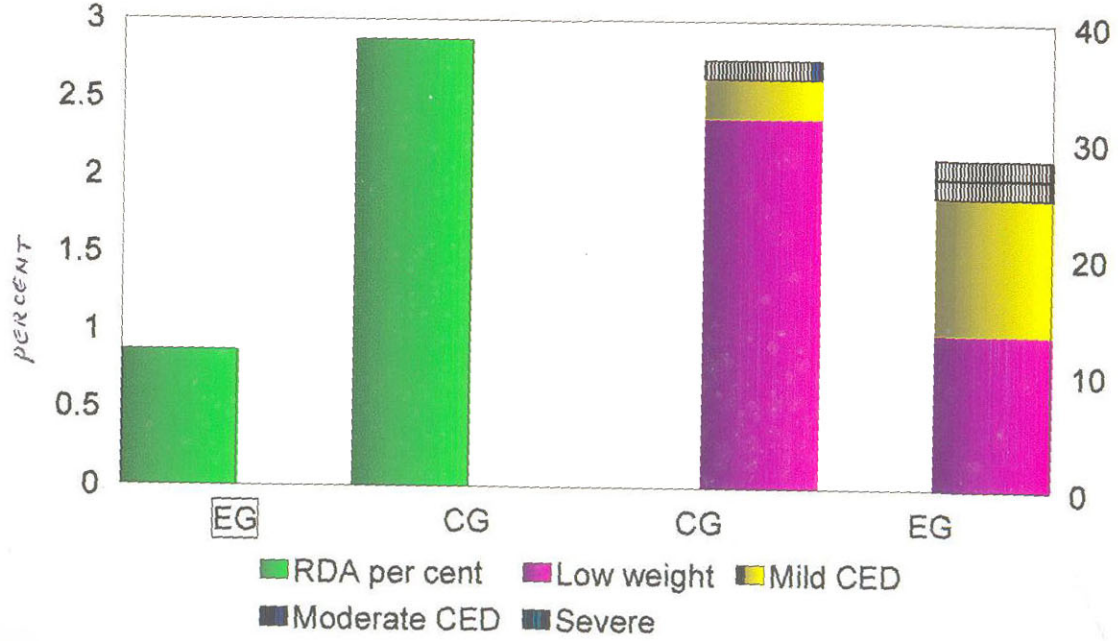


Fig. 8. Energy intake and body weight

Table 46. Percentage distribution of the beneficiaries based on BMI (Mean value)

Classification	EG		CG	
	Initial	Final	Initial	Final
CED(II) Severe < 16.0	1.67 (1)	-	-	-
CED (II) Moderate 16.0-17.0	1.67 (1)	-	1.67 (1)	-
CED (I) Mild 17.1 - 18.5	11.66 (7)	5.00 (3)	3.33 (2)	1.67 (1)
Low weight 18.5 - 20.0	13.33 (8)	16.67 (10)	31.67 (19)	31.67 (19)
Normal > 20	71.67 (43)	78.33 (47)	63.33 (38)	66.66 (40)

Figures in paranthesis denotes number of respondents

Majority of the respondents in both the groups (71.67 per cent of lactating women beneficiaries in EG and 63.33 per cent in CG) were observed to be belonging to normal BMI (>20). After the feeding experiment an increase from 71.67 per cent to 78.33 per cent (6.66 per cent increase) was observed in the shift to Normal, >20. In the control group also, there was an improvement in similar shift from 63.33 per cent to 66.66 per cent (3.33 per cent increase). Severe CED was observed among 1.67 per cent of lactating women beneficiaries in EG, but after the feeding experiment an improvement in shift from "severe" and "moderate" CED to "low weight status" was observed (Fig. 8). The data was tested statistically and found that significant difference was observed in EG; while no significant difference in CG was observed.

4.6.3. Clinical assessment of lactating women beneficiaries

Clinical examinations of the two groups for signs and symptoms related to inadequate nutrition is found useful for revealing information on their correct nutritional status.

Clinical symptoms observed in the experimental and control groups were negatively scored based on the manifestations for each deficiency and thus the total score obtained by which individual in the study group was assessed (Table 47).

As indicated in Table 47 there was a positive shift in the number of lactating women beneficiaries who were healthy and free of any clinical symptoms, with a score of 100. In the EG, on completion of the experiment similar reduction in the clinical manifestation was observed. Improvement was not observed in the control group. However, during the experiment among lactating women beneficiaries in the two groups, there was a shift from the category of 80-89 per cent scores to 90-99 per cent scores.

Test for proportion indicated that at a per cent score of 100, there was no significant difference between the EG and CG in the initial stage, while there were significant differences at 90-99 and 80-89 scores in the initial stage, whereas in the final stage there was significant difference at all stages.

Chisquare test indicated high significant difference in the scores awarded in initial and final stages, for both EG (226.58) as well as CG (27.35).

Table 47. Distribution of lactating women beneficiaries based on clinical score (in percentage)

Percent score	EG			CG		
	Initial	Final	Variation	Initial	Final	Variation
100	11.67 (7)	55 (33)	+43.33	6.67 (4)	8.33 (5)	+1.66
90-99	75.00 (45)	33.33 (20)	-41.67	55.00 (33)	63.33 (38)	+8.33
80-89	13.88 (8)	11.67 (7)	-1.66	38.33 (23)	28.33 (17)	-10.00

Figures in paranthesis denote number of respondents

Various signs and symptoms of deficiency diseases observed in the study group are presented in Table 48. An improvement in the general health condition viz. "Good" (among the two groups) was observed as a positive shift in the per cent of lactating women beneficiaries from 'fair' status. But more lactating women beneficiaries in the case of EG were found involved in such changes. Symptoms of vitamin A deficiency viz. xerosis conjuctiva, dry and wrinkled skin were observed in 20.00 per cent of lactating women beneficiaries in the EG and 25.00 per cent in CG. But these were found reduced to 13.33 per cent and 16.67 per cent, respectively in the CG and EG.

B complex deficiency of mild angular stomatitis was observed among 36.67 per cent of lactating women beneficiaries in EG and 28.33

Table 48. Percentage distribution of respondents based on the clinical manifestations

Percent score	EG			CG		
	Initial	Final	Variation	Initial	Final	Variation
General Health						
Good	28.33 (17)	53.33 (32)	+25.00	28.33 (17)	38.33 (23)	+10.00
Fair	61.67 (37)	46.67 (28)	-15.00	53.33 (32)	41.67 (25)	-11.66
Poor	10.00 (6)	00	00	18.34 (11)	20.00 (12)	+1.66
Clinical disorders						
Vitamin A deficiency-xerosis of conjuctiva, dry and wrinkled skin	20.00 (12)	13.33 (8)	-6.67	25.00 (15)	16.67 (10)	-8.33
Vitamin B complex deficiency-mild angular stomatitis	36.67 (22)	16.67 (10)	-20.00	28.33 (17)	30.00 (18)	+1.67
Vitamin C deficiency - spongy bleeding gum	8.33 (5)	6.67 (4)	-1.66	11.66 (7)	8.33 (5)	-2.33
Anaemia - dry pale skin, palelook	65.00 (39)	21.66 (13)	-43.34	63.33 (38)	58.33 (29)	-5.00
Other health problem						
Dental caries tooth decay	76.67 (46)	80.00 (48)	+3.33	86.67 (52)	83.33 (50)	-3.33

Figures in paranthesis denote number of respondents

per cent in the CG. But, unlike in the case of EG, more lactating women beneficiaries in the CG were found affected by this disorder on completion of the experiment. 8.33 per cent of lactating women beneficiaries in the EG and 11.66 per cent in the CG were observed to have complained about bleeding gums.

Symptoms of anaemia was found exhibited in 65 per cent of lactating women beneficiaries in EG and 63.33 per cent in CG. An increase in dental caries and tooth decay was observed among the lactating women beneficiaries in EG from 76.67 per cent to 80.00 per cent, on completion of the experiment. However a decrease in this manifestation was observed among more number of lactating women beneficiaries in CG from 86.67 per cent to 83.83 per cent.

4.6.4 Assessment of Biochemical parameters of the respondents

Biochemical indicators represent the most objective assessment of the nutritional status of an individual, providing sub clinical informations. Nutrient intakes are reflected in their levels present in blood, serum, urine and these biochemical changes often precede the clinical symptoms. Hence they may be used as early indicators of malnutrition.

Results of the assessment of Haemoglobin (Hb) levels of beneficiaries in EG and CG are presented in Table 49.

Table 49. Percentage distribution of respondents based on haemoglobin levels

N = 120

Haemoglobin levels	Details of LWB		
	EG	CG	X^2 values
> 12 g/dl	40 (24)	35 (12)	2.702^{NS}
< 12 g dl	60 (36)	65 (39)	

Figures in parenthesis denote number of respondents
NS - Not significant

From the Table it was observed that 40.00 per cent lactating women beneficiaries in EG and 35.00 per cent in CG were observed to have haemoglobin levels above normal (> 12g/dl) while 60 per cent of lactating women beneficiaries in EG and 65 per cent in CG were found to have levels below normal.

4.6.5. Formulation of an efficiency index

Supplementary nutrition component of ICDS is mainly composed of delivery of food supplements, participation by beneficiaries and utilisation of food supplements by the target population. The first two aspects may determine the efficiency of the programme while the third component is related to the effectiveness of utilisation by the target population. The criteria adopted for assessing the efficiency of these

components were by determining the proportion of the targeted quantity of food supplement delivered at the anganawadi centre, participation rate by the beneficiaries and improvement in the weight profile of the beneficiaries during the experimental period. Variables like differnces in dietary intake, clinical signs and morbidity status were not accounted for developing this index. It was hypothesised that differences in all these variables between the beneficiaries of the two groups might not exist, due to the elimination of sampling differences during selection of beneficiaries in the two groups.

For developing Efficiency Index, Programme Efficiency Index (PEI) and Utilisation Efficiency Index (UEI) were developed using the formulae, tried in Poshak project (Gopaldas, 1975). The PEI was developed from the data on proportion of food supplements reaching the centre during the experimental period and the participation rate of the beneficiaries for the food supplement UEI was developed from the data on variation in weight profile of the beneficiaries before and after the feeding experiment.

The relative performance could be measured by an increment in the weight status and a reduction in the standard deviation of the variable weight status.

The efficiency of the experiment was also measured in terms of reaching the normal weight status, the "standard weight" presribed for Reference Woman by ICMR.

The weight status of women beneficiaries were calculated by assigning weightage numbers. Maximum weightage (w_4) was given to women beneficiaries whose weight were 20 per cent below the standard weight prescribed by ICMR while w_3 for women with 10 per cent below the standard weight, w_2 for women with 5 per cent below the standard weight and w_1 for women with standard weight and above the standard weight prescribed for adult women.

Two indices developed, one for measuring the aggregate impact called Aggregate Efficiency Index (AEI) and the other to measure the distribution character of the feeding experiment, called Distributive Efficiency Index (DEI) were then combined to give a measure of the efficiency of utilisation of the programme inputs by the intervened beneficiary population. This was called the Utilisation Efficiency Index (UEI)

The formulae used for this purpose are

$$UEI = \sqrt{AEI \times DEI}$$

$$AEI = \frac{\text{Percent increase in mean weight status between initial and final reading of experimental/control groups}}{\text{Ratio between SDs of final and initial values}}$$

$$AEI = \frac{(\overline{Y} - \overline{X})}{\overline{X}} \times 100 \times \frac{SDI}{SDF}$$

Where X and Y are the mean weight status of the control and experimental groups and SDI and SDF are the standard deviations of the weight status, worked out from the initial and final values of the two groups.

$$DEI = \frac{\text{Per cent increase in the weight status between initial and final reading of the beneficiaries in experimental and control groups}}{\text{Ratio between SD of the final and initial values}}$$

$$DEI = \frac{(\Sigma\ wiyi - (\Sigma\ wixi)}{\Sigma\ wixi} \times 100 \times \frac{SDI}{SDF}$$

where Σ wiyi or wixi are the means of the weight status of the beneficiaries.

PEI was found to be as high as 100 in the EG and 52.80 in the CG. DEI, AEI and UEI were also found to be 0.92, 1.92 and 1.33 for the CG respectively and 12.72, 2.92 and 6.38 for the EG indicating the vital role of food supplement in ICDS programme for a woman in special condition.

The higher the indices for PEI, AEI and UEI, in the EG, the more efficient was the implementation of the programme. The levels of programme efficiency (EI) in descending order of importance were higher in the reoriented programme (25.25) when compared to existing ICDS (8.37). This confirms the fact that the effective delivery of food supplements to the target population is essential, if a high order of programme efficiency is to be achieved.

Table 50. Efficiency Indices of existing and re-oriented ICDS programme

Particulars	PEI	DEI	AEI	UEI	EI
Existing ICDS (Control)	52.80	0.92	1.92	1.33	8.37
Reoriented ICDS (Experimental)	100	12.72	2.92	6.38	25.25

PEI - Programme Efficiency Index
DEI - Distributive Efficiency Index
AEI - Aggregate Efficiency Index
UEI - Utilization Efficiency Index
EI - Efficiency Index

4.6.6 Attitude of beneficiaries towards newly developed food supplement

The attitude of beneficiaries in the EG to the newly developed food supplement was assessed using standard procedures (Likert scale). Fifty statements related to the food supplement were drafted and circulated among the experts and based on their views, 20 statements were selected and pre-tested in the field. The finalised statements were administered to lactating women beneficiaries and Table 51 details the scores obtained and the influence of their education level on availing scores.

The score obtained for the statements is 40 to 59. Maximum score expected is 80 and minimum 20. As depicted in Table the education level of the lactating women beneficiaries were observed to influence the scores awarded. The 20 statements were further classified (Table 52) as health oriented statements (7), food quality oriented statements (4) statements pertaining to its feasibility, as a food supplement for an intervention programme (6) and statements oriented to the satiety feeling

Table 51. Attitude scores of beneficiaries towards newly developed food supplement

Score (Maximum score 80)	Lower primary and Upper primary n = 5	High school n = 45	College n = 10
50 - 59	5.00 (3)	50.00 (30)	15.00 (9)
40 - 49	3.33 (2)	25.00 (15)	1.67 (1)

Figures in paranthesis denotes number of respondents

Table 52. Classification of statements and scores obtained

Particulars of statements	Total number of statements	Maximum score obtained	Mean score
Health oriented statements	6	24	2.48
Eating quality oriented statements	4	16	2.87
Feasibility as a food supplement for an intervention programme	6	24	2.51
Satiety oriented statements	4	16	1.63

given to the food supplements (4). Table 52 details the maximum and minimum scores and mean scores obtained for each group. As revealed in the Table food oriented statements, and feasibility as a food supplement for an intervention programme were found to have much influence on shaping the attitude of the beneficiaries. This was followed by health oriented statements and satiety oriented statements.

4.6.7. Indepth studies on sub sample

The criteria adopted for assessing the improved health/nutritional status of selected lactating women beneficiaries of experimental group at the end of intervention period, in comparison with their counterparts in the control group, were improvement in the anthropometric indices and the biochemical parameters, reduction in the quantum of clinical signs and variation in their dietary intake.

With the above informations, Nutritional Status Index (NSI) for individual beneficiaries in the EG was worked out.

4.6.7.1. Actual food intake of lactating women beneficiaries

Actual food intake is a direct method of nutrition monitoring. Twenty beneficiaries each from EG and CG were selected and their dietary intakes were computed from individual food consumption by actual weighment. This enabled to determine the quantity and quality of food consumed by the respondents and to locate the inadequacies in the dietaries if any. Details pertaining to the actual food intake of the two groups is presented in Table 53 as comparison with Recommended Dietary Allowances (RDA) stipulated by ICMR (1999).

Table 53. Average food intake of lactating women beneficiaries

Food Groups (g)	RDA (g)/day	EG Intake	EG Per cent RDA	CG Intake	CG Per cent RDA
Cereals	470.00	573.85	122.00	543.25	116.00
Pulses	35.00	5.65	16.14	13.20	37.71
Green leafy vegetables	100.00	10.65	10.65	00	00
Other vegetables	40.00	73.00	182.60	66.60	166.50
Root and Tubers	50.00	37.20	74.40	62.65	125.30
Milk	200.00	95.15	47.58	95.35	47.68
Fruits	30.00	13.50	45.00	7.50	25.00
Oils and Fats	30.00	11.85	39.50	12.00	40.00
Sugar	30.00	24.75	82.50	21.75	72.50
Fish	30.00	118.50	395.00	136.20	453.00
Coconut	-	32.95	-	49.40	-

Among the different food articles, consumption of cereals was found to be more in both the groups compared to RDA. The percentage RDA consumption of cereals was 122 per cent among EG and 116 per cent among CG. The consumption of pulses was very low in the diets of the two groups. The percentage consumption of pulses was 16.14 per cent and 37.71 per cent respectively in EG and CG. Consumption of green leafy vegetables was found to be very low (10.65 g per cent) among the beneficiaries of EG as against the RDA 100. While in the case of CG, this food article had no place in their daily dietaries.

Vegetables were found to be included in adequate amount in the dietaries of the EG (73.00 g) and in CG (66.60 g) corresponding to 182.50 per cent and 166.50 per cent respectively. Consumption of roots and tubers, milk, oils and fats, sugar and jaggery were found to be very low in comparison with the RDA of foods in the two groups. Consumption of fish was observed to be very high in the two groups, and all the respondents were non vegetarians, meeting 395.00 per cent and 453 per cent of RDA specified for fish, respectively in the dietaries of beneficiaries in EG and CG. Coconut was used daily by EG (32.95 g) and by CG beneficiaries (49.40 g).

The intake of nutrients by the respondents was computed from the quantity of foods consumed by the respondents and the details of comparison with the RDA are presented in Table 54. The nutrients present in the diets of the beneficiaries of EG were more than their counterparts in the CG for all the nutrients except energy. As presented in the Table, the energy intake as well as thiamine, the lactating women beneficiaries in EG as well as in CG were found to be above the RDA level; More than 90 per cent of RDA stipulated were found met for the two groups for protein and riboflavin. Minerals like calcium and iron were inadequate in the diets of the two groups, since even 75 per cent of RDA were not met. The diets of the two groups were found to be very poor in ß-carotene since only 14-21 per cent of RDA specified were found met Vitamin C intake in their diets were also low since only 50 to 60 per cent of RDA were found met in EG and CG.

Table 54. Average nutrient intake of respondents

Nutrients	RDA	Average nutrient intake		Per cent of RDA	
		EG	CG	EG	CG
Energy (kcals)	2425.00	2446.17	2478.06	100.87	102.18
Protein (g)	75.00	70.40	73.25	93.86	97.66
Iron (mg)	30.00	16.04	18.57	53.47	61.89
Calcium (mg)	1000.00	659.65	719.49	65.96	71.94
β-carotene (mg)	3800.00	770.06	565.70	20.26	14.89
Thiamine (mg)	1.20	1.58	1.53	132.00	127.46
Riboflavin (mg)	1.40	1.36	1.27	97.04	90.60
Niacin (mg)	17.50	14.86	13.80	87.44	78.83
Vitamin C (mg)	80.00	47.21	44.96	59.00	56.20

4.6.7.2. Direct parameters to assess the nutritional status of beneficiaries

Adequacy of diet is well reflected in the health status of an individual, pertaining to physical status, clinical profile, and haemoglobin status, which are considered as direct parameters to determine the nutritional status of a person.

Table 55 depicts the direct parameters to assess the nutritional profile of the beneficiaries. Anthropometric indices shown in the Table

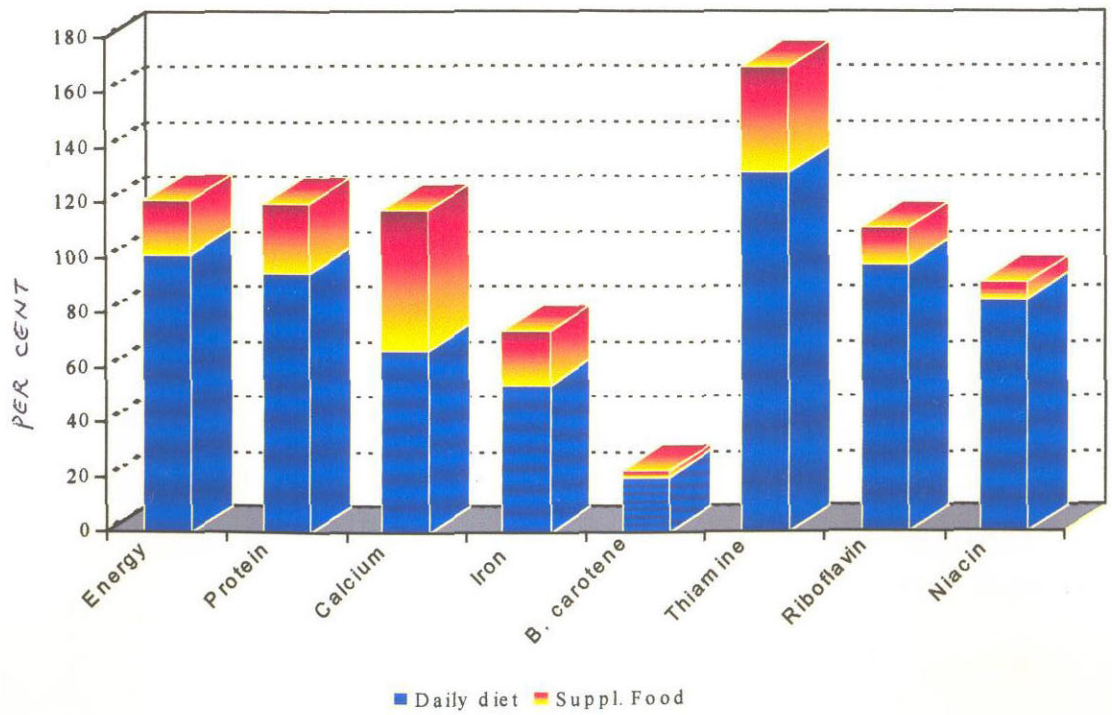


Fig. 9. Per cent contribution of nutrients from food supplement to normal daily diet

Table 55. Direct parameters to assess the nutritional profile of the beneficiaries

Parameters	EG				CG			
	Initial	Final	Variation	't' value	Initial	Final	Variation	't' value
Anthropometric Indices								
Weight (kgs)	44.22	46.13	+1.91	7.111*	46.62	46.60	-0.02	–
Height (cms)	151.92	151.92	–	–	152.40	152.40	–	–
Mid Upper Arm Circumference (cms)	25.14	25.31	+0.17	–	23.71	23.70	-0.01	–
Chest circumference (cms)	81.00	81.25	+0.25	–	79.77	79.90	+0.13	–
Hip circumference (cms)	87.70	88.90	+1.20	–	89.35	89.35	–	–
Waist Circumference (cms)	75.45	75.65	+0.30	–	74.30	74.30	–	–
Skin fold triceps (mm)	14.65	–	–	–	13.22	–	–	–
Haemoglobin status								
> 12 g/dl	(9) 45.00	(12) 60.00	+15.00	8.682*	(5) 25.00	(9) 45.00	+20.00	5.043*
< 12 g/dl	(11) 55.00	(8) 40.00	-15.00	–	(15) 75.00	(11) 55.00	-20.00	–
Clinical score								
100	–	(2) 10.00	+10.00	11.960*	–	–	–	–
90-99	(6) 30.00	(12) 60.00	+30.00	–	(7) 35.00	(8) 40.00	+5.00	3.683*
80 -89	(14) 70.00	(6) 30.00	-40.00	–	(13) 65.00	(12) 60.00	-5.00	–

Figures in parenthesis denotes number of respondents * - Significant at 5 per cent level

revealed that the initial weight and height of the lactating women beneficiaries were below the standard. It was observed that there was a change in the weight profile from 44.22 kg to 46.13 kg in the case of EG and from 46.62 kg to 46.60 kg in the case of CG. The initial mean body weight of the beneficiaries of CG were observed to be slightly higher when compared to the beneficiaries of EG but slight decrease was observed during the study period.

Mid upper arm circumference was observed to be slightly higher among EG, 25.14 cm initially and 25.31 cm finally, with a variation, of 0.17 cm. In the case of beneficiaries of CG the value was 24 cm, the observed values were 23.71 initially, and a decrease in the final value as 23.70, was also observed.

There was a change of +0.25 cms in the chest circumference of EG from 81 cms to 81.25 cm and in the case of beneficiaries of CG, the change was +0.13 cms from 79.77 to 79.90 cms. Hip circumference values of EG was observed to be 87.80 cm initially and 88.90 cm finally with a change of +1.20 cm. A comparison of the waist circumference revealed that the difference was +0.30 cm from 74.45 cm to 75.65 cm. But in the case of beneficiaries of CG, no change was observed in the initial and final values of these measurements. For skinfold triceps, the value was 14.65 mm among the beneficiaries of EG and 13.22 mm for CG.

Haemoglobin status of EG and CG beneficiaries were carried out among a sub sample of 20 each (Table 55). It was observed that

there was an improvement in haemoglobin status of EG beneficiaries (15%) as well as in CG beneficiaries (20%). The number of beneficiaries having haemoglobin above 12 g/dl was observed to be nine initially (45 per cent) and was found to increase to twelve finally (60 per cent) in the EG. In the CG initially there were five beneficiaries, having haemoglobin values above 12 g/dl. But the number was increased to nine (25 per cent to 45 pe cent). 55 per cent of EG beneficiaries and 75 per cent of CG beneficiaires were observed to be below 12 g/dl haemoglobin level initially. After the six months study period, the percentage was found to decrease, ie an improvement in the haemoglobin status was observed. Fourty per cent of EG beneficiaries and 55 per cent of CG beneficiaries were found to have their haemoglobin levels below 12 g/dl.

The presence of clinical signs and symptoms of different deficiency disorders were assessed among the sub sample. The clinical scores of EG and CG beneficiaries and the percentage were depicted in Table 55. It was observed initially that none of the beneficiaries in the two groups were 100 per cent healthy. Ninety to ninety nine per cent score were obtained for 30 per cent of EG beneficiaries and 37 per cent of CG beneficiaries initially. In the final observation 10 per cent of the EG beneficiaries were found to have 100 per cent score, while 60 per cent lactating women beneficiaries in EG and 40 per cent in the CG, were observed to attain scores in the range of 90 to 99. 80 to 89 scores were found obtained for 70 per cent of EG beneficiaries and 65 per cent of CG beneficiaries during iniitial evaluation. This percentage was observed to be reduced to 30 and 60 respectively in EG and CG beneficiaries, during final evaluation.

Detailed biochemical investigation viz. estimation of total serum protein and albumin were carried out in the blood drawn from selected 20 lactating women beneficiaries each, from EG and CG. The results are depicted in Table 56.

A comparison of data generated on serum protein revealed that there was 20 per cent shift from low to high level in the EG group while in the CG group the shift was only 5 per cent. The initial serum albumin level of <3.5g per cent was observed among 55 per cent of lactating women beneficiaries of EG and 70 per cent in the CG. After the intervention programm a shift of 2.5 per cent from low to high level was observed among EG.

Serum iron level indicates that estimation of serum iron in EG and CG prior to the experiment revealed that none of the lactating women beneficiaries was in a deficient stage. However on completion of experiment there was substantial improvement in the serum iron level. In EG 15.00 per cent of lactating women beneficiaries had serum iron level above 200 μg/dl. In the CG also the number of lactating women beneficiaries having a serum iron level of 100 to 200 μg/dl were found to be from 85.00 to 90.00 per cent.

Total Iron Binding Capacity (TIBC) is found to be 250-416 μg/dl (Good Hart and Shils, 1980). Prior to the experiment 35.00 per cent of the lactating women beneficiaries in EG and 40.00 per cent in CG were not having normal level of TIBC. On completion of the experiment there was a shift of 25.00 per cent lactating women beneficiaries to normal stage, while in the case of CG it was observed to be 10.00 per cent

Table 56. Serum protein and serum albumin levels of lactating women beneficiaires (in percentage)

Parameters	EG				CG			Normal values	't' value
	Initial	Final	Change	't' value	Initial	Final	Change		
Serum protein observed value								6 - 8g %	
< 6 g per cent	45.00 (9)	25.00 (5)	-20	4.808*	40.00 (8)	35.00 (9)	-5		0.318NS
6 - 8g per cent	55.00 (11)	75.00 (15)	+20	–	60.00 (12)	65.00 (13)	+5		–
Serum albumin observed value								3.5 to 5 g %	
3.5 g per cent	55.00 (11)	30.00 (6)	-25	7.303*	70.00 (14)	60.00 (12)	-10		0.365NS
3.5 to 5 g per cent	45.00 (9)	70.00 (14)	+25	–	30.00 (6)	40.00 (8)	+10		–

Figures in paranthesis denotes number of respondents * - Significant at 5 per cent level NS - Not significant

Table 57. Percentage distribution of lactating women beneficiaries based on serum iron and TIBC

Parameters	Normal value	EG			CG		
		Initial	Final	Change	Initial	Final	Change
Serum iron (µg/dl)	63-202*						
> 200		–	15.00 (3)	+ 15	–	–	–
100 - 200		90.00 (18)	85.00 (17)	-5	85.00 (17)	90.00 (18)	+5
60 - 100		10.00 (2)	–	-10	15.00 (3)	10.00 (2)	-5
< 60		–	–	–	–	–	–
TIBC (µg/dl)	25-416**						
> 400		15.00 (3)	30.00 (6)	+15	30.00 (6)	30.00 (6)	–
250 - 400		50.00 (10)	60.00 (12)	+10	30.00 (6)	40.00 (8)	+10
< 250		35.00 (7)	10.00 (2)	-25	40.00 (8)	30.00 (6)	-10

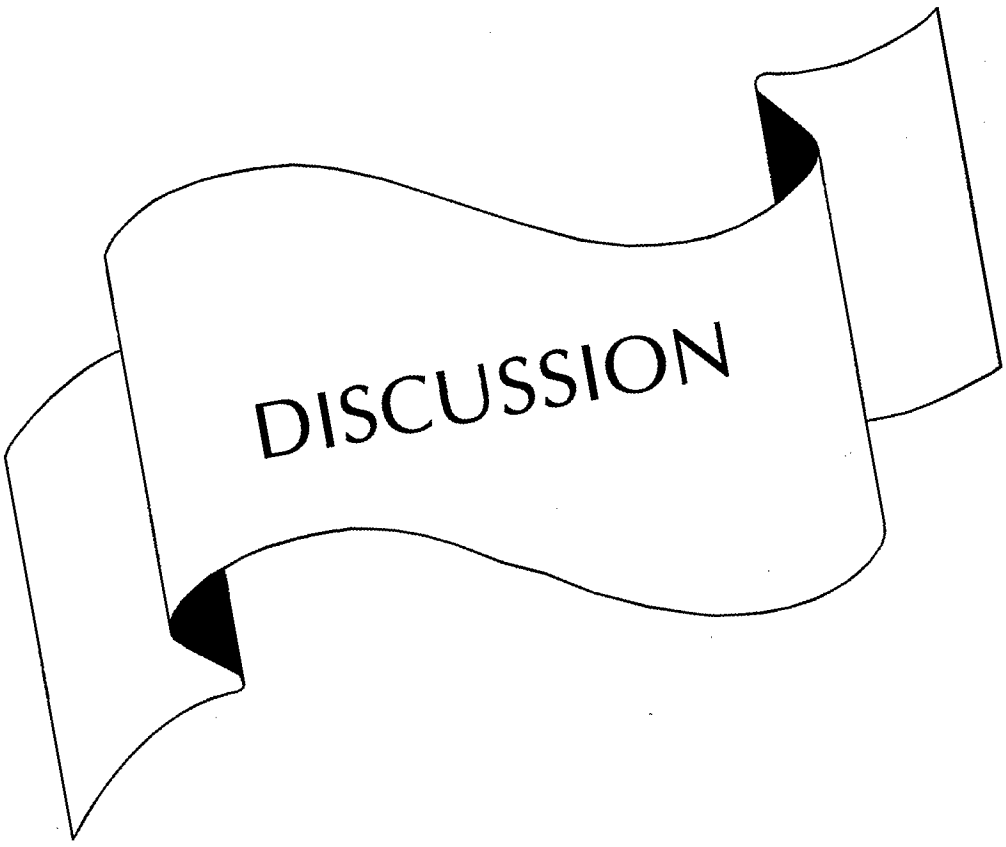
Figures in parenthesis denotes the number of respondents

* Harper, 1990
** Good Hart and Shils, 1980

Nutritional Status Index (NSI)

Nutritional Status Index of EG beneficiaries were worked out with the parameters such as weight, height, Body Mass Index (BMI), haemoglobin level and clinical score.

Data collected prior to the experiment resulted in NSI of 3.28 and a similar treatment of data collected on completion of the experiment revealed NSI to be 3.68 indicating an improvement in the nutritional status of lactating women beneficiaries in EG.


DISCUSSION

DISCUSSION

Investigation on the "Impact of Soya enriched food supplement on the nutritional status of women beneficiaries of ICDS", is an attempt to evaluate the existing supplementary nutrition component of ICDS, to formulate a suitable food supplement using indigenous food materials to replace the existing one and to ascertain the impact of this newly developed food supplement on women beneficiaries.

While a holistic approach is essential to prevent malnutrition in poor communities in our country, supplementary feeding programmes like ICDS can help in alleviating the problem, at least among the vulnerable segments of the population. In Kerala, ICDS is in operation for the past several years. Earlier, in similar intervention programmes, major thrust was on protein but now realising that the gap in the current dietaries is energy rather than protein, efforts were made to increase calorie density of supplementary foods for vulnerable conditions like lactation.

5.1 Evaluation of the existing supplementary nutrition component of ICDS

In the present study twenty anganwadi centres with 120 lactating women beneficiaries were selected as subjects. As a first step,

programme efficiency at these anganwadi centres with reference to the supplementary nutrition component was assessed to find out the influence of the basic facilities extended to implement the programme in proper way. From among the centres studied, only 40 per cent were found to satisfy the requirement related to the basic facilities.

The most commonly employed approaches in the supplementary nutrition component of ICDS programme in these centres are "on the spot feeding" conducted under supervision and "take home" food system operated through anganwadi centre functioning solely as a distribution agent. Between these two, "take home" method was found to be more popular in the centres studied. As can perhaps be anticipated the 'take home' method was found to suffer from the inherent disadvantage of dispersion of the "carry home" food to family members other than the target beneficiary. But this method in a way is also observed to avoid the dangers of cross infection that are likely to be present in the "on the spot" feeding approach.

The participation rate or response of the recipient community in these centres were measured in terms of hour often the target population availed themselves of this service actually offered to them. Many earlier studies have also revealed that on the "spot feeding" ensures consumption by the beneficiary when compared to take home system and this may influence the programme efficiency (Ukkuru, 1993). However on the spot feeding system was found unpopular among beneficiaries as well as among field functionaries in many anganwadi centres due to difficulty on

the part of the women beneficiaries to come to the centre, their laziness, and excess time to be spent in the centre by the field functionaries, for distributing the supplement.

As part of the operational feasibility of the supplementary nutrition component of package of ICDS, impact on target women population and its cost effectiveness were also ascertained. The daily food supplement provided to the women beneficiaries through supplementary nutrition component of ICDS on an average is observed to help to supplement, approximately an additional 446.20 kcals energy and 12.16 g protein per day. However information on whether the women beneficiary actually consumed the daily ration or the ration dispersed to children and other members in the home, is found unavailable.

Participation by the lactating women beneficiary receiving ICDS food supplement from different anganwadi centres were found varying. Hind sought suggests that anganwadi centre, with high per cent deficit was clearly an unfavourable one, underlining many difficulties in actual distribution system, and among these the important one being the accessibility of the beneficiaries.

Another notable point in this context was that supplementary nutrition component by itself was the most effective means of nutrition education. The programme is observed to serve as a magnet to draw the women beneficiaries to the anganwadi centre where they were exposed to a variety of health services and the food served was a learning aid for the recipients.

A woman enrolled as a pregnant mother beneficiary might discontinue her participation from the ICDS programme after delivery in the normal situation and the major reason for continuing as beneficiary in the programme was found to be due to the motivation and interest of field functionaries of the anganwadi centre.

Distance of anganwadi centre and the location of house of beneficiaries were found to have no influence on the rate of participation. Contradiction was observed in the studies of Chakkladar *et al.* (1989). According to him, restricted participation of the beneficiaries in the programme is mainly due to the location of anganwadies which is far away. In the present study the distance between anganwadi centres and location of houses were observed to be convenient to the beneficiaries. The houses of beneficiaries were found located within a walkable distance of 5 to 10 minutes (38.33 per cent) and 10 to 15 minutes (61.67 per cent).

Free food, medical aid, and education classes were the attractions of beneficiaries in attending anganwadi regularly by 53.33 per cent of beneficiaries. The rest 46.67 per cent of the beneficiaries were interested in the programme, but due to other inconveniences at home they were not regularly attending the anganwadi programmes.

Supplementary nutrition component was found to be the first package of preference for beneficiaries (45.00 per cent). In the studies regarding the implementation of ICDS programme conducted at different parts of Kerala by Prema *et al.* (1990), similar observations have been made. Wodge (1980) in his study conducted among the ICDS

beneficiaries in different states of India, had also found that supplementary nutrition component was ranked high in terms of awareness and coverage, among the different components of ICDS.

General health profile of the women beneficiaries also show the need for such nutrition intervention programme since more than 16.00 per cent of beneficiaries were found under nourished, 11.66 per cent with clinical manifestations and 70 per cent were found suffering from anaemia, with the haemoglobin level below 12 g/dl.

Attitude of field functionaries will influence the effectiveness of the programme implementation. An assessment of the attitude of the field functionaries in this study revealed that they were positive about ICDS package of services such as supplementary nutrition component, health check ups and medical services. They were also of the view that the monotony of food supplement distributed under supplementary nutrition component needs to be avoided by introducing more variety. According to these functionaries provision of basic facilities such as own building, water, light and sanitary facilities may improve the effective functioning of the programme. They were also found dissatisfied about the present remuneration and financial help extended for the implementation of ICDS programme.

Food is the most expensive single component of supplementary nutrition programme under ICDS and hence every effort made in ensuring its efficient logistical delivery and its consumption by the target population in any feeding programme will go a long way in increasing the cost effectiveness of the programme.

Cost of delivering ICDS food supplements per woman beneficiary per annum reveals inclusion of a high input cost which covered the salaries of field functionaries of the centre. The expenditure incurred for the implementation of supplementary nutrition component of ICDS at anganwadi centre was estimated and found that it is Rs.6.87/ beneficiary / day which covered the cost of food supplement, processing charges, transportation and administrative costs including salaries. Verification of records at one Panchayath (Venganoor) revealed that for the 19 anganwadi centres available total financial outlay exclusively for supplementary nutrition component was Rs.5.53 lakhs/annum and total number of beneficiaries in the programme including pre-school children and women beneficiaries were 800. The cost of supplementary nutrition/ beneficiary/year was found reported to be Rs.691/- ie about Rs.2.30/ beneficiary/day excluding administrative charges.

5.2 Formulating a suitable food supplement to replace the existing one

During the last 2-3 decades, considerable work has been carried out by several workers on the development of protein and oil seed enriched cereal foods for combating nutritional disorders among the vulnerable sections of our population.

In this experiment, major constraints taken into account for the production of a suitable food supplement were availability of food components, reasonable cost, adequate shelf life of the products, adequate nutritive value, wide acceptability, physiological tolerance, flexible

composition, easy processing, familiar form of the product and safety and hygienic handling.

ICDS norms were followed in formulating the food supplement. A comparable product based on indigenously grown commodities was considered as an ideal food supplement with higher nutrient content and low cost. The aim in the present experiment was to deliver at least 500 kcals of energy and 20 g protein/woman beneficiary/day. A broad based composition using several types of foods was attempted on the presumption that nutrients lacking in one food item could be supplemented by those in another component of the food mixture, since the amino acid profile of pulse and cereal proteins is complementary. It was also felt that a single indigenous food of appropriate type is not available at present, in adequate supply.

With these conceptions raw materials selected in this study were rich in energy protein and other protective nutrients. Major ingredients selected were rice, wheat, soya, green gram, groundnut, gingelly seeds, spices like jeera, omum, cooking oil and a medicinal herb "poovarasila (*Thespesia propulnea*). Ninety seven combinations of formulations were computed. From these, 15 combinations with higher nutritional quality, amino acid scores and chemical scores were selected. These initial selections were followed by a further selection of five food supplements based on the level of amino acid score; chemical score and nutrient density, for further indepth study.

A lactating woman needs extra nutrients to secrete adequate quantities of breast milk and to maintain her own health. For this she needs to eat a wide variety of foods with higher quantity, quality and greater frequency of use. In this context the nutritional significance of food supplement given to her becomes important. To analyse critically, nutritional quality, acceptability, cost and long shelf life are the prime elements to be satisfied in an ideal food supplement as stated by Gopaldas (1975). Analysis of the nutritional composition of the newly developed food supplements and existing ICDS food supplement reveal the supremacy of food supplement with reference to protein, calcium, phosphorus, fibre and fat.

Protein is a major nutrient element required for the body to carry out a wide range of functions essential for the maintenance of life. The protein content in the developed food supplements was from 13.30 g to 17.86 g/100g the highest concentration in food supplement IV and V in which green gram and soya were included as pulses. Higher concentration of protein was observed in all the food supplements evolved, may be due to the presence of soya as a common ingredient in all the developed food supplements, inclusion of different types of pulses like green gram and bengal gram and also nuts and oil seeds like groundnut and gingelly in different proportions. Low protein content of ICDS food supplement (10g/100g) was mainly due to lack of variety of food ingredients, since ICDS food supplement was composed only of rice and green gram.

Energy is essential for rest, activity, growth and maintenance of good health. All the developed food supplements were found to be blended processed foods of high calorie density, in the range of 398 kcals/

100g to 440 kcals/100g. Food supplement IV with highest concentration of energy of 440 kcalories of energy/100 g and lowest concentration was found in food supplement (I) (398 kcals/100g) ICDS food supplement had an energy concentration of 345 kcals/100g.

Carbohydrate is a source of energy, and the developed food supplements contributed 35 to 55 g carbohydrate per 100 g. While ICDS food supplement, rice and green gram were observed to provide 73.85 gram of carbohydrate per 100 g. This also indicates the monotony of the ingredients in the existing ICDS food supplement.

Fat is a concentrated source of energy and the presence of fat in the developed food supplements improves the energy concentration. Fourteen to 17 g of fat either as "visible" or "invisible" form, was found included in the food supplements developed while these advantages were lacking in the ICDS food supplement which contained only negligible amount of fat (0.6 g/100g).

Minerals such as calcium, iron and phosphorus content in different food supplements were also found to be high. Calcium concentration among the food supplement evolved were found to vary from 420 to 462 mg/100 g with highest concentration in food supplement IV (462.80 mg/ 100g) ICDS food supplement was observed to contribute only 35.53 mg/ 100g of calcium.

The trace mineral iron was also found to be present in varying amounts in the developed food supplements, the concentration

ranging from 3.60 mg/100g to 5.32 mg/100g with the highest concentration in food supplement IV (5.32 mg/100g). The ICDS food supplement was also observed to provide a considerable source of iron (4.38 mg/100g)

Non nutrient components like phytic acid, and fibre were in varying concentration. The fibre content in different food supplements ranged from 1.10 g to 3.17 g/100g of the food supplements. The lowest concentration (1.66 g/100g) was observed in the food supplements IV and V while ICDS food supplement contained only 1.10 g of fibre per 100 g. Similarly, phytic acid was in the range of 68.38 mg to 139.64 mg per 100 g in different food supplements while ICDS food supplement contained only 90.76 mg/100g.

Quality of protein present in the food supplement is equally important as its quantity. Protein quality is found influenced by the concentration of essential amino acids present in each food. Plant protein in general, show large variations in the quality, because of one or more limiting essential amino acids. A combination of cereals, millet and pulses provide most of the amino acids which complement each other to provide better quality protein. This principle was observed while including different protein rich food ingredients for the formulation of various food supplements.

For complete nutritional evaluation, biological assays, through animal or human experiments is essential. The quality of five food supplements developed were assessed through animal feeding experiments

to measure the Protein Efficiency Ratio (PER) and Nitrogen Balance studies including Biological Value, Digestibility Coefficient and Net Protein Utilization (BV, DC and NPU).

PER gives a clear picture of the quality of the protein. PER value of 2.10 is the optimum value specified for supplementary foods by the Protein Advisory Group of FAO (1971). PER for standard diet, (G.VII) in the present experiment was observed to be the highest (3.39) while lower values were reported by Thirumaran (1993) and Prema *et al.* (1999) for similar diets as 3.27 and 3.10 respectively. PER value for developed food supplement was found to be the lowest for G III (2.12) and highest for food supplement IV (2.98). Food supplement II contained bengal gram and other four food supplements contained green gram. This may be the reason for lower PER for food supplement III. ICDS food supplement had a PER value of 2.39.

Digestability Coefficient (DC), Biological Value (BV) and Net Protein Utilisation (NPU) of developed supplementary foods were found out through nitrogen balance studies. The standard diet contained casein (G.VII), gave the highest BV of 78.87. Prema (1999) had reported BV of 85 per cent for similar diets and Chellammal (1995) had reported a value of 79.92 for casein diet. In this experiment Biological Value of different developed supplementary foods varied from 74.84 (G.III) to 79.75 (G.V). ICDS food supplement (G.VI) had a value of 75.40 which was higher than the BV of food supplement fed to G.III.

Digestibility Coefficient (DC) for developed food supplements were found out and noted the highest value for food supplement IV as

90.92. All the developed food supplements and ICDS food supplement (VI) were observed to have a higher DC above 80. DC for the standard casein diet was observed to be 90.85. In a ragi based food supplement DC of 95.02 ± 2.95 per cent has been reported by Jessy (1987) while in a cassava weaning mix DC value of 95.16 has been reported by Chellammal (1995).

The Net Protein Utilization of developed food supplements were found out from the relationship between the nitrogen retained in the body and total nitrogen intake. The values obtained for developed food supplements were observed to range from 60.88 (ICDS food supplement) to 71.65 (Standard Casein diet). 70.92 was found to be the highest value for food supplement fed to G.IV. As reported, NPU value was found to be 66.83 for a soya based supplementary food containing parboiled rice, soya flour and ground nut (Sailexmi, 1995).

The type of food ingredients present in the food supplement, and the application of heat during processing, are found to have a role in deciding the protein quality of a particular food. It has been found that fortification of chapathis with soya increased the *in vitro* protein digestability from 71.30 to 73.10 per cent from the studies conducted by Rawati *et al.* (1994). The present study clearly proved that the developed food supplements were better in protein quality than the existing ICDS food supplement.

While developing and processing new supplements, efforts must be taken to assess their acceptability as suggested by Dahiya and Kapoor

(1994). In this experiment ingredients in the food supplements were dry flours, mixed together and roasted. Roasting is a simple popular practice to which almost all cereals, pulses and oil seeds included were subjected. Despite a slight loss of protein quality through heat treatment the process is said to be advantageous since this processing greatly enhances acceptability and increases shelf life. The developed food supplements were tested for their organoleptic qualities like appearance, colour, flavour, texture, taste, doneness and overall acceptability. Five point score card was used for scoring and it was observed that all the food supplements got scores of 4 and 5. The minimum score obtained for each quality parameter was observed to be 3 out of 5. Food supplement (IV) obtained highest score for colour, texture, flavour, taste, doneness and overall acceptability. Combination III was observed to have minimum scores for different quality aspects, while the score for ICDS food supplement was 4.20. The popularity of all the food supplements over ICDS supplement is probably due to its better taste and other preferable and organoleptic variables.

Shelf life qualities are essential parameters to be assessed since they determine the suitability of a particular product (Livingstone *et al.*, 1993), Varsany (1993) reported that the mechanism and kinetics of the food deterioration can be controlled by the storage techniques applied. In the present investigation the developed five supplements were stored in glass containers and stored for a period of six months, with an objective to identify a mix with a shelf life under natural conditions of temperature and humidity. Acceptability scoring was done for the stored samples for

appearance, colour, flavour, texture, taste and overall acceptability. A gradual decrease in the scores for the parameter "appearance" was observed during the storage period. The mean scores for different quality attributes like "colour", "flavour", "texture" and "taste" were observed in decreasing order with the progress of storage period. As the mean scores of quality attributes were decreasing the over all acceptability scores for different food supplements were also decreasing gradually till the end of six months. At the end of six months it was observed that the minimum decrease in the score for overall acceptability was observed in food supplement IV, where the initial overall acceptability score was 4.85 and final score was `1.90'.

Chemical analysis of the stored food supplements were also carried out after three months and at the end of six months storage period. An increase in the moisture level and peroxide value was observed in stored food supplements. It was observed that the moisture level was below 10 per cent except in food supplement III and ICDS food supplement. Rathod and Udipi (1991) opine that most dehydrated cereal products have a good shelf life if their moisture content is below 10 per cent.

According to Sankaran (1993) several factors such as raw material quality, storage temperature, storage containers, process employed and the environment in which it is processed will have an effect on the microbiological quality of the processed foods. The deterioration of stored foods is caused by damage due to bacterial, fungal and insect infestations. Damage due to insects may be considerable since they not

only consume stored food but also contaminate them with insect fragments, faeces and webbing and metabolic products with foul odour. In the present study, the stored food supplements except ICDS food supplement were observed free from insect or pest attack. But in the case of ICDS food supplement ingredients viz. rice and green gram stored in glass bottles, the insect infestation was observed after five months of storage. The insect as *Sitophilus orysae* was also identified. There was no fungal growth in any of the stored food supplements and bacteria were seen only in food supplement III and total count was 40,000/gm.

Processing loss, yield ratio and economic feasibility of the developed food supplements were estimated. The weight loss during processing was kept minimum in order to facilitate maximum out put or yield, the yield of the food supplement both during processing and preparation is reported to be one of the major factors affecting the cost of finished products. The ingredients of a product should give maximum yield and minimum processing loss. In the present investigation the processing loss per cent was observed to be 19.44 to 24.04. Highest loss was observed in the food supplement V (24.04 per cent). The yield ratio was observed to vary from 83.80 to 88.89 per cent.

Cost per kilogram of developed food supplements were calculated from the ingredients cost which was the input cost. The output cost was calculated by adding 10 per cent of overhead charges to the input cost, as labour and fuel charges. The cost of production of one kg of food supplements is shown to be in the range of Rs.27/- to Rs.30/-.

The best food supplement from the tested five food supplements were taken to the field to test their operational variability, capacity of satisfying the needs of the target group and improving their nutritional status. Based on the nutritional, organoleptic and shelf life qualities of food supplements the combination IV with 50 per cent wheat, 15 per cent soya, 10 per cent green gram, 5 per cent gingelly seeds, 5 per cent omum, 10 per cent oil and 5 per cent poovarasila was ranked the highest in all the parameters and was selected for further experiments.

The selected food supplement was found to be a concentrated source of protein (17.86 g/100g) and energy (440 kcals/100 g) and also with high protein quality. The over all acceptability mean score of the fresh as well as stored supplement was found the highest in food supplement IV when compared to other food supplements developed. Moisture and peroxide level were also observed to be the lowest in the food supplement IV. The food supplement selected was also found to fit in to the traditional food pattern of the community. Using this mix, different recipes were prepared.

During the development of new food product or the reformation of existing products the identification of changes caused by processing method, by storage or by the use of new ingredients, their acceptability could be assessed by conducting preference test on large number of consumers. Preference test on a large number of persons is also required and their evaluation should come spontaneously based on their own judgement. In the present study the developed food supplement was tested

among 50 institutional staff, 50 field functionaries and 100 lactating women beneficiaries and their opinion on the degree of liking were obtained.

Four recipes were developed using food supplements plus jaggery or sugar as sweetening agent. The preference for the four recipes were recorded and analysed and found that Recipe IV was found highly acceptable among the judges.

This recipe was introduced to the anganwadi centre through demonstrations which was repeated in all the twenty centres. These demonstrations were attended by the field functionaries as well as by the target population. After the demonstrations, preference studies were conducted among the field functionaries and lactating women beneficiaries. The developed food supplement sweetened with jaggery (Recipe IV) was highly preferred by the field functionaries and the lactating women beneficiaries.

5.3. Demographic profile of lactating women beneficiaries included in the field experiment

The paramount importance of nutrition of a woman during lactation is for her own health and that of her off spring and for the satisfactory performance of lactation. Hence she is included in the category of nutritionally vulnerable section of the population. Because of this reason this category was also found included as a beneficiary in the supplementary programmes including ICDS programme implemented in the country.

Demographic profile of the beneficiaries, of the reoriented feeding experiment as well as of the control group (60) participating in the existing ICDS programme, were elicited to ensure the fact that all these women beneficiaries were from similar socioeconomic and dietary background.

As per the census data (2001) and report of Kerala Statistical Institute (2000) population in Thiruvananthapuram district is found predominated by Hindu community followed by Christian and Muslim. Similar representation was observed in the samples selected for the present study. Many families surveyed were found to be nuclear type and of smaller size with an average of three members. Sex ratio of adults in the families were found to be in match with the census data (2001). But among the child population, male members were found to be more. Based on the income level, more than 85 per cent of the families in the two groups were to be identified as BPL families. Many families in this category were also found in possession of land and houses with basic amenities like, water, electricity and toilet facilities. The occupational status of the heads of the families also directed attention to the fact, that many seek employment in unorganised sectors with no assurance of regular work, proper pay and benefits, confirming to approved social standards. The state of vulnerable members of these households, living in such background needs to be compassionate.

For women, pregnancy and lactation are amongst the most stress ful periods which sustained a rapidly growing foetus often under hostile

conditions of poverty and over work. But the lactating women beneficiaries selected in this experiment, were found to be moderately educated, young women with one to two children and belonging to the early developmental cycle of the household. This first stage is also considered as a 'phase of expansion' which starts from the marriage of two people until the completion of their family of procreation. In structural terms, it corresponds to the period, during which the off springs are dependent on the parents and this phase is a 'high risk phase' in terms of economic survival and an adequate food supply. This is the time when the household as a whole experiences the greatest risk of inadequate food supply, when pregnancy and lactation in the mother and the presence of young growing children mean special nutrient needs.

Both economic and nutritional considerations are relevant to any discussion on food intake. Dietary intake was found to be markedly influenced by income level as revealed in the diet surveys conducted by NNMB (1996), and it is accepted that an insufficient level of real income within the family is the main cause for inadequate food consumption. The current food price policy is concerned to ensure supply more of habitual foods that contribute most to total household's food expenditure of the BPL families.

Household income was found to be the main cause for inadequate food consumption. The current food price policy of the country is concerned to ensure supply more of the habitual foods contributing major food expenditure of the BPL families. In this survey also, expenditure

on food is generally found associated with socio economic factors like purchasing power of the households and availability of food locally. Income level of the families were also, found to have direct association with the food expenditure of the families. Rao (1994) opined that majority of Indians consume cereal based diet. Kerala diet is also a representation of Indian diet. Ukkuru (1993) conducted a study in Malapuram district among ICDS beneficiaries and had found that the pattern of food purchased by the beneficiaries were found influenced by food subsidy programmes and that their daily diets were predominated with cereals like rice and wheat available through PDS (Public Distribution System) shops at subsidised rates.

In many families, cassava was found to have equal preference and importance to cereals, despite their lower content in some nutrients and these food crops were found to reduce substantially the cost per calorie, when compared to cereals.

Pulses such as green gram, red gram, black gram dal and bengal gram had found a place in the dietaries of Keralites but not in the measures stipulated for a balanced diet. The quantity of pulses purchased in these families was also observed inadequate to meet the daily requirement of each and every family members. Consumption pattern of Keralites, as reported by Kerala Statistical Institute (2000) reveals that 98 per cent of the Keralites are habituated to non-vegetarian foods and hence cheaper fish based preparations were preferred to extravagant pulse based preparations. This might have been the reason for the less frequent purchase and use of these food articles.

Purchasing pattern related to vegetables and green leafy vegetables by the families revealed the need for inclusion of green leafy vegetables in the daily diet. The respondents in both the groups were found aware of the availability of these food articles locally but were found reluctant to use the same in the daily diet. Comparatively, more vegetables were found purchased by these families but not enough to meet the individual requirements of the members.

Coconut was an essential item in the daily dietaries of the families since it was an integral part of the gravy of dishes based on vegetables or fish. Coconut requirement was not met fully through home production and occasionally supplemented with local purchase.

Among cooking oils, coconut oil (1-1.5 kg) was commonly purchased spending approximately Rs.50/month at the minimum. Considering the fat requirement of the family members this purchased quantity was found highly insufficient. Milk, sugar and fish were the food articles daily used, along with the staple foods.

Main use of sugar was found for preparing tea or coffee with milk and jaggery was used mainly for preparing supplementary foods to pre-school children and infants. Sugar or jaggery based preparations were also found a place in the diet during festive occasions. Local fair price shops were the major sources for these food articles.

Unlike milk and sugar the quantity of fish purchased daily was above the RDA levels, and forms the major source of complete protein.

On an average an amount of Rs.15 to 20 was found spent daily for purchasing fish by these families in these two groups. Among the various dishes, fish based preparations were found preferred by all the families. According to the respondents, lactating women beneficiaries had an added advantage of consuming fish which is identified as a galactogogue.

Like fish, meat was also found highly preferred but due to high cost the purchase was limited to fortnightly or once in a month. Frequency of purchase of this food item was observed to be directly influenced by the occupational status and daily income to the family.

Compared to these animal foods, fruit consumption was negligible among all the beneficiaries. Purchase was found to be influenced by season. However, underexploited minor fruits like rose apple fruit, goosberry and guava, freely available were more frequently consumed and expensive fruits like apple, orange and grapes were included as special foods to pregnant and nursing mothers.

Snacks, bakery items and Ready to Eat (RTE) foods were found included in the meal pattern of pre-school or school going children as mid morning or mid noon snacks while these foods were not consumed due to high cost by other members.

The purchasing pattern throws light on a fact that a desirable dietary pattern do not exist as such among these families. The nutrients requirements can be met by any number of combinations of different foods. It is probably true that these habitual diets may be adequate in energy.

Based on the food use frequency scores, the diets of these families were found to be monotonous ones predominated by cereals. Roots and tubers, fish, coconut, oils and few condiments were the additional food articles found to be added to taste. Sugar and milk, were used daily for tea or coffee. The observations made in this context were found in tune, with the observations of Mony (1993) about the diets of the agricultural labour families. Similar results were unfolded in the diet surveys conducted among fisher men folks by Karuna (1993) and among agricultural labourer's families by Jyothi (1993) in Thiruvananthapuram district.

As observed earlier consumption of pulses, green leafy vegetables meat, roots and tubers and fruits were found to be less frequently used among these families. This observation is in tune with the earlier studies conducted in Thiruvananthapuram district as early as 1990 by Sujatha, and most recently by Juna (1999) and Kavitha (1999) among the vunlerable sections of the population.

Sugar based dishes or animal foods were consumed during special occasions like birth days, marriages and festivals. Similar observations among the low income groups were reported in earlier studies by Ukkuru (1993) ad Kavitha (1999).

Nutrient needs vary at different stages of life cycle. Beliefs and practices of people, about the requirements form the foundation on which food habits were formulated among the families surveyed. Dietary care was observed to be given to infants by feeding food supplement in the

form of porridge which were rich in minerals and proteins. Ragi flour, banana flour, milk and jaggery were found added to these dishes. Similarly extra dietary care was given to pre-school and school going children by giving protein rich foods like milk and egg, over and above the normal family meal. Even though special nutritional care was not given for adolescent boys, respondents were conscious to give special dietary attention to the girls at least during the on set of menarche, pregnancy and lactation. Energy dense and protein rich foods and medicinal leaves were found included in the diets of adolescent girls during this period. Special dietary care was given to pregnant and lactating mothers also. Modification of the regular diet for old and sick people also reveal their awareness about the role of diet in soothening the present body condition.

Dietary taboos and prejudices form a part of the socio-cultural pattern of a community and play a significant role in the special foods of lactating mothers. An objective assessment of the existing traditional feeding habits of lactating mothers and their families and their food beliefs is necessary before economically feasible culturally acceptable and nutritionally desirable food supplements are formulated and introduced.

Dietary practices followed for the benefit of vulnerable populations revealed the consciousness of the beneficiaries regarding their extra needs. Households with more dependent members and the female working members present are observed to be more vulnerable to food shortage. These problems are well reflected in the provisioning of food within the household. The actual allocation of food was found to be the

responsibility of house wives. In these households priority in food allocation is found given to working males followed by children and lastly females. Probably this is a strategy for maintaining the earning/working capacity of the house hold at the expense of reproduction need and raising of children, who are perceived as an economic liability.

5.4. Conduct of supplementary studies

The food supplement evolved in the laboratory was fed to the lactating women beneficiaries selected from ICDS centres for a period of six months. The food supplement developed was a blended processed food of high calorie density and reduced dietary bulk sweetened and fully pre-cooked. The health profile of the equal number of beneficiaries participating in the existing ICDS programme were also monitored for six months for comparison. The impact of the food supplement was assessed through selected anthropometric indices, clinical scores and changes in the serum profile. Nutrition monitoring also included indirect measures like qualitative information about the diet intake. As reported by Swaminathan (1998) to get an overall picture of the nutritional status of individuals or population groups it is better to use combinations of methods. The reoriented programme demonstrated better results with less investment than that expended in the existing ICDS programme.

According to Park and Park (1991) anthropometric measurements are valuable indicators of nutritional status and they reflect the pattern of growth and development and how individual deviate from the average at various ages in body size, build and nutritional status.

The mean weight status of an intervened group was found to be a reliable tool for monitoring and evaluating a feeding programme. In this experiment mean initial weight of the beneficiaries of the two groups were found to be below reference standards stipulated for reference woman. Similar results were reported about lactating mothers by Bishnoi *et al.* (1999) and Meena *et al.* (2000). Weight loss during lactation among Indian women is reported to be 1.8 - 7.3 kg over a period of one year. In this case such loss was not observed among lactating women beneficiaries in the EG while in CG beneficiaries 11.67 per cent of beneficiaries were found to have weight loss in the range of 0.5 kg to 1.5 kg. during the six months experimental period. Mid upper arm circumference, chest circumference and waist hip ratio of lactating women beneficiaries were observed to be comparable with the standard values, higher values observed in this result might be due to the physiological changes undergone during pregnancy and parturition. Usually after delivery at least 56 days care ie. nutritional, medical and physical is prescribed for lactating women and that might influence the waist, hip and chest measurements of beneficiaries.

As indicated in BMI classification, a shift in 6.66 per cent and 3.33 per cent to normal in EG and CG respectively were observed in the beneficiaries indicating that there is not much variation between existing ICDS food supplement and newly evolved food supplement.

Consumption of nutritionally inadequate diet resulted in signs of nutritional deficiencies such as anaemia, mild angular stomatitis pale

conjuctiva and spongy bleeding gums. In the present study, both EG as well as CG beneficiaries showed such type of deficiency disorders in varying rates. After the feeding experiment among EG beneficiaries an improvement was seen as reduction in the symptoms related to angular stomatitis. Reports of NNMB (1996) had revealed that anaemia is the most wide spread nutritional disorder in the country with high prevalence.

Food intake was found to be of similar pattern as observed in the data related to food use frequency. A comparison between the two groups revealed that cereal consumption was observed to be appreciably adequate in both the groups. Pulse consumption was below the RDA levels. Jood *et al.* (1999) and Bishnoi *et al.* (1999) had also reported that the mean daily intake of pulses by lactating mothers in different zones of Haryana was below the RDA. Among the various food groups included in the dietaries, consumption of fish was above the RDA levels. Decreased intake of green leafy vegetables by these women was found not due to lack of knowledge, or non-availability but mainly due to indifference. Earlier findings of several studies had observed, similar results in the daily diets of lactating mothers in different parts of India and Kerala (Jood *et al.*, 1999; Bishnoi *et al.*, 1999; Gupta, 1994, Ukkuru, 1993).

Consumption of vegetables was observed to be adequate unlike the findings in the earlier studies which showed a lower intake of vegetables by lactating mothers in different zones of Haryana district (Jood *et al.*, 1999) and Parbhani district (Meena *et al.*, 2000) and in northern parts of Kerala (Ukkuru, 1993).

Intake of food items like milk and milk products, fats and oils, sugar and jaggery, roots and tubers and fruits were also found to be very low. Studies conducted in Kerala, at different zones showed similar findings (Ukkuru, 1993, Sujatha, 1990; Karuna, 1993) as against northern parts of India, where the consumption of these food ingredients were found adequate (Jood *et al.*, 1999; Meena *et al.*, 2000).

The energy requirement during lactation is computed from the energy cost of lactation, viz. volume of milk secreted, its energy content and efficiency of conversion of food energy into milk energy. And additional intake of energy recommended during lactation by ICMR (1999) is 550 kcal/day for the first six months. Since Indian women continue to lactate beyond six months with reduced milk out put, an extra allowance of 400 kcals per day is recommended for the remaining period of six months to one year. Even when the mother is nursing her baby, the production of milk involves only about 500-600 calories and part of this is met from stores acquired during pregnancy. Energy intake by the beneficiaries, in the experiment was found to be adequate in both the groups. Adequate intake of energy by lactating women were reported by earlier researchers (Butte *et al.*, 1984; Gupta, 1994; Ukkuru, 1993; Jood *et al.*, 1999), where as others (Finley *et al.*, 1988; Hira *et al.*, 1988; Kaur and Sehgal, 1991) had reported lower intake of energy during lactation. However the calorie adequacy of the diets of these lactating women beneficiaries were not found reflected in their body weights. Juna (1999) has also reported that weights of women during pregnancy and during post portum period had no association with their dietary intake.

ICMR recommendation (1999) for protein during lactation is 25 g per day for the first six months and 18 g per day for 6-12 months. This higher recommendation is mainly to compensate for the lower NPU of 65 for the protein derived from cereal based Indian diets. Protein intake by the beneficiaries in the two groups were found adequate as against earlier findings in northern parts of India, reported lower intake of protein by lactating mothers (Jood *et al.*, 1999; Bishnoi *et al.*, 1999; Gupta, 1994, Kaur and Sehgal, 1991; Hira *et al.*, 1988; Rawtani and Verma, 1989; Chaudhary, 1985; Rosales, 1982 and Prema *et al.*, 1981). In the diets of the beneficiaries rice was the staple food, which supplies the major protein well supplemented with fish. As reported by the lactating women beneficiaries consumption of fish would increase breast milk secretion.

Daily fat intake of the beneficiaries were lower and similar observations about the lactating women beneficiaries of ICDS in Malappuram district had been reported in the earlier studies of Ukkuru (1993). While studies conducted at northern parts of India by Jood *et al.* (1999) and Meena *et al.* (2000) revealed a higher intake of fat by the lactating women, probably due to higher consumption of milk and milk products and concentrated sugar based sweet preparations during this period.

To meet the additional need of calcium for breast milk, a total allowance of 1200 mg daily is recommended for the lactating women by ICMR (1999) so as to prevent maternal demineralisation which accompanies lactation. Calcium and iron intake were found below the RDA stipulation in the diets of beneficiaries of the two groups. These

increases can be achieved by adding about 300-500 g of milk, 50 g of other leafy vegetables or fruits consumed by these women were highly inadequate and this might be the reason for low calcium and iron content in their diets.

During lactation an additional allowance has been suggested to be about 350 μg of Vitamin A or 1400 μg of β-carotene. In the present study the dietary intake of β-carotene was found below RDA in both the groups. The diets in general are found to be lacking in β carotene rich foods like milk, green leafy vegetables and fruits.

The requirement of B-complex vitamins like thiamin, riboflavin and niacin are related to calories, the additional amount recommended during lactation is based on the additional calories, recommended. During first six months of lactation thiamin, riboflavin and niacin are needed as 0.3, 0.3 and 4.0 mg respectively and during 6-12 months of lactation, this was reduced to 0.2, 0.2 and 3 mg respectively. In the present investigation the intake of thiamine was found adequate but niacin and riboflavin intakes were found far below the RDA stipulated.

During lactation, the requirement of vitamin C is doubled to compensate for the amounts secreted in milk. Fresh fruits and vegetables are the major sources of vitamin C and these foods were found included in limited quantities and hence their diets were observed to be deficient in vitamin C, far below the RDA.

The food supplement (110 g) helped to supply approximately 484 K calories per day. The lactating women beneficiaries were found to

have grossly deficient intakes of β-carotene (80.00 to 85.00 per cent) calcium (30.00 to 35.00 per cent) vitamin C (40.00 to 45.00 per cent) and Iron (40.00 to 47.00 per cent) and the food supplement, in this context, were also found to supply 19.60 g protein, 509 mg calcium and 5.85 mg iron. Based on the information generated, it appears that the calorie contribution of the food supplement to the lactating women beneficiaries diet was probably not required and was to some extent a waste of an expensive resource. What was needed most was a supplement of vitamin A, C and minerals like calcium and iron. A combination of massive oral vitamin A coverage twice a year, together with a monthly quota of inexpensive 'take home' nutrients tablet consisting of vitamin C, Iron and folic acid and calcium would have filled their major mineral/ vitamin deficits in their diets instead of an expensive food ration.

5.5. Direct parameters to assess the nutritional status of beneficiaries

Anthropometric, clinical and blood profile ascertained through selected variables showed an improvement in the health status of the beneficiaries on completion of the feeding programme. An increase in weight was observed among beneficiaries who participated in the feeding programme while beneficiaries in the control group were found to maintain the weight. Noticeable changes in Mid Upper Arm Circumference, Hip Circumference and Waist Circumference of the beneficiaries of the two groups were not obsered, probably because of the energy protein adequacy in their diets.

Studies conducted at different parts of India had shown that an increased intake of iron and other haemopoietic elements, there would

be a subsequent increase in the haemoglobin levels of recipients (Harshala *et al.*, 2000; Guzman *et al.*, 1988). In the present study comparatively iron intake of beneficiaries of EG was more due to the iron rich food supplement. However by this supplementation, the iron needs of lactating women beneficiaries stipulated in RDA were found not met. The intake of iron in the daily diet of CG beneficiaries were below the level of RDA and the extra iron received through ICDS supplement is only 4.38 mg. However the clinical signs and symptoms viz. mild angular stomatitis, paleness of skin, and conjuctiva, were found disappearing after six months feeding experiment among lactating women beneficiaries in the EG (25 per cent) mainly because of better intake of nutrients. Similar trends were not observed in the case of lactating women beneficiaries in the CG.

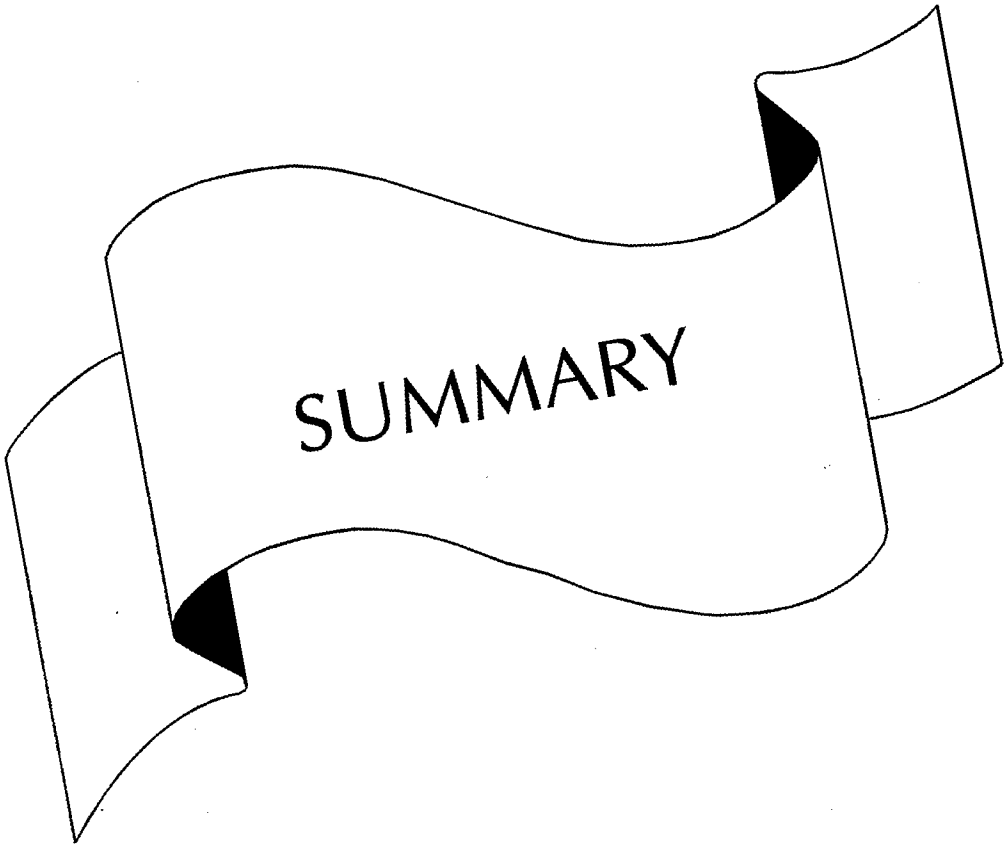
Serum protein and albumin levels in the EG and CG beneficiaries were assessed and observed a higher shift from low level to higher level was observed among EG beneficiaries. An enhancement in serum protein and albumin indicates a general improvement in the health profile and it serves as a confirmation of a condition in which the clinical manifestations had disappeared.

The successful implementation of the reoriented ICDS programme, under the direction of the investigator also indicates the cost effectiveness and feasibility of producing indegenous food supplements at the anganwadi centre level, under the supervision of field functionaries. The advantage of small scale production unit at the centre level may result in substantial savings in transportation and administrative costs and

economic benefits to the small entrepreneurs (mainly rural women from the neighbour hood). This may also help to generate better community participation in the intervention programme.

Another notable point, is about the nature of food supplement. What our mothers, living in the rural areas, need is, not energy dense protein rich food supplement. In its place, distribution of vitamin and mineral tablets may perhaps be far more useful and considerably cheaper. However, this observation stresses the need for the creation of awareness about mineral and vitamin rich foods.

The study reveals that the familiar indigenous foods are readily accepted and so in the existing ICDS programme, instead of rice and green gram gruel, emphasis needs to be placed upon the anganawadi centre based production units. However, success of such a programme rests heavily on the understanding and commitment of the field functionaries.


SUMMARY

SUMMARY

The present study entitled "Impact of soya enriched food supplement on the nutritional status of women beneficiaries of ICDS", was carried out at Venganoor and Thiruvallam Panchayaths of Athiyannoor ICDS Block, Thiruvananthapuram district in 20 selected ICDS Centres, with 120 lactating women beneficiaries distributed as sixty in experimental group and sixty in control group.

The study comprised of evaluation of the existing supplementary nutrition component of ICDS, formulation of a suitable food supplement using indigenous food materials to replace the existing one and ascertaining the impact of this newly developed food supplement on women beneficiaries.

Assessment of programme efficiency of the existing supplementary nutrition component revealed, lack of infrastructure facilities in many centres and take home food system was found more popular. ICDS food supplement is found to provide 446.20 kcals and 12.16 g protein per day per woman beneficiary at average expense of Rs.6.87 covering the cost of the supplement, processing charges, transportation and administrative cost including salaries. Many beneficiaries were regular in attending the feeding and this component was the most preferred

package of ICDS. Assessment of the attitude of implementing staff towards ICDS programme revealed their views about monotony of the supplementary nutrition component and need for better basic facilities.

In the process of evolving a suitable food supplement ninety seven possible combinations of formulations were worked out from which 15 combinations were selected. Further, five combinations were identified based on the amino acid score, chemical score and high nutrient density. Among the five, food supplement IV was found the best food supplement for the nutrient density.

Protein quality evaluation through animal experiments revealed that food supplements developed were comparable with the PER, BV, DC and NPU of standard diets.

Organoleptic quality evaluation of the food supplements noted that food supplement IV was ranked highest for appearance, colour, texture, flavour, taste, doneness and overall acceptability. Increase in moisture and peroxide value and decrease in quality variables were noted in all the food supplements during storage for six months.

Cost of production of one kilogram of food supplement was found to be around Rs.27 to 30/-. Yield ratio of food supplements were in the range of 0.83 to 0.88. Processing loss per cent was ranged between 19 to 24.

Based on the amino acid score, chemical score, nutrient density, physiological tolerance, shelf life qualities, organoleptic qualities and cost of the product, food supplement IV was selected as the best one,

components of which were wheat flour (50 per cent) soya powder (15 per cent) green gram powder (10 per cent) crushed gingelly (5 per cent) crushed omum (5 per cent) dried poovarasila powder (5 per cent) and palm oil (10 per cent). The product was rich in protein and energy. Protein was found to be of quality with PER 2.98, BV 78.41 DC 90.92 and NPU 70.92. Over all acceptability score was 4.85 with minimum changes in moisture level and peroxide value.

Among the different recipes developed with selected food supplement, a recipe with food supplement and powdered jaggery was selected by experts through headonic tests. Demonstration of the recipe among field functionaries and lactating women beneficiaries also resulted positively.

A feeding experiment of six months duration with selected recipe IV was conducted in 10 centres with 60 lactating women beneficiaries and equal number of lactating women beneficiaries of existing ICDS supplementary feeding programme was monitored as control group.

Socio economic and demographic profile of lactating women beneficiaries in EG and CG revealed that nuclear type of families of small size (3 and 4) were common. Heads of families were employed in unorganised sector. Monthly income status of many families were found to be in the range of Rs.1500 to Rs.2500/-. Many women beneficiaries were found to be moderately educated.

Food purchasing and food use frequency of the families revealed the predominance of cereals, fish, milk, vegetables, coconut, oil and sugar

in the daily diets and pulses, roots and tubers and green leafy vegetables were less common.

An assessment of food habits of the families revealed occasional preparation of sugar and jaggery based preparations during festivals and special foods given to vulnerable members like children, pregnant and lactating mothers.

Information related to intra family food distribution revealed the importance given to male members followed by children, aged members and lastly women in the family.

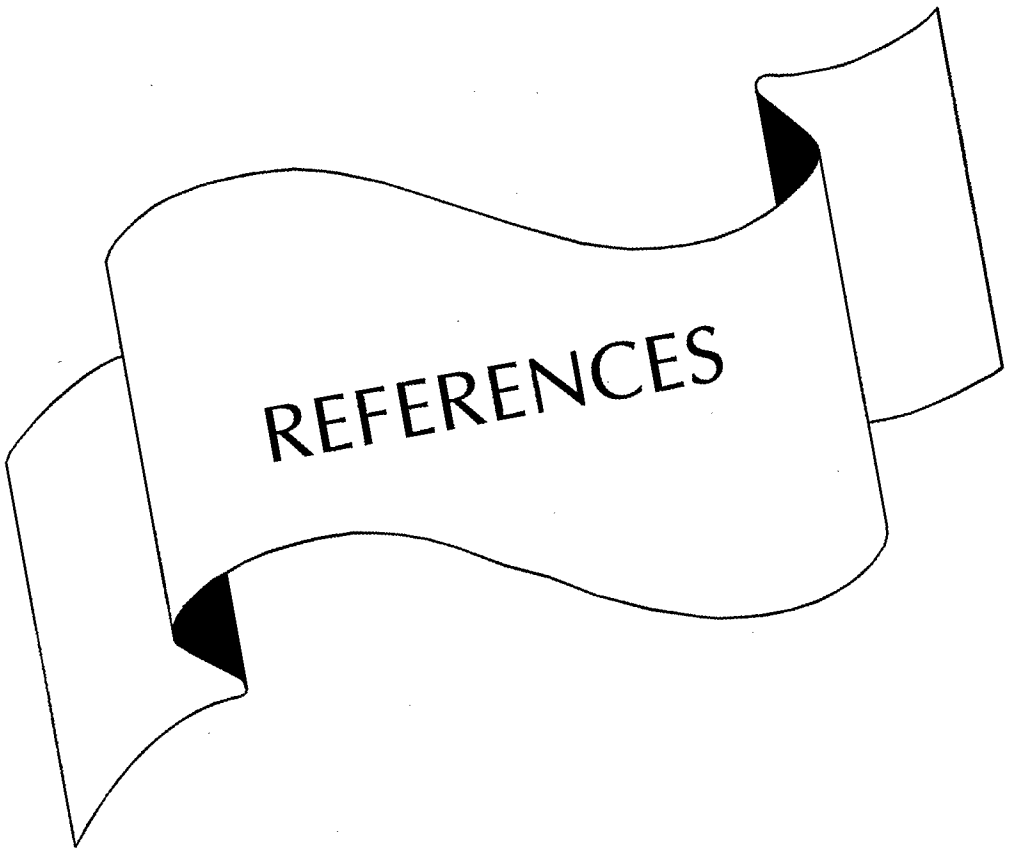
Anthropometric assessment of the lactating women beneficiaries showed that the weight and height were below the reference standards while waist hip ratio worked out was found above the normal value of 0.7 indicating the prevalence of gluteus obesity. The BMI worked out indicated that 71.00 per cent of EG and 63.00 per cent of CG beneficiaries were identified in the normal group (BMI >20).

Changes in clinical manifestations viz., anaemia, wrinkled skin and angular stomatitis and recovery to normal stage were observed among more number of women beneficiaries in EG.

Actual food intake of 20 beneficiaries each from the two groups when analysed, revealed that the intake of staples like cereals and fish was adequate in the two groups. Intake of pulses, green leafy vegetables, sugar, oil, fruits, milk and milk products were below the RDA stipulated

in the two groups. Intake of roots and tubers was more among the beneficiaries of CG. Riboflavin, niacin and vitamin C, β-carotene, iron and calcium level were also below the RDA stipulation.

Impact of food supplement on the nutritional status was analysed through anthropometric measurements and blood profile. The weight, height, mid upper arm circumference, waist hip circumference, skinfold triceps, haemoglobin status and clinical scores had shown improvement in the EG beneficiaries while it was not in CG beneficiaries. Changes in blood profile of serum protein, serum albumin, serum iron and TIBC towards "normal" and "above normal" were also observed among beneficiaries in the EG. Nutritional status index was developed prior to the experiment and on completion of the experiment on the basis of the five selected parameters such as weight, height, clinical score, BMI and blood profile and there was marked improvement in Nutritional Status Index due to the supplementary feeding programme.


REFERENCES

REFERENCES

ACC/SCN. 1992. *Nutrition and Population Links*. Nutrition Policy Discussion Paper No.II. United Nations, New York, p. 61

Adair, L.S. and Pollitt, E. 1983. Outcome of maternal nutritional supplementation. A comprehensive review of the Baconchow study. *Am. J. Cli. Nutr.* **41**: 948-978

Adikari, N.S. 1992. Prevention of diseases through nature cure. *Yojana.* **36**:42-44

Adsule, R.N., Kodam, S.S. and Salunkhe, D.K. 1986. Chemistry and technology of green gram (*Vigna radiata* (L) CRC. Rev. *Fd. Sci. Nutr.* **25**(1): 73

Ahmed, A.M., Singh, B. and Singh, V. 1993. Improvement of sensory and nutritional qualities of sorghum based '*kisara*' by supplementation with groundnut. *J. Fd. Sci. Tech.* **30**(2): 121-126

Alexander, M. 1985. Compating malnutrition. *Kurukshetra* **34**(2): 3-14

Anila, E., Irvin, E.L., and Priya, S. 1994. Implications of anti nutritional components in soya bean foods. *Crit. Rev. Sci. Nutr.* **34**(1) : 31-37

Annie, S., Livingstone, S., Jain, J. and Nagappa, G. 1993. Development and nutritional quality evaluation of weaning foods based on malted, popped and roller dried wheat and chick pea. *Int. J. Fd. Sci. Tech.* **28**: 35-43

Anuradha, V. and Sangeetha, K. 2001. Development and impact of soy malt product in improving the iron status of anaemic adolescent girls (16-18 years). *Indian J. Nutr. Dietet.* **38**: 141

AOAC, 1976. Association of Official Agriculture Chemists. Official Methods of Analysis. Washington. p. 94-97

Arora, P.N. and Malhan, P.K. 1998. *Biostatistics.* Himalaya Publishing House, Bombay. p. 445

Asha, P., Chaudhary, A. and Noor, P. 1988. Food fads and dietary intake of nursing mothers. *Am. J. Cli. Nutr.* **38**: 1204-1208

Ashakawatra and Salil Sehgal. 1998. Nutrient intake of the lactating labourers of Hisar City. *Indian J. Nutr. Dietet.* **35**; 294

Ashraf, N.R. and Bwembya, P.A. 1988. Supplementation of the traditional zambian diet with soyabean product. *Nutr. Rep. Int.* **88**(4): 719-727

Ashturkar, P.B., Pande, V. and Reddy, S. 1992. Development and evaluation of weaning food formulations. *J. Fd. Sci. Tech.* **29**(3): 197-198

Aswathy Neerja, Joshi, K.C., Gandhi, A.P. and Sinha, L.K. 1991. Studies on the preparation of poshak - A soyabased supplementation food. *Indian J. Nutr. Dietet.* 28-78

Balgui, R.S., Murmu, B. and Dash, B.P. 1998. Health and nutrition status of ashram school children in two districts of Orissa. *Indian J. Nutr. Dietet.* **35**: 329

Beaton, G. 1992. *The Raymond Pearl Memorial Lecture, 1990.* Nutrition Research in Human Biology. Changing perspectives and interpretations. *Human Biology*. p. 40

*Berger, K.G. 1992. Food uses of palm oil. Malasian Palm oil promotion Council, p. 2-20

Bhatia, B.D., Tyagi, N.K. and Sur, A.M. 1988. Nutritional indicators during pregnancy. *Indian Peadiatrics*. **25**: 952-958

Bhatnagar, S. and Goyal, M. 2000. Nutrient composition and recipe development of supplementary foods Bajra moth beans and ground nuts. *Indian J. Nutr. Dietet.* **37**; 54-58

Bhatnagar, S. and Singhal, A. 1984. Food supplementation and pregnancy outcome. *Indian Med. Res.* **78**. 1002-1010

Bhatnagar, S., Dharmasakti, N.S., Sundaram, K.R. and Seth, V. 1983. Effect of food supplementation in the last trimester of pregnancy and early postnatal period on maternal weight and infant growth. *Indian Med. Res.* **77**: 366-372

Bhosnam, S. 1991. Cultivation and utilization of pulses. *J. Agr. Sci.* **48**(4): 304-308

*Bishnoi, S. 1999. Effect of processing and cooking methods on nutritional value of peas (*Pisum sativum*). M.Sc. thesis Haryana Agricultural University, Hissar, p. 215

Bishnoi, S., Sudesh jood, Salif Sehgal, Asha Kawatra and Shashikala Yadav. 1999. A study on Nutritional Status of Rural lactating women of Haryana. *Indian J. Nutr. Dietet.* **36**: 275-282

Butte, N.F., Garza, C., Stuff, J.E., Smith, E.B. and Nichols, B.L. 1984. Effect of maternal diet and body composition on lactation performance. *Am. J. Cli. Nutr.* **39**: 296

Census of India. 2001. Provisional population totals. Series 33. Govt. of India. p. 69

CFTRI. 1992 *Food and Allied Industries News (Jan-March)*. Central Food Technological Research Institute, Mysore p. 62

Chakkaladar, B.K., Rao, P.R.S., Krishna, R. and Jyothi, K. 1989. Assessment of impact of ICDS. Scheme on pre-school children udupi project, Karnataka. In : Research on ICDS: An over view Vol.1 (1975-85) eds. Punhapi, R. and Maharajan, R.) NIPCCID; p.307

Chandrasekhar, V., Bhooma, N. and Reddy, S. 1988. Evaluation of a malted weaning food based on low cost locally available foods. *Indian J. Nutr. Diet.* **25**(2): 37-43

Chaudhary, A. 1985. *Studies on ARF from jowar.* In the ARF story compendium of research on ARF. International Workshop on ARF Technology, 1990. M.S.University, Baroda. p. 318

Chellammal, S. 1995. Developing complementary food products based on cassava and sweet potato. Ph.D. Thesis, Kerala Agricultural University, Thrissur, p. 325

Chellammal, S. and Prema, L. 1995. Developing complementary food products based on cassava and sweet potato. Ph.D. thesis. Kerala Agricultural University, Thrissur, p. 318

Cheriyan, S.K.U. and Tarur, J.C. 1992. Effect of storage on germination and microflora on soyabean. *Indian J. Agri. Sci.* **67**(7): 500-502

Dahiya, S. and Kapoor, A.C. 1993. *In vitro* and *in vivo* availability of iron from home processed supplementary foods. *J. Fd. Sci. Tech.* **31**(2): 122-125

Dahiya, S. and Kapoor, A.C. 1994. Studies on weaning foods - Iron availability and utilisation. *J. Fd. Sci. Tech.* **32**(5): 235-240

Devadas, R.P. 1987. *Nutritional meal programme for children in Tamil Nadu.* Notes, comments, club and family community unit for co-operation with UNICEF and WFP, AIHSHEW, Coimbatore. p. 262

Devadas, R.P. 1993. Report of the study conducted on soya flour in the noon meal. Avinashilingam Institute for Home Science and Higher Education for women, Coimbatore, p. 210

Directorate of Economics and Statistics. 1998. Agriculture Statistics at a glance. Ministry of Agriculture, Government of India, New Delhi. p. 220

Easwaran, P., Beatrice, A.D. and Kalpana, N. 1998. Development of selected bean in culinary foods using defatted soya flour. *Indian J. Nutr. Dietet.* **35**: 255-261

Edwards, A.L. 1957. *Techniques of Attitude Scale Construction.* Vakil, Feffer and Simon's Ltd. Bombay, p. 312

FAO, 1971. Protein Advisory Group report. Food and Agricultural Organisation, Rome, p. 256

FAO. 1992. *Creating a well fed world.* Food and Agricultural Organisation, Rome, p. 210

FAO. 1997. FAO Year Book. Rome, Italy, p. 120

FAO/WHO/UNU, 1985. Energy and protein Requirements. WHO Technical report Series, World Health Organisation, Geneva,. p. 24

Ferro-Luzzi, G.E. 1980. Food avoidance of pregnant women in Tamil Nadu in J.R.K. Robson, *Fd. Eco. Cult.* 101-108

Finley, D.A., Tool, S. and Curl, V. 1985. Maternal diet and Pregnancy outcome. *J. Am. Dietet. Ass.* **85**: 678-684

Gahlawat, P., Sehgal, S. 1994. Shelf life of weaning foods developed from locally available food stuffs. Plant foods for Human Nutrition. **45**: 349-355

Gandhi, A.P. 1991. Studies on the preparation of poshak - A soya based supplementary food. *Indian J. Nutr. Dietet.* **28**: 78

Garza, C., Stuff, J.E., Smith, E.B. and Nichols, B.L. 1984. Effect of maternal diet and body composition on lactation performance. *Am. J. Cl. Nutr.* **39**: 296-306

Geervani, P. and Jayasree, G.A. 1988. A study on the nutritional status of adolescent and adult pregnant and lactating women and growth of their infants. *J. Trop. Ped.* **34**: 234-237

Ghassemi, H. 1990. *Women, food and Nutrition issues of a globus focus.* In-Women and Nutrition. Nutrition policy discussion paper 6, ACC/ SCN symposium report, United Nations, New York, p. 60

Ghosh, S. 1986. Health for all by 2000 myth or reality. *Indian J. Paed.* **53**(6): 691-697

Ghosh, S. 1993. Infant Feeding. UNICEF. 1-15

Goodhart, R.S. and Shills, M.F. 1980. *Modern Nutrition in Health and Disease.* Sixth edition. Lea and Febiger, Philadelphia, p. 334

Gopalan, C. 1992. *Nutrition in Development Transition in South East Asia.* WHO, Regional Office for South East Asia, New Delhi, p. 103

Gopalan, C., Ramasastri, B.V. and Balasubramaniyan, S.C.. 1991. *Nutritive Value of Indian Foods*. NIN. ICMR, Hyderabad, p. 47

Gopaldas, T. 1975. Project poshak. CARE, INDIA, New Delhi, p. 315

Gopaldas, T. 1989. Cited in review of traditional practices in mother and child care in Gujarat. Seminar report. (27-28 Feb). p. 68

Gopaldas, T. and Sheshadri, S. 1987. *Nutrition Monitoring and Assessment.* Oxford University Press, New Delhi, p. 268

Gopaldas, T., Lansra, A.C., Srinivasan, N., Varadarajan, S., Shingwekar, I., Seth, A.G., Ranjna, Mathur, R.S. and Bhargava, V. 1975. *Project poshak* Vol. 1 New Delhi, p. 242

Gornov, K.H. 1989. The protein problem and soya bean trends quality and affectiveness. *Nutr. Abstr.* **62**(4): 275

Government of India. 1997. India 1996. Ministry of information and broad casting, New Delhi, p. 67

Gross, R., Agdeppa, I.A., Werner, J.S., Dillon, D. and Sastroamidjojo, S. 1997. Daily verses weekly iron supplementation in programmatic and economic implication for Indonesia. *Fd. Nutr. Bult.* **226**(9): 502-505

Gupta, C. and Sehgal, G. 1991. Development, Acceptability and Nutritional value of weaning mixtures. Plant foods for Human Nutrition. **41**(2): 107-116

Gupta, D.K. and Nanjappa, C. 2000. Studies on the preparation and storage evaluation quick cooling sprouted green gram (Vigna Radiata) curry mix. DFRL. *Indian Fd Packer.* **54**(2): 56-58

Gupta, M. 1994. Studies on nutritional improvement of traditional supplementary foods for lactating women. Ph.D. Thesis. Haryana Agricultural University, Hisar, p. 268

Gupta, S.B. and Srivastava, B.C. 1989. Comparative study of morbidity and mortality of children under six years and utilization of health services in an ICDS an non-ICDS block in up. In : Research on ICDS : An over view. Vol. 1 (1975-85) Eds: Punhani, R. and Mahajan, R. NIPCCID : 345-346

Gupta, S.K. and Kaur, B. 1982. Utilization of potato for weaning food manufacture. *J. Fd. Sci. Tech.* **19**(1): 23

Guzman, C., Challenge,O. and Chandy, J. 1988. Effect of iron supplementation and iron status of mother infant. *J. Nutr.* 4 : 252-258

Hanna, M. and Hemeda. 1997. *Bulletin of Nutrition.* Institute of the Arab Republic of Egypt Vol. 17 No. 2: 5-7

Harper, H.A. 1990. Review of physiological chemistry, XXII ed. Large Medical Publication, Maruzen Co. Ltd., Philadelphia, p. 207

Harshala, R. and Premakumari, S. 2000. Health and nutritional status of working women in Coimbatore and their exposure to occupational hazards. *Indian J. Nutr. Dietet.* 37 : 350-358

Hautvest, J.G. 1997. Adequate nutrition in pregnancy does matter. E.J. obstet. *Gynecol. Reprod. Biol.* **75**(1): 33-35

Hira, C.K., Murgal, V. and Pathak. 1988. Nutritional status of lactating Panchabi women. *Ecol. Fd. Nutr.* **21**: 159-162

ICMR. 1973. Studies on pre-school children. Report of the working party of the ICMR. Tech. Rep. Series. No.26. Indian Council for Medical Research, New Delhi. p. 148

ICMR. 1983. Studies on weaning and supplementary foods. Report of the working party of the ICMR, Tech. Rep. Series. No.37. Indian Council for Medical Research, New Delhi. p. 148

ICMR. 1999. Nutritive value of Indian Foods, National Institute of Nutrition, Hyderabad, p. 167

Indira, S. 1997. ICDS coverage in India and evaluation of impact of the programme. J. Home Sci. 12: 120-125

Indris, N.A. 1995. PORIM shortening based on palm oil products. **32**: 145

Irvin, E.L. 1994. Implications of Antinutritive components in soybean foods. *Critical Rev. Sci. Nutr.* **34**(1): 31-37

Jackson, M.L. 1973. In soil chemical analysis. Pretice Hall. The Eagle wood cliffs, NJUS. A report by Frentice Hall of Inda (Pvt.) Ltd. New Delhi 62-65

Jain, J., Stone, L. and Annie, S. 1999. Development of supplementary foods. *Int. J. Fd. Sci. Tech.* **26**: 80-85

Jain, P., Kolali, U. and Ahuja, A. 1999. Non-formal pre-school education activities for intervention in ICDS. *J. Dairying. Fds. HSci.* **18**(3&4): 213-216

Jayalakshmi, N. and Neelakantan, S. 1987. Studies on the acceptability of sorghum - soyabean blends in South Indian dishes and their keeping quality. *Indian J. Nutr. Dietet.* **25**(8): 204-208

Jayalakshmi, N. and Neelakantan, S. 1988. Studies on the acceptability of sorgum soya blends in South India dishes and their keeping quality. *Indian J. Nutr. Dietet.* **26**(8): 204-207

Jelliffe, D.B. 1966. The Assessment of Nutritional Status of the community. World Health Organisation, WHO, Geneva, p. 388

Jessy, P. 1987. Developing indegenous weaning food based on ragi flour. M.Sc. Thesis. Kerala Agricultural University, Thrissur, p. 312

Jimbu, B. and Ige, T. 1990. Concentration of Cr, Fe, Cu and Zn in some Nigerian food grain. *J. Radio Anolytion and Nuclear Chemistry* **44**(b): 447-452

Jogyabathi, A., Naveedakhatoon and Jamuna Prakash. 2001. Effect of cooking media on in vitro digestability of legumes. *Indian J. Nutr. Dietet.* **38**: 11-14

Johnson, L.F. and Curl, E.A. 1972. Methods for research on the ecology of soil born plant pathogens, soil chemistry, INC. New York, p. 247

Jood, S., Bishnoi, S. and Sehgal, S. 1999. Nutritional status of rural lactating women from three zones of Haryana in winter season. *J. Diarying Fd.* HSc. 18 (3 and 4): 155-165

Juditkatona, 1993. Issues in food and nutrition ACC/SCN Symposium report. Nutrition policy discussion paper No.12 WFP, United Nations, New York, p. 100

Juliano, B.O. 1985. Criteria and tests for rice grain qualities. In Rice Chemistry and Technology. American Association Cereal Chemistry, INC. USA. p. 465

Juna, L.P. 1999. Nutritional profile of pregnant women with reference to iron. M.Sc. Thesis, Kerala Agricultural University, Thrissur, p. 272

Jyothi, A. 1993. Factors influencing the working efficiency of women engaged in stone breaking with special reference to Nutritional Status. M.Sc. Thesis, Kerala Agricultural University, Thrissur p. 173

Karleskind, D., Lege, I., Malpin, B. and Moor, C.V. 1991. Improving and production in soy based yoghert by additing cheese whey proteins and mineral salts. *J. Fd.Sci.* **56**(4): 999-1001

Karuna, M.S. 1993. Nutritional status of women engaged in fish vending in Trivandrum district, Ph.D. Thesis, Kerala Agricultural University, Thrissur p. 268

Kaur, Y. and Sehgal, S. 1991. Nutritional status of rural lactating women. *J. Res.* **21**: 307-309

Kavitha, M.S. 1999. Effect of Iron and Vitamin supplementation on iron profile of Anaemic Adolescent Girls, Ph.D. Thesis, Kerala Agricultural University, Thrissur, p. 350

Kavitha, P., Parwathi Easwaran, P. and Uma Maheswari, S. 2001. Effect of different methods of cooking on the Dietary fibre content of wheat and wheat products and their hypoglycemic effect on NIDDM patients. *Indian J. Nutr. Dietet.* **38**(b): 173-178

Kerala Statistical Institute, 2000. Growth of population in Kerala, Kerala Statistical Institute, Thiruvananthapuram. p. 128

Khanum, F., Sudharshana Krishna, K.R., Anil Dutt Semwal and Viswanathan, K.R. 2001. Proximate composition and mineral contents of spices. *Indian J. Nutr. Dietet.* **38**: 93

Lechting, A., Habicht, J.P. and Delgado, H. 1976. Effect of food supplementation during pregnancy on birth weight. *Paediatrics* **56**: 508-520

Livingstone, A.S., Feng, J.J. and Malleshi, N.G. 1993. Development and nutritional quality evaluation of weaning foods based on malted popped and roller dried wheat and chick pea. *Int. J. Fd. Sci. Tech.* **28**(1): 35-43

Lutter, C.K., Mora, J.O., Habicht, J.P., Rasmussen, K.M., Robson, D.S., Setters, S.G., Super, C.M. and Herrera, M.G. 1998. Nutritional supplementation. Effects on child stunting because of diarrhoea. *Am. J. Clin. Nutr.* **50**: 1-8

Madsin, H.B. and Bhutelsum, G. 1995. Trends. *Fd. Sci. Tch.* 32:71 - 78

Malleshi, N.G. 1995. Weaning foods. CFTRI Press, Mysore, p. 45

Malleshi, N.G., Balasubramanyan, N., Indiramma, A.R. and Desikachar, A.S.R. 1989. Packaging and storage studies on malted ragi and green gram based weaning food. *J. Fd. Sci. Tech.* **26**: 68-71

Martin, A. 1950. Rose bengal agar in soil micro organisms and plant growth. M.S. Subharao. Oxford IBH Publisher and Co., p. 292

Meena, G. and Usha, B. 1990. Scope and trends of soya protein utilisation for beverage production. *Beverage and Fd. World* **2**: 22-23

Meena, J., Vijaya, N. and Reddy, S.N. 2000. Food and nutrient intake, anthropometric measurements and haemoglobin status of lactating women in urban and rural areas of Parbhani District. *Indian J. Nutr. Dietet.* **37**: 288-293

Mony, E.P. 1993. Food preference and Dietary habits of adolescents among agricultural labourers. MSc. Thesis, Kerala Agricultural University, Thrissur p. 162

Mora, J.O., Herrera, M.G. and Wagner, M. 1978. Maternal malnutrition and pregnancy outcome. *Am. J. Clin. Nutr.* **24**: 312-318

Mora, J.O., De Paredes, B., Wagner, M., Suescum, J., Christiasen, M. and Herrera, M.G. 1979. Nutritional supplementation and outcome of pregnancy. *Am. J. Clin. Nutr.* **25**: 455-462

Nath, M. and Geervani, P. 1998. Nutritional status of pregnant and lactating mothers and infants of urban slums of Hyderabad. *Indian J. Nutr. Diet.* **15**: 422-428

National Academy of Sciences. 1982. *Nutritional Analysis of Public Law 480 Title II commodities.* National Academic Press. Washingtone, DC. p. 216

Neelakantan, N. 1988. A modern treatise on preventive medicine and community health. Vol. 2 Neela Publishers, Thiruvananthapuram p. 286

NIN. 1983. A mannual of laboratory techniques. NIN ICMR. Hyderabad, p. 136

NIN. 1991. Maternal Body Mass Index (BMI) and Birth weight. *Nutr. News.* **12**(1): 3

NIN. 1993. Nutrition trends in India. Indian Council for Medical Research, Hyderabad. p. 38

NNMB. 1991. Nutritional Status of Indian Adults. National Institute of Nutrition. ICMR, Hyderabad. p. 126

NNMB. 1996. Nutritional Status of rural women. Report of the year 1995. National Institute of Nutrition. ICMR, Hyderabad, p. 5-150

Nutrition News. 1991. A report of the expert group of National Institute of Nutrition, **12**(2): 2-3

Pandey, V. and Rohinidevi. 1990. Food habits and consumption pattern of tribal families. *Maha. J. Extn. Edn.* **99**: 106-110

Park, J.E. and Park. K. 1997. Community Nutrition Programmes. Text book of Preventive and Social Medicine. Banarsidas Bhagot Publishers, Jabalpur, India, p. 436

Patel, R.T. and Ali, N. 1990. Soy potential raw material for food industries, productivity. J. d. Sci. Tech. 30: 427-434

Patel, R.T. and Shukla, R.D. 1990. Studies on open sun drying of blanched soy bean. *J. d. Sci. Tech.* **27**(2): 116-118

Pawar, M.S. 1988. Women and family violence politics and programmes *Social change* **18**(3): 36

Pellet, P.L. and Young, V.R. 1980. Nutritional evaluation of protein food. United Nations University Food and Nutrition Supplement. p. 4

Pelletier, D., Msukwa, L. and Ramakrishna, D. 1991. Nutrition in project planning. *Food Policy* 127-139

Popkin, B. 1992. Nutrition and population Links. ACC/SCN symposium report. Nutrition policy discussion paper No.11, United Nations, New York, p. 61

Prema, K., Madhava Reddi, R. and Ramalakshmi, B.A. 1981. Changes in anthropometric indices of nutritional status in lactating women. *Nutr. Rep. Int.* **24**: 893-900

Prema, L. 1999. Development of soya rice blended food recipes. Research report on ICAR adhoc scheme. Kerala Agricultural University, Thrissur, p. 212

Prema, L. Vimalakumari, N.K., Ukkuru, M., Geetha. P. and Xavier, N. 1990. Attitude of rural women towards supplementary nutrition and other services of ICDS implemented in Kerala. Report prepared for WFP, UN, New Delhi, p. 310

Prentice, A.M. 1983. Prenatal supplementation of African women and Birth weight. *Lancet.* 489-492

Prentice, A.M. 1992. Variation in dietary intake, birth weight and Breast milk out put in Gambia. In maternal nutrition during pregnancy and lactation. Eds. Abei, N. and White Head, R.G., Haper and Row, L. and Popkin, B. 1992. Nutrition and population links. ACC/SCN Symposium report. Nutrition Policy discussion paper No.11, United Nations, New York, p. 61

Prentice, A.M., Cole, T.J., Foord, F.A., Lamb, W.H. and White head, R.G. 1987. Increased birth weight after prenatal dietary supplementation of rural African Women. *Am. J. Clin. Nutr.* **46**: 912-925

Ramachandran, 1989. Nutrition in pregnancy women and Nutrition in India. (eds. Gopalan, C. and Kaur, S.). Nutrition Foundation of India, special publication No.5, 153-193

Rao, M. 1985. Nutrient intake of lactating mothers. *Eco. Fd. Nutr.* **16**: 93-103

Rao, N.S. 1994. Palm oil use and capability in India. *Fd. Nutr. Bull.* **15**(2): 149-156

Rathod, P. and Udipi, S.A. 1991. The nutritional quality of weaning foods incorporating amaranth. *Fd. Nutr. Bull.* **13**(2): 114-116

Rawati, A. Singh, B.K.G. and Mitra, S.K. 1994. Effect of soy fortification on quality characteristics of chapathis. *J. Fd. Sci. Tech.* **31**(2): 114-116

Rawtani, T. and Verma, M. 1989. A study on nutritional status and food practices of the pregnant and lactating women residing in selected dessort areas of Jodhpur. *Indian J. Nutr. Dietet.* **26**: 304-310

Richey, S.J. and Harper, L.T. 1987. Estimating protein digestability for human from rat assays. In protein quality in human assessment and *in vitro* estimate, AVI Publishing Co., INC, West Port, Connecticut, p. 260

Rosales. 1982. Nutrient intake of lactating mothers of two to six months of lactation. *J. Dairy Fds. HSc.* **18**(3): 165

Rounet, J.M., Hendry, O., Caporiceio, Besancon, P. 1992. Comparitive study of nutritional qualities of defatted cotton seed and soyabean meals. *Soyabean Abstr.* **15**(5): 17

Sadasivam, S. and Manickem, A. 1992. *Biochemical Methods for Agricultural Sciences*. Wiley Eastern Ltd., New Delhi, p. 8

Sadik, N. 1991. Nutrition and population links. Breast feeding family planning and child health. ACC/SCN report Nutrition policy discussion paper No.11, United Nations, New York, p. 60

Sailaxmi, S. 1995. Evaluating the Nutritional quality of soyabased supplementary foods. M.Sc. Thesis. Kerala Agricultural University, Thrissur, p. 198

Sandeep, S., Gurumukh Singh and Mital, B.K. 1993. Physical characteristics and composition of certain new varieties of soyabeans. *J. Fd. Sci. Tech.* **31**(2): 145-147

Sankaran, R. 1993. Microbial standard for processed foods and rapid methods for microbiological quality assurance. Proceedings of the third International Food Convention, Mysore, p. 105

Sathyapriya, R. and Vijayalakshmi, P. 1998. Breast milk output as influenced by consumption of selected galactogogues. *Indian J. Nutri. Dietet.* 35 : 198-203

Sharma, S. and Chand, G. 1989. Perception and participation of the community in ICDS. In : Research on ICDS : An over view ; 1975-85 Eds. Punhani, R and Maharaja, R. NIPCCID : 267-268

Singh, G. 1987. Nutritious Soyabean. *Indian Fmrs' digest.* **21**(8): 37-39

Singh, N., Singh, D., Chauhan, G.S. and Suresh, I. 1994. Some physico-chemical and sensory characteristics of beverage developed from defatted soyaflour. *Bev. fd. wld.* , **21**(2): 18-19

Sinha, A.and Pandey, H. 1998. Maternal and Infant feeding practices of 'Ho' tribe women in Bihar. *Inidan J. Nutr. Dietet.* **35**: 325-328

Sinha, L.K. and Nawab Ali. 1993. Soya bean processing and utilisation project. Preparation of medium fat soy flour at small scale. *J. Fd. Sci. Tech.* **30**(1): 14-146

Sinha, L.K., Singh, G. and Ponte, G.J. 1991. Baking and Nutritional characteristics of soya fortified bread. *Indian Baker,* **23**(1): 31-34

Solanki, S. 1986. Formulation and shelf life study of malted ready to eat mixes. *Indian J. Nutr. Diet.* **23**: 35-38

Srihareni, D. and Lakshmi, V.K. 2001. Effect of supplementation of cynodon Doctylon (Arungeupal) juice/powder on anaemic pregnant women 920-30 years) *Indian J. Nutr. Dietet.* **38**: 10-12

Stottingfus, R.J., Hakimi, H., Miller, K.W., Ranmussen, K.M., Dawiessah, S., Habieht, J.P. and Dibley, M.J. 1992. High-dose vitamin A supplementation of breast feeding Indonesian mothers : Effects on the vitamin A status of Mother and infant. *J. Nutr.* **2**: 128-132

Subhash, C. and Arya. 1990. Infant and Child Care. Vikas publishing House, p. 35

Sujatha, A.S. 1990. Food consumption and energy expenditure pattern of self employed women in unorganised sector. MSc Thesis, Kerala Agricultural University, Thrissur, p. 220

Swaminathan, M. 1984. *Essentials of Food and Nutrition.* Ganesh and Company, Madras, p. 139

Swaminathan, M. 1990. Advanced text Book on Food and Nutrition. The Bangalore Printing and Publishing Co. Ltd., Bangalore, p. 487

Swaminathan, M. 1990. Handbook of Food Science and Experimental Foods. Processed supplementary and Novel Foods. Ganesh and Co., Madras. p. 221

Synder, H.E. and Kwon, T.W. 1987. Soya utilisation. Van Nostrand Reinold Co. New York. p. 148

Tamiguchi, H., Hirotsaka, M., Narita, H. and Kito, M. 1987. Functionality and digestibility of soy protein isolate through chemical phosphorelation. *J. Fd. Sci.* **48**: 716

Tarat, R.K. and Sharma, B.K. 1999. Nutritional aspects of Edible oils. *Yojana* 43-45

Thakar, V. and Jyotsna, A.P. 1990. A study on the nutritional status of pregnant mothers in the anganwadis of Nagpur city. *Indian J. Nutr. Dietet.* **27**(3): 82-89

Thakar, V. and Patil, I.A. 1990. A study on the nutritional status of children in anganwadies of Nagpur city. *Indian J. Nutr. Dietet.* 27(3): 82-89.

Thirumaran, A.S. 1993. Processing and evaluation of nutritive ready to use foods suitable for farm families, Ph.D. Thesis, Mother Theresa University, Kodaikanal. p. 325

Udani, P.M. 1990. Nutritional Problems in Children. The Indian Science proceeding of National Symposium on workshop on child Nutrition. The Indian Science LTM Medical College Hospital, Bombay. p. 160

Ukkuru, M. 1993. Nutritional status of ICDS Beneficiaries with respect to participation. Ph.D. Thesis submitted to KAU, Thrissur, p.340

UNESCO. 2000. A report on medicinal plants No.3. *Indian J. Nutr. Dietet.* **38**(1): 2-3

UNICEF. 1983. A report of a workshop on weaning foods. UNICEF, New Delhi, p. 40

UNICEF. 1984. Child Atlas of India. Sixth Five Year Plan, Government of India, Planning Commission, New Delhi, p. 70

Varsany, I. 1993. Packaging of food interaction between the food and package and predicting shelf life of food. *Proc. 3rd Inter. Fd. Conv.*, Mysore, p. 143

Vijayalakshmi, P. and Priya, S.R. 1998. Breast milk out put as influenced by consumption of selected galactogogues. *Indian J. Nutr. Dietet.* **35**: 198-203

Wang, H. and Murphy, P.A. 1994. Isoflavone content in commercial soyabean foods. *J. Agric. Fd. Chem.* 1049-1072

Watts, B.M., Jlimaki, G.L., Jeffery, L.E. and Elias, L.G. 1989. Basic Sensory methods for Food Evaluation. International Development Research Centre (IDRC), Ottawa, Canada, p. 452

Weingarther, K.E., Das Liell, K.K., Singh, S.R. 1989. Soybean utilisation in Africa. *Trop. Grain leg. Bull.* 30(3): 2-4

Wenxun, F. and Xiaoshu, C. 1994. Food uses of palm oil in China. *Fd. Nutr. Bull.* **15**(2): 147-148

Widge, M.K. and Aijaz, R. 1986. ICDS in four States. *Social change* **16**(7): 22-26

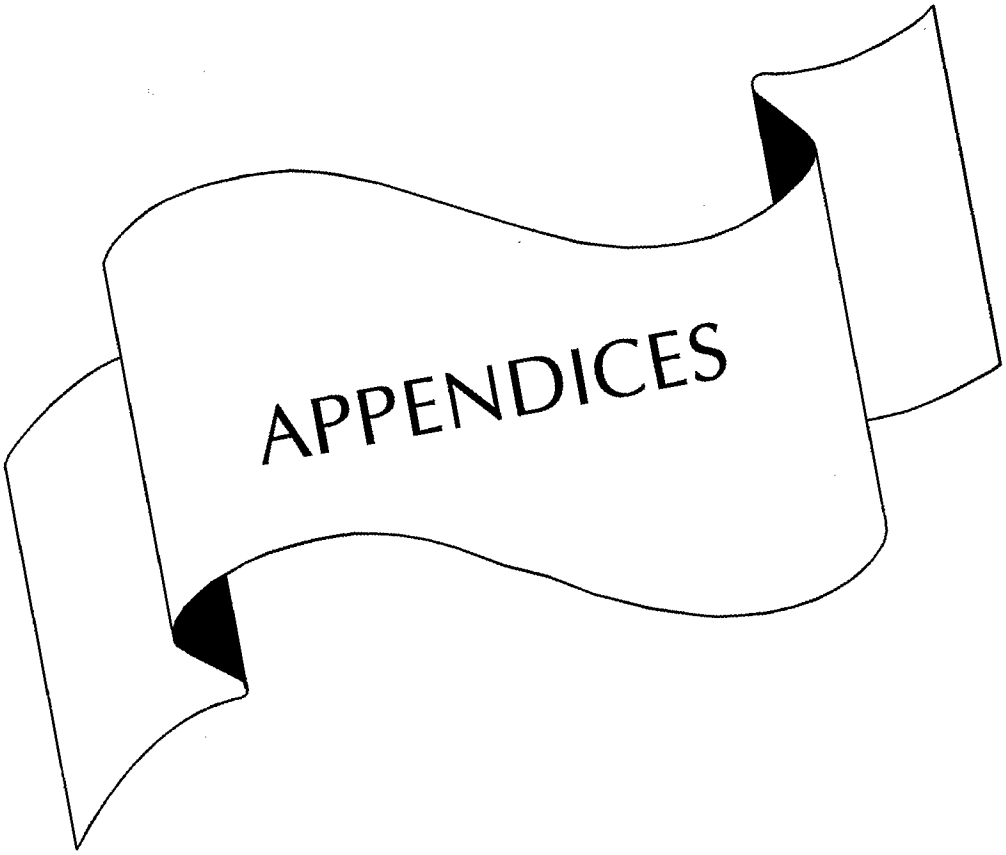
Wodge, 1980. Maternal and child health services through ICDS scheme. *Haryana Health J.* 38(10) : 13-17

Wolf, W.J. 1969. Chemical and physical properties of soya bean. University of Mussouri, USA, p. 3927

Yadav, N.R. and Leiner, I.E. 1978. Nutritional evaluationof dry roasted Navy bean flour and mixtures with cereal proteins. Nutritional improvement of food and feed proteins. Plenum Press,USA, p. 412

Yadav, S.K. and Sehgal, S. 1995. Effect of home processing on ascorbic acid and b-carotene content of spinach (*Spinacia oleracia*) and Amaranth (*Amaranth tricolour*) leaves. *Pl. Fds. Hum. Nutr.* **47**: 125-131

* - Originals not seen


APPENDICES

APPENDIX I

ATTITUDE OF IMPLEMENTING STAFF TOWARDS ICDS PROGRAMME

NAME OF PANCHAYAT :

ANGANWADI No. :

ADDRESS :

NAME OF TEACHER :

NAME OF AYA :

STATEMENTS	SA	A	UN	D	SD
1. Anganwadi Centre promotes the nutritional status of beneficiaries through supplementary feeding.					
2. Anganwadi centre promotes the health status of beneficiaries through medical care.					
3. Anganwadi centres are not felt need of the community.					
4. Anganwadi centres are not accepted by the community.					
5. Monthly physical measurements helps to assess the nutritional status of the beneficiaries.					
6. Maintenance of growth chart is very essential to measure the nutritional status of beneficiaries.					
7. Health charts helps to assess the health condition of the beneficiaries					
8. Enrollment of more women beneficiaries is needed to improve the nutritional status of women in the community.					
9. The financial support from the authorities is sufficient to meet the different needs of the beneficiaries of Anganwadi.					
10. Services in the Anganwadi centre helps to improve the nutritional status of beneficiaries.					
11. Referral services improves the health of the beneficiaries.					
12. The food supplied through anganwadi is nutritious.					
13. The quantity of food supplied through anganwadi is inadequate.					
14. Participation rate in the feeding is increasing day by day.					
15. Medical care received through Anganwadi is adequate.					
16. Adequate facilities are available in the Anganwadi for the conduct of supplementary nutrition programme.					
17. Local people approach towards anganwadi is very satisfactory.					
18. Variety in supplementary food is needed.					
19. Ready to serve nutritious supplementary food will help to save money, time and energy.					
20. Remuneration to the Anganwadi staff to be increased.					

SA - Strongly Agree A - Agree UN - Undecided
D - Disagree SD - Strongly Disagree

APPENDIX II

FORMULATIONS OF FOOD SUPPLEMENT

Formulation Number	Ingredients and Amount	Protein (g)	Fat (g)	Carbo-hydrate	Energy (kCals)	Calcium (mg)	Iron (mg)	Amino acid score	Chemical score	Cost (Rs.)
1	A_1 60 B_1 15 G_1 5 F 10 E 10	11.75	14.20	52.47	379.60	480.60	3.30	73.89	67.00	23.70
2	A_1 60 B_1 15 G_3 5 F 10 E 10	11.42	15.31	51.87	384.25	502.85	3.33	73.89	67.00	23.70
3	A_1 60 B_1 15 G_2 5 F 10 E 10	11.13	13.39	53.93	377.30	488.10	5.81	73.89	67.00	23.70
4	A_2 60 B_1 15 G_1 5 F 10 E 10	14.93	13.92	47.91	377.20	508.80	5.94	81.53	91.00	22.90
5	A_2 60 B_1 15 G_3 5 F 10 E 10	14.85	14.26	47.31	395.75	531.05	6.06	81.53	91.00	22.90
6	A_2 60 B_1 15 G_2 5 F 10 E 10	14.31	13.29	49.37	374.90	516.30	6.19	81.53	91.00	22.90
7	A_1 60 B_1 15 G_1 5 G_2 5 G_3 5 E 10	12.68	15.90	56.41	431.45	557.75	6.29	73.89	91.00	22.90
8	A_2 60 B_1 15 G_1 5 G_2 5 G_3 5 E 10	15.86	15.62	51.13	429.50	580.55	8.81	81.53	91.00	22.90
9	A_1 50 B_1 15 B_3 15 G_1 5 F 5 E 10	13.51	14.12	56.47	430.70	455.30	3.55	77.50	80.00	26.30
10	A_1 50 B_1 15 B_3 15 G_3 5 F 5 E 10	13.43	14.46	55.87	449.25	427.35	3.58	77.50	80.00	26.30
11	A_1 50 B_1 15 B_3 15 G_2 5 F 5 E 10	12.89	13.49	57.93	444.40	462.80	6.06	77.50	80.00	26.30
12	A_1 50 B_1 15 B_2 15 G_1 5 F 5 E 10	14.31	13.96	56.37	411.00	443.60	3.52	85.75	84.00	26.40
13	A_1 50 B_1 15 B_2 15 G_3 5 F 5 E 10	14.23	14.30	55.77	429.55	465.55	3.55	85.75	84.00	26.30
14	A_1 50 B_1 15 B_2 15 G_2 5 F 5 E 10	13.48	12.97	57.83	548.20	501.10	6.03	851.75	84.00	26.30
15	A_1 50 B_1 15 B_3 10 D_1 5 G_1 5 F 5 E 10	13.97	16.47	55.39	425.40	449.00	3.47	82.88	79.00	28.00
16	A_1 50 B_1 15 B_3 10 D_1 5 G_3 5 F 5 E 10	13.89	16.81	54.79	423.95	463.25	3.50	82.28	79.00	22.00
17	A_1 50 B_1 15 B_3 10 D_1 5 G_2 5 F 5 E 10	13.35	15.84	56.85	423.15	448.50	5.98	82.28	79.00	22.00
18	A_1 50 B_1 15 B_2 10 D_1 5 G_1 5 F 5 E 10	14.66	16.07	54.86	422.80	441.20	3.45	87.24	84.00	28.00
19	A_1 50 B_1 15 B_2 10 D_1 5 G_3 5 F 5 E 10	14.58	16.41	54.26	441.35	463.45	3.48	87.24	84.00	28.00
20	A_1 50 B_1 15 B_2 10 D_1 5 G_2 5 F 5 E 10	14.04	15.44	56.82	420.50	448.70	5.96	87.24	84.00	28.00
21	A_1 50 B_1 15 D_2 15 G_1 5 F 5 E 10	13.69	20.19	51.61	445.75	642.50	4.25	73.23	84.00	34.20
22	A_1 50 B_1 15 D_2 15 G_3 5 F 5 E 10	13.61	20.53	51.01	464.30	664.75	4.28	73.23	84.00	34.00
23	A_1 50 B_1 15 D_2 15 G_2 5 F 5 E 10	13.07	19.61	54.07	443.45	650.00	6.76	73.23	84.00	34.00

APPENDIX II (Contd...)

Formulation Number	Ingredients and Amount	Protein (g)	Fat (g)	Carbo-hydrate	Energy (kCals)	Calcium (mg)	Iron (mg)	Amino acid score	Chemical score	Cost (Rs.)
24	A_1 50 B_1 15 B_3 10 D_2 5 G_1 5 F 5 E 10	12.97	16.64	55.20	425.05	517.70	3.73	78.08	75.00	29.20
25	A_1 50 B_1 15 B_3 10 D_2 5 G_3 5 F 5 E 10	12.89	16.98	56.60	443.60	539.95	3.81	78.08	75.00	29.20
26	A_1 50 B_1 15 B_3 10 D_2 5 G_2 5 F 5 E 10	12.35	16.01	56.66	422.75	525.20	6.26	78.08	75.00	29.20
27	A_1 50 B_1 15 B_2 10 D_2 5 G_1 5 F 5 E 10	14.27	16.24	54.78	422.85	509.90	3.76	83.73	80.00	30.00
28	A_1 50 B_1 15 B_2 10 D_2 5 G_3 5 F 5 E 10	14.19	16.58	54.18	441.35	532.15	3.79	83.73	80.00	30.00
29	A_1 50 B_1 15 B_2 10 D_2 5 G_2 5 F 5 E 10	13.65	15.61	56.24	420.50	517.40	6.27	83.73	80.00	30.00
30	A_1 50 B_1 15 H15 G_1 5 F 5 E 10	14.52	13.97	55.04	407.70	441.80	13.27	-	-	24.50
31	A_1 50 B_1 15 H15 G_1 5 F 5 E 10	14.44	14.31	54.44	426.25	464.50	13.33	-	-	24.50
32	A_1 50 B_1 15 H15 G_2 5 F 5 E 10	13.90	13.34	56.50	405.40	449.30	15.78	-	-	24.50
33	A_1 50 B_1 15 H10 D_1 5 G_1 5 F 5 E 10	14.64	16.22	53.98	460.60	440.00	9.95	-	-	20.00
34	A_1 50 B_1 15 H10 D_1 5 G_3 5 F 5 E 10	14.56	16.56	53.38	479.15	462.25	9.98	-	-	20.00
35	A_1 50 B_1 15 H10 D_1 5 G_2 5 F 5 E 10	14.02	15.59	55.44	458.30	447.50	12.46	-	-	20.50
36	A_1 50 B_1 15 H10 D_2 5 G_1 5 F 5 E 10	16.07	20.67	56.40	474.95	457.70	11.19	-	-	21.20
37	A_1 50 B_1 15 H10 D_2 5 G_3 5 F 5 E 10	15.16	21.01	55.60	492.50	479.95	11.23	-	-	21.20
38	A_1 50 B_1 15 H10 D_2 5 G_2 5 F 5 E 10	15.04	15.44	57.86	472.65	465.20	13.70	-	-	21.20
39	A_2 50 B_1 15 B_3 15 G_1 5 F 5 E 10	16.16	14.72	52.07	428.70	474.30	5.65	89.09	92.00	25.50
40	A_2 50 B_1 15 B_3 15 G_2 5 F 5 E 10	16.08	14.54	52.00	447.25	496.45	5.68	89.09	92.00	25.50
41	A_2 50 B_1 15 B_3 15 G_3 5 F 5 E 10	15.54	14.09	53.53	426.40	481.80	8.16	89.09	92.00	25.50
42	A_2 50 B_1 15 B_2 15 G_1 5 F 5 E 10	16.96	14.56	51.97	409.00	462.00	5.27	96.30	95.00	25.40
43	A_2 50 B_1 15 B_2 15 G_2 5 F 5 E 10	16.88	14.30	51.37	427.55	484.25	5.30	96.30	95.00	25.40
44	A_2 50 B_1 15 B_2 15 G_3 5 F 5 E 10	16.34	14.18	53.43	407.50	469.50	7.78	96.30	95.00	25.40
45	A_2 50 B_1 15 B_3 10 D_1 5 G_1 5 F 5 E 10	16.62	17.57	50.99	386.30	468.00	5.57	88.30	91.00	27.20
46	A_2 50 B_1 15 B_3 10 D_1 5 G_3 5 F 5 E 10	16.54	17.41	50.39	405.00	490.25	5.60	88.30	91.00	27.20
47	A_2 50 B_1 15 B_3 10 D_1 5 G_2 5 F 5 E 10	16.00	16.44	52.45	384.15	475.55	8.02	88.30	91.00	27.20
48	A_2 50 B_1 15 B_2 10 D_2 5 G_1 5 F 5 E 10	17.21	16.67	50.46	420.80	460.20	5.55	95.14	96.00	27.70

APPENDIX II (Contd...)

Formulation Number	Ingredients and Amount	Protein (g)	Fat (g)	Carbo-hydrate	Energy (kCals)	Calcium (mg)	Iron (mg)	Amino acid score	Chemical score	Cost (Rs.)
49	A_2 50 B_1 15 B_2 10 D_2 5 G_3 5 F 5 E 10	17.23	17.01	49.86	439.35	482.45	5.58	95.14	96.00	27.70
50	A_2 50 B_1 15 B_2 10 D_2 5 G_2 5 F 5 E 10	16.69	16.04	51.92	418.50	467.70	8.11	95.14	96.00	27.70
51	A_2 50 B_1 15 B_3 10 D_2 5 G_1 5 F 5 E 10	15.62	17.24	50.80	423.05	536.70	5.88	86.23	86.00	30.00
52	A_2 50 B_1 15 B_3 10 D_2 5 G_2 5 F 5 E 10	15.54	17.58	50.20	441.60	558.95	5.85	86.23	86.00	30.00
53	A_2 50 B_1 15 B_3 10 D_2 5 G_3 5 F 5 E 10	15.00	16.61	52.29	438.55	544.00	8.36	86.23	86.00	30.00
54	A_2 50 B_1 15 B_2 10 D_2 5 G_1 5 F 5 E 10	16.92	16.84	50.88	420.80	528.90	5.86	91.87	92.00	29.60
55	A_2 50 B_1 15 B_2 10 D_2 5 G_3 5 F 5 E 10	16.84	17.23	49.78	439.35	557.15	5.95	91.87	92.00	29.60
56	A_2 50 B_1 15 B_2 10 D_2 5 G_2 5 F 5 E 10	16.30	16.31	51.84	418.50	536.40	8.37	91.87	92.00	29.60
57	A_2 50 B_1 15 H15 G_1 5 F 5 E 10	17.17	14.57	50.64	405.70	460.80	15.07	-	-	20.50
58	A_2 50 B_1 15 H15 G_3 5 F 5 E 10	17.09	14.91	50.04	424.25	533.30	15.39	-	-	21.10
59	A_2 50 B_1 15 H15 G_2 5 F 5 E 10	16.55	13.94	52.10	403.40	468.30	18.21	-	-	21.10
60	A_2 50 B_1 15 H10 D_1 5 G_1 5 F 5 E 10	17.29	16.55	49.58	458.60	459.00	12.05	-	-	20.50
61	A_2 50 B_1 15 H10 D_1 5 G_3 5 F 5 E 10	17.21	16.89	48.98	477.15	481.25	12.88	-	-	20.70
62	A_2 50 B_1 15 H10 D_1 5 G_2 5 F 5 E 10	16.67	15.92	51.84	474.10	466.50	14.56	-	-	20.70
63	A_2 50 B_1 15 H10 D_2 5 G_1 5 F 5 E 10	18.65	21.27	52.00	472.95	476.70	13.29	-	-	21.00
64	A_2 50 B_1 15 H10 D_2 5 G_3 5 F 5 E 10	18.57	21.61	51.40	491.30	498.95	13.32	-	-	21.00
65	A_2 50 B_1 15 H10 D_2 5 G_2 5 F 5 E 10	18.03	21.62	53.46	470.65	484.50	15.80	-	-	21.00
66	A_1 50 B_1 15 D_1 15 G_1 5 F 5 E 10	14.88	19.92	56.86	386.14	436.55	3.32	73.40	72.00	28.80
67	A_1 50 B_1 15 D_1 15 G_3 5 F 5 E 10	14.88	20.26	56.26	404.95	438.80	3.35	73.40	72.00	28.80
68	A_1 50 B_1 15 D_1 15 G_2 5 F 5 E 10	14.26	19.29	58.32	384.10	444.05	5.83	73.40	72.00	28.80
69	A_2 50 B_1 15 D_1 15 G_1 5 F 5 E 10	17.53	20.02	51.96	384.41	455.55	5.42	78.90	84.00	28.00
70	A_2 50 B_1 15 D_1 15 G_3 5 F 5 E 10	17.45	20.36	51.36	402.96	477.75	5.45	78.90	84.00	28.00
71	A_2 50 B_1 15 D_1 15 G_2 5 F 5 E 10	16.91	19.39	50.25	382.11	463.00	7.93	78.90	84.00	28.00
72	A_1 25 A_2 25 B_1 15 B_2 15 G_1 5 F 5 E 10	17.06	16.21	52.11	422.70	450.90	4.42	88.55	92.13	28.00
73	A_1 25 A_2 25 B_1 15 B_3 15 G_1 5 F 5 E 10	16.02	16.30	52.00	422.70	450.90	4.42	90.45	96.25	28.00

APPENDIX II (Contd...)

Formulation Number	Ingredients and Amount	Protein (g)	Fat (g)	Carbo-hydrate	Energy (kCals)	Calcium (mg)	Iron (mg)	Amino acid score	Chemical score	Cost (Rs.)
74	A_2 50 B_1 15 D_2 15 G_1 5 F 5 E 10	16.04	20.79	47.21	443.75	661.50	6.35	86.63	96.00	34.20
75	A_2 50 B_1 15 D_2 15 G_3 5 F 5 E 10	15.96	21.13	46.61	462.30	683.15	6.30	86.63	96.00	34.20
76	A_2 50 B_1 15 D_2 15 G_2 5 F 5 E 10	15.42	20.16	48.69	441.45	669.00	8.86	86.63	96.00	34.20
77	A_1 50 B_1 15 C_1 15 G_1 5 F 5 E 10	11.01	13.97	56.59	395.30	432.50	3.04	56.00	66.75	18.00
78	A_1 50 B_1 15 C_2 15 G_1 5 F 5 E 10	11.06	13.94	47.46	359.30	420.50	2.55	56.76	68.02	18.40
79	A_1 50 B_1 15 C_3 15 G_1 5 F 5 E 10	11.00	13.98	48.30	363.10	425.90	2.53	56.37	67.70	18.50
80	A_1 50 B_1 15 C_1 10 D_1 5 G_1 5 F 5 E 10	12.26	15.95	53.66	407.40	381.90	3.01	55.81	73.43	21.00
81	A_1 50 B_1 15 C_2 10 D_1 5 G_1 5 F 5 E 10	12.25	15.95	48.22	390.90	377.40	2.67	56.28	72.84	21.20
82	A_1 50 B_1 15 C_3 10 D_1 5 G_1 5 F 5 E 10	12.29	15.91	47.66	388.60	373.80	2.70	56.07	85.26	21.50
83	A_1 50 B_1 15 B_4 15 G_1 5 F 5 E 10	14.49	15.25	47.15	403.95	411.85	2.23	88.13	85.52	21.70
84	A_1 50 B_1 15 B_5 15 G_1 5 F 5 E 10	12.39	15.32	46.74	404.25	389.35	3.00	90.62	85.04	21.90
85	A_1 50 B_1 15 B_4 10 D_1 5 G_1 5 F 5 E 10	13.39	15.91	51.12	405.70	425.67	3.33	78.48	85.19	21.90
86	A_1 50 B_1 15 B_5 10 D_1 5 G_1 5 F 5 E 10	13.60	16.02	50.85	405.90	429.57	3.51	79.60	86.43	21.80
87	A_2 50 B_1 15 B_4 15 G_1 5 F 5 E 10	14.22	15.43	25.40	316.70	418.85	3.66	91.87	97.29	21.50
88	A_2 50 B_1 15 B_5 15 G_1 5 F 5 E 10	12.12	15.15	29.99	317.00	387.35	3.93	93.54	99.53	21.00
89	A_2 50 B_1 15 B_4 10 D_1 5 G_1 5 F 5 E 10	13.02	16.15	29.37	318.45	431.74	4.26	92.03	96.97	22.50
90	A_2 50 B_1 15 B_5 10 D_1 5 G_1 5 F 5 E 10	18.96	16.32	29.10	318.65	436.57	4.44	93.15	98.21	22.50
91	A_2 50 B_1 15 B_4 10 D_2 5 G_1 5 F 5 E 10	12.63	16.32	29.29	318.10	500.44	3.13	90.32	90.60	22.00
92	A_2 50 B_1 15 B_5 10 D_2 5 G_1 5 F 5 E 10	12.57	16.37	29.02	318.30	505.27	4.75	91.43	91.84	22.00
93	A_2 50 B_1 15 C_1 15 G_1 5 F 5 E 10	11.01	13.97	56.59	395.30	432.50	3.04	63.61	78.55	20.10
94	A_2 50 B_1 15 C_2 15 G_1 5 F 5 E 10	11.00	13.98	48.30	363.10	425.90	2.53	64.37	78.76	20.40
95	A_2 50 B_1 15 C_3 15 G_1 5 F 5 E 10	11.06	13.94	47.46	359.30	420.50	2.55	63.99	80.04	20.30
96	A_1 50 B_1 15 B_4 10 D_2 5 G_1 5 F 5 E 10	12.63	16.14	51.04	405.35	494.37	3.64	84.43	84.95	21.30
97	A_2 50 B_1 15 B_5 10 D_2 5 G_1 5 F 5 E 10	12.57	16.00	50.77	405.55	498.27	3.82	85.61	77.90	21.30

APPENDIX III

SCORE CARD FOR SENSORY EVALUATION OF THE FOOD SUPPLEMENT

ATTRIBUTES	SCORE	1	2	3	4	5	6	7	8
I. APPEARANCE									
Very good	5								
Good	4								
Fair	3								
Poor	2								
Very poor	1								
II COLOUR									
Most Acceptable	5								
Acceptable	4								
Fairly Acceptable	3								
Not Acceptable	2								
Not at all acceptable	1								
III TEXTURE									
Smooth crisp grains	5								
Smooth and grainy	4								
Grains with less lumps	3								
Grains with lumps	2								
Powdery	1								
IV FLAVOUR									
Most acceptable	5								
Acceptable	4								
Fairly Acceptable	3								
Not acceptable	2								
Not at all acceptable	1								
V TASTE									
Very good	5								
Good	4								
Fair	3								
Poor	2								
Very poor	1								
VI DONENESS									
Well cooked	5								
Cooked	4								
Uncooked	3								
Over cooked	2								
Charred	1								
VII OVERALL ACCEPTABILITY									
Highly acceptable	5								
Acceptable	4								
Slightly acceptable	3								
Neither acceptable nor unacceptable	2								
Unacceptable	1								
Total score									

Signature

APPENDIX IV

STANDARDISATION OF RECIPIES

1. Recipe I

   Food supplement ..... 100 g

   Jaggery ..... 20 g

   Jaggery was dissolved in just enough water and filtered. Boiled the solution to soft ball stage syrup and mixed with food supplement and rolled to lime size balls.

2. Recipe II

   Food supplement 100g

   Sugar ..... 20 g

   Sugar was made up to a syrup of soft ball stage with little water. Mixed it with food supplement and rolled to lime size balls.

3. Recipe III

   Food supplement ..... 100 g

   Jaggery ..... 20 g.

   Powdered jaggery was mixed with food supplement

4. Recipe IV

   Food supplement ..... 100 g

   Sugar ..... 20 g.

   Powdered sugar was mixed with food supplement.

APPENDIX V

HEDONIC RATING FOR THE PREFERENCE OF RECIPES

(CODE NUMBERS)

ATTRIBUTES	SCORE	R1	R2	R3	R4
Like extremely	9				
Like very much	8				
Like moderately	7				
Like slightly	6				
Neither like nor dislike	5				
Dislike slightly	4				
Dislike moderately	3				
Dislike very much	2				
Dislike extremely	1				

Name Signature

R1 Recipe I

R2 Recipe II

R3 Recipe III

R4 Recipe IV

APPENDIX VI

HEDONIC RATING FOR THE PREFERENCE OF SELECTED RECIPE

Attributes	Score	Rating
Like extremely	5	
Like very much	4	
Like moderately	3	
Neither like nor dislike	2	
Dislike	1	

Name
Signature

APPENDIX VII

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF AGRICULTURE, VELLAYANI
DEPARTMENT OF HOME SCIENCE

QUESTIONNAIRE TO ELICIT INFORMATION ON SOCIO ECONOMIC AND DIETARY PROFILE OF RESPONDENTS

Sl.No. Date .....

Name of Panchayath : .....

Anganwadi centre : .....

No. : .....

1.	Type of Beneficiary	:		
2.	Name	:		
3.	Address	:		
4.	Respondent's age (years)	:		
5.	Religion	:		
6.	Caste/Sub caste	:		
7.	Type of family	:		
8.	Marital status (no. of years)	:		
9.	Details of Family	:		
	a) Family size (no.)	:		
	b) Adult members	:	Males	Females .....
	c) Children	:	Males	Females .....
10.	Respondents educational status	:		
11.	Major occupation	:		
12.	Monthly occupational income	:		
13.	Monthly income from other sources	:		
14.	Land holding	:		
15.	Possession of House	:		
16.	Facilities available in the House	:		
17.	Total monthly income	:		
18.	Total monthly expenditure	:		
19.	Monthly family expenditure	:		
19a.	Monthly food expenditure	:		

20. Monthly food expenditure :

Items	Expenditure	Frequency of use
Cereals		
Pulses		
Roots and Tubers		
Cooking oil		
Nuts & oil seeds		
Green leafy vegetables		
Other vegetables		
Fruits		
Milk and milk products		
Egg		
Meat		
Fish		
Sugar		
Jaggery		
Purchase of other items of food		
Bread		
Baked Foods		
Jam/Squash/Beverages		
Pickles		
Instant foods		
Ready to eat foods		
Health drinks		

21. How many times meals are taken in a day.

22. Do you have specific time schedule for taking foods? Yes / No.

23. If yes timings of meals

Meals	Time
Break fast	
Lunch	
Tea	
Dinner	
Others (specify)	

24. Do you consume left over foods?

25. How often do you take food from outside

26. What are the common cooking methods followed in your home (rank according to the order of preference)

Boiling
Steaming
Frying
Shallow frying
Baking
Roasting

27. What are the foods prepared during special occasions

Festivals
Birth days
Marriage
Death ceremonies

28. Special foods given and restricted during special conditions

Special condition	Given	Restricted
Infants		
Weaning infants		
Pre-school children		
Adolescents		
Pregnancy		
Lactation		
Aged people		
Diseased condition (name the disease)		

29. In feeding whom do you consider important in the family (Give ranks)

Father/Mother/Children/Male members/Female member/Aged persons/Guest

30. Habits respondent/Husband

31. Recreational activities of respondent

32. Special care given to pregnant and Nursing mothers

1) How many pregnancies have you had (include Abortions/miscarriages/still birth)

2) How many children are alive?

Male	No.	Age (years)
Female		

3) What are the special Dietary and health care given

1) Pregnancy
2) Lactation

APPENDIX VIIa

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF AGRICULTURE, VELLAYANI
DEPARTMENT OF HOME SCIENCE

DATA PERTAINING TO PROGRAMME EFFICIENCY

1. ICDS Centre No. :
2. Name of Anganwadi and address :
3. Name of Anganwadi worker :
4. Name of Aya/Helper :
5. No. of women Beneficiaries in the centre :
   Pregnant :
   Lactating :
6. Type of food/items of food distributed in the centre :
7. Individual food ration
8. Cost of individual ration
9. Cost of fuel charges
10. Cost of cooking utensils
11. Cost of seasonings/food accessories
12. Source of food materials
13. Cost of Transportation
14. Quantity transported
15. Method of transportation
16. Storage of food materials
17. Cost of storage
18. Frequency of supply of food materials and quantity supplied each time.
    Cost of ppn of food supplement
19. Medicines supplied to the beneficiary
20. Cost of medicine
21. Mothers meeting (interval/no. of participants/Education classes)
22. Details of attendance of beneficiaries
    (The data to be collected from the centre for last three months)
23. Time schedule of Anganwadi
24. Time motion study (Time spent for each activity in the centre/day)

	Activity undertaken	Time spent
1) Teacher		
2) Aya		

25. Total monthly salary of teacher/Aya

APPENDIX VIIb

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF AGRICULTURE, VELLAYANI
DEPARTMENT OF HOME SCIENCE

COST EVALUATION OF THE PROGRAMME

Name and address of Anganwadi :

1. Cost of Transportation of food from .....
   (Distributing place) to Anganwadi centre

2. Cost of storage and distribution of food

3. Cost of individual ration

4. Cost of materials for women's education

5. Cost of medicines and materials for medical services

6. Cost of implementing personnel's time.

   (The time for delivering inputs and services)

   (Portion of the salary is calculated by the total time spent in the centre for different activities)

7. Cost of materials if any given to the beneficiary

8. Cost of the programme/women/year
   (act by adding up the above costs 1 to 8)

APPENDIX VIIc

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF AGRICULTURE, VELLAYANI
DEPARTMENT OF HOME SCIENCE

IMPACT OF RATE OF PARTICIPATION OF BENEFICIARY

1. Anganwadi No. :
2. Name of Beneficiary :
3. Type of beneficiary
4. How long you been beneficiary in the ICDS programme
5. The reason for becoming a beneficiary
6. How for the Anganwadi from your home?
7. Do you go to Anganwadi regularly?
8. What are the services you received from the centre?
9. Do you like the food supplement served in the Anganwadi?
10. The type of food served in the Anganwadi
11. Do you consume the food supplement fully? Yes/No
12. If No. What would you do the left over
13. Do you consume if a new food supplement is given to you? Yes/No

APPENDIX VIII

PROCEDURE FOLLOWED FOR TAKING ANTHROPOMETRIC MEASUREMENTS

1. Weight

The weight was measured using a platform balance as it is portable and convenient to use in the field. The weighing balance was checked periodically for accuracy. The scale was adjusted to zero before each measurement. The subject was weighed with minimum clothing. The lactating women beneficiary was made to stand on the centre of the plat form without touching anything and looking straight. Care was taken to use the balance on a firm surface. The weight was recorded to the nearest 0.25 gkg. Each reading was taken twice to ensure correctness of th emeasurement.

2. Height

To measure the height, anthropometric rod designed by National Institute of Nutrition was used. The rod was placed perpendicular to the ground, taking care to see that the floor area was even and not rough. The subject was asked to remove slippers and made to stand with the centre of her back touching the scale with her feet parallel and heels buffoles, shoulders and back of the head touching the rod. The head was held comfortably erect, the arms hanging losely by the side. The ruler was held on the top of the head in the centre crushing the hair at right angle to the scale and height was read off from the lower stage of the ruler to the nearest 0.5 cm. Each reading was taken twice to ensure correctness of the measurement.

3. Mid Upper Arm Circumference (MUAC)

Mid upper arm circumference was measured to the nearest 0.1 cm with the slithole tape by placing gently but firmly around the mid arm to avoid compression of the soft tissues. The left upper arm was measured at its mid point.

4. Chest circumference

The flexible, non-stretchble tape was used to measure the chest of the lactating women beneficiaries at nipple line. The average of the inspired and expired chest measurement to the nearest 0.1 cm was taken as the chest measurement.

APPENDIX IX

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF AGRICULTURE, VELLAYANI
DEPARTMENT OF HOME SCIENCE

SCHEDULE TO ELICIT INFORMATION ON THE CLINICAL STATUS OF RESPONDENTS

Name of Respondent : Anganwadi No. :

1. General health	:	Good (o) Fair (1) Poor (2) Very poor (3)
2. Eyes	:	
Conjuctival xerosis	:	Absent (o) Slightly dry (1) Dry wrinkled (2)
Bitot spots	:	Absent (o) Present (1)
Discharge	:	Absent (o) Present (1)
Corneal crosses	:	Absent (o) Slightly dryness (1) Haziness (2)
Corneal vascularisation	:	Absent (o) Present (1)
Night blindness	:	Absent (o) Present (1)
3. Mouth		
Lips	:	Normal (o) Discolouration (1) Fissures (2)
Tongue	:	Normal (o) Angular stomatitis (1) Red and raw (2)
Buccal mucosa	:	Normal (o) Fissured (1) Ulcered (2)
Gums	:	Normal (o) Bleeding (1)
Teeth	:	Normal (o) Mottled and discoloured (1) Chalky teeth (2) Dental carries (3)
4. Hair	:	Normal (o) Lost lustre (1) Sparse and brittle (2)
5. Face	:	Normal (o) Symmetrical or sub orbital pigmentation (1)
6. Skin	:	Normal (o) Dry (1) Phrynoderma (2)

7. Any other signs of deficiency symptoms (specify)

APPENDIX X

ATTITUDE OF BENEFICIARIES TOWARDS NEWLY DEVELOPED FOOD SUPPLEMENT

Sl.No.	STATEMENTS	SA	A	UN	D	SD
1.	Developed food supplement promotes good health.					
2.	Developed food supplement is very good in flavour.					
3.	Developed food supplement is not good in taste.					
4.	Developed food supplement is very nutritious					
5.	The food supplement is very good for breast milk production.					
6.	Developed food supplement is very costly.					
7.	Developed food supplement provided to women beneficiaries in the Anganwadi centres is inadequate in quantity.					
8.	Food supplement provided to women beneficiaries is excess in quantity.					
9.	Newly developed food supplement to be given to pre-school beneficiaries also.					
10.	Consumption of food supplement continuously for longer periods is very difficult.					
11.	Food supplement has good shelf life.					
12.	This nutritious food supplement is worth to buy and consume.					
13.	Processed packed food supplement is acceptable.					
14.	Developed food supplement needs modification in preparation					
15.	Newly developed food supplement is ready to eat processed product.					
16.	The newly developed food supplement is very good for pregnant mothers.					
17.	The newly developed food supplement is very good for lactating mothers.					
18.	Consumption of newly developed food supplement caused asmatic complaints.					
19.	Present food distribution system (take home) is acceptable.					
20.	Reorientation of newly developed food supplement through general feeding is to be recommended.					

APPENDIX XI

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF AGRICULTURE, VELLAYANI
DEPARTMENT OF HOME SCIENCE

FAMILY DIET SURVEY SCHEDULE, ONE DAY WEIGHMENT

Name of Respondent ..... Anganwadi No. and Place .....

Meals	Menu	Wt. of Raw Ingredients used by the Family (g)	Wt. of total cooked food consumed by the family (g)	Amount of cooked food consumed by the respodnent (g)	Raw Equivalents used by the individual (g)
Early morning					
Breakfast					
Lunch					
Tea					
Dinner					
Any other					

APPENDIX XII

INITIAL AND FINAL ANTHROPOMETRIC MEASUREMENTS OF LACTATING WOMEN BENEFICIARIES IN THE EXPERIMENT GROUP

	INITIAL							FINAL					
No.	Wt.	Ht.	AC	CC	HC	WC	ST	Wt.	Ht.	AC	CC	HC	WC
1	42	150	21	78	88	80	10	43	150	21	78	88	80
2	40	148	20.4	79	80	70	11	42	148	20	80	82	70
3	48	144	22	68	80	70	8	50	144	23	68	82	70
4	50	156	25	78	82	70	12	52	156	25	80	86	70
5	42.5	152.5	28	70	72	60	10	45	152	28	70	72	68
6	55	154	28	78	82	75	12	56	154	28	80	88	80
7	55	152	25	82	88	72	20	55.5	152	26	82	888	72
8	45	153	22	78	86	80	12	46	153	22	78	86	80
9	47	152	23.5	74	78	73	14	49	152	24	74	78	74
10	49	150	23.6	80	82	74	12	50	150	24	80	82	74
11	48	152	23	82	88	78	10	49	152	25	82	88	78
12	54	156	24.8	84	90	78	20	55	156	25	84	90	80
13	60	156	28	92	104	89	222	62	156	20	92	104	90
14	66	157	30	95	106	96	25	65	157	30	94	104	96
15	49	152	24	86	88	79	14	52	152	24	86	88	80
16	50	156	24	88	88	80	15	52	156	24	88	88	80
17	49	155	22	82	90	84	17	50	155	23	82	90	84
18	50	154	23	80	82	76	11	52	154	24	80	82	76
19	46	154	23.2	83	88	82	20	47.5	154	23.5	83	90	86
20	44	151	24.5	78	84	76	21	45.5	151	25	78	84	76
21	51	154	24.5	80	95	86	20	52	154	24	80	95	86
22	45	148	20	80	88	76	12	46	148	20	81	82	76
23	47	150	18	82	89	76	12	48	150	18	82	80	76
24	60	153	29	92	102	89	20	62	153	28	92	102	88
25	44	150	22	80	84	80	20	46	150	24	80	86	72
26	50	150	26	82	92	80	28	54	150	26	82	92	80
27	62	160	28	92	99	90	23	62	160	28	92	100	90
28	45	147	24	82	88	75	20	46	147	25	85	88	75
29	45	158	21.5	79	89	72	16	46	158	22	80	89	72
30	71	153	32	102	104	90	33	70	153	32	100	104	90

(Appendix XII Contd...)

	INITIAL							FINAL					
No.	Wt.	Ht.	AC	CC	HC	WC	ST	Wt.	Ht.	AC	CC	HC	WC
31	49	156	23.5	82	91	80	18	50	156	24	82	90	80
32	53	151	25.5	83	92	80	17	54	151	25	84	92	80
33	45	157	21.5	76	84	72	13	46	157	21.5	76	84	72
34	54	154	23	84	87	80	10	55	154	25	84	88	80
35	42	144	22.5	78	84	70	9	43	144	23	78	84	70
36	35	146	19	72	68	61	5	36.5	146	20	74	70	62
37	54	157	25	82	86	76	18	55	157	26	80	88	76
38	40	149	20	76	92	70	14	42	149	20	76	82	70
39	39	148	20	76	86	80	10	42	148	22	74	86	80
40	44	157	22.5	76.5	86	80	8	45.5	157	23	76	86	80
41	48	156	24	76	96	80	11	50	156	24	76	96	80
42	43.5	144	22.3	78	88	82	12	45	144	23	78	88	82
43	46	149	23	76.5	89	76	9	47	149	27	76	89	76
44	48	145	26.3	80	86	72	8	49.5	145	26	80	88	72
45	40	160	19	70	69	54	5	42.5	160	22	72	69	54
46	60	154.5	24	80	102	90	12	62	155	25	82	102	90
47	49.5	142	25	72	85	72	11	52	142	25	72	86	72
48	40.5	143	22.5	72	62	50	6	42.5	143	23	72	62	50
49	53	159	22	80	88	78	19	54	159	24	82	88	80
50	54	156	26.5	84	86	80	12	55	156	28	84	86	80
51	48	150	32	78	99	80	10	49.5	150	32	78	99	80
52	54	153.5	32	82	96	88	14	52.5	154	32	82	96	88
53	50	152.5	30	82	90	78	13	55	152	30	82	90	78
54	52	154	30	82	84	80	12	48	154	30	82	86	80
55	47	150	30	78.5	86	80	12	52.5	150	30	78	86	80
56	51	155	30	80	99	88	10	52	155	30	80	99	88
57	49	153	25	80	92	80	12	50	153	25	80	92	80
58	55	158	24	84	104	90	12	50	158	24	84	104	90
59	51	155	23	80	106	90	13	53	155	24	80	106	90
60	52	156	26	82	88	80	12	53	156	26	82	88	80

Wt. - Weight (kg) Ht. - Height (cm) AC - Arm Circumference (cm)
CC - Chest Circumference (cm) WC - Waist Circumference (cm) HC - Hip Circumference (cm)
ST - Skinfold Thickness (mm)

APPENDIX XIIa

INITIAL AND FINAL ANTHROPOMETRIC MEASUREMENTS OF LACTATING WOMEN BENEFICIARIES IN THE CONTROL GROUP

	INITIAL							FINAL					
No.	Wt.	Ht.	AC	CC	HC	WC	ST	Wt.	Ht.	AC	CC	HC	WC
1	42	150	22.2	78	86	74	18	42	150	22	78	86	74
2	40	148	20.4	79	82	76	12	40	148	20	80	82	76
3	47	150	25	78	82	76	14	47	150	25	78	82	76
4	49	154	23	72	84	74	13	49	154	23	72	84	74
5	48	155	22	72	85	73	12	48	155	22	72	85	73
6	45	155	20	70	89	72	10	45	155	20	70	89	72
7	45	148	24	68	80	70	12	45	148	24	68	80	70
8	50	155	24	82	92	82	19	50	155	24	82	92	80
9	52	156	23	82	94	80	14	50	156	23	83	94	80
10	50	150	30	66	88	80	13	50	150	30	66	88	80
11	48	157	22	82	88	78	18	48	157	22	82	88	72
12	46	152	23	80	86	80	10	45	152	23	86	8	80
13	43	147	26	82	88	82	10	43	147	26	82	88	82
14	50	152	27	82	99	88	14	51	152	27	82	99	88
15	51	153	24	82	99	82	13	50	153	24	82	99	82
16	52	158	25	88	94	92	14	53	158	25	88	94	92
17	54	157	24	82	88	72	25	55	157	24	82	88	72
18	52	155	28	82	100	82	15	52	155	28	82	100	82
19	50	155	26	82	102	88	16	52	155	26	82	102	88
20	40	156	24.2	78	88	70	11	40	156	25	78	89	72
21	45	150	23.5	92	86	80	12	45	150	23	92	86	80
22	46	155	27	90	92	86	15	46	155	26	90	92	86
23	50	152	25	90	102	88	12.5	49	152	24	90	102	88
24	52	148	23.5	92	106	90	16	52	148	24	92	106	90
25	48	150	22	88	90	86	15	48	150	23	88	90	86
26	48	156	30	84	102	88	16	48	156	30	84	102	88
27	51	154	25	82	98	78	14	51	154	25	82	98	78
28	52	154	24	82	102	80	12	52	154	24	82	102	90
29	45	147	22	76	89	75	10	45	147	22	76	89	75
30	48	150	24	75	88	78	12	48	150	25	75	89	78

(Appendix XII Contd...)

	INITIAL							FINAL					
No.	Wt.	Ht.	AC	CC	HC	WC	ST	Wt.	Ht.	AC	CC	HC	WC
31	46	152	26	74	94	78	14	46	152	26	74	94	78
32	53.5	150	21.5	76.5	88	63	12	52	150	22	75	88	64
33	54	152	22.2	74.5	88	72	12	53	152	22	72	86	72
34	59	154	27	82	102	88	13	59	154	27	82	100	88
35	45	155	22	78	84	76	14	46	155	22	80	84	76
36	47	154	24	82	89	80	10	47	154	24	80	89	80
37	46	150	26	82	88	80	12	45.5	152	25	82	88	80
38	48	152	22	80	88	75	12	47	152	29	80	88	76
39	45	148	21	82	98	78	10	45	148	22	82	98	78
40	47	155	20	80	88	80	10	47	155	70	80	88	80
41	46	150	23	78	89	69	8	46	150	24	80	89	69
42	63	157	28.2	86.5	98	84	10	62	157	28	86	100	84
43	51	158	21	78	87	72	18	50	158	21	78	86	72
44	63	154.5	24	82	104	98	14	63	154	24	82	102	98
45	46	149	23	76	89	72	10	46	149	23	76	89	72
46	42	148	22	78	89	72	10	42	148	22	78	89	72
47	55	150	29	88	88	80	14	54	150	29	86	88	80
48	46	154	25	74	86	78	12	46	154	25	74	86	78
49	47	150	24	76	88	77	13	47	150	24	76	88	77
50	48	151	24	78	88	80	12	48	151	24	78	88	80
51	45	152	27	75	84	74	10	46	152	27	75	84	74
52	44	150	26	72	82	76	10	44	150	26	72	82	76
53	50	157	28	80	98	84	14	50	157	28	80	98	84
54	50	156	27	80	90	84	14	50	156	27	80	90	84
55	48	149	22	80	99	84	13	48	149	22	80	99	84
56	47	150	26	73	88	80	8	48	150	26	73	88	80
57	48	155	23	72	88	82	12	47	155	23	72	88	82
58	53	157	30	82	105	95	18	53	157	30	82	105	95
59	43	152	23	86	88	78	12	43	152	23	84	88	76
60	47	150	23	76	86	80	10	47	150	23	76	86	80

IMPACT OF SOYA ENRICHED FOOD SUPPLEMENT ON THE NUTRITIONAL STATUS OF WOMEN BENEFICIARIES OF ICDS

By

C. NIRMMALA, M.Sc.

ABSTRACT OF THE THESIS
SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENT FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY IN FOOD AND NUTRITION
FACULTY OF AGRICULTURE
KERALA AGRICULTURAL UNIVERSITY

DEPARTMENT OF HOME SCIENCE
COLLEGE OF AGRICULTURE
VELLAYANI, THIRUVANANTHAPURAM

2002

ABSTRACT

The study comprises evaluation of existing supplementary nutrition component of ICDS and ascertaining the impact of newly developed food supplement on the nutritional status of women beneficiaries of ICDS.

Assessment of programme efficiency of the existing supplementary nutrition component of ICDS revealed lack of infra structure facilities and basic facilities in many centres. Irregularity in feeding was mainly due to delay in effecting the supply and due to administrative constraints.

An attempt was made to standardise food supplement suitable for lactating women beneficiaries. With this objective, 97 food formulations were computed and from this 15 combinations were selected. From among these 5 combinations with high nutritive value, amino acid score, and chemical score, were selected. Nutrient density, physiological tolerance, shelf life qualities, organoleptic qualities and cost were the major parameters administered to select the best combination.

Different recipes were standardised using the chosen food supplement as the base mix. Nine point hedonic scale was administered to select the suitable recipe, with the help of 50 experts at the institutional level.

The acceptability of the same was tested at the field level through preference studies among field level functionaries (50) and women beneficiaries (100). Most acceptable recipe was selected for the feeding programme. A feeding experiment of 6 months duration was conducted with selected recipe in 10 centres with 60 lactating women beneficiaries where the evaluated food supplement was to replace the existing ICDS supplement. In this feeding programme 60 beneficiaries of existing ICDS programme in other centres formed CG.

Socio economic and demographic profile of the beneficiaries of the two groups were elicited to ensure that there was no variation between the two groups in this respect. Many beneficiaries were belonging to nuclear type BPL families with 3 to 4 members and employed in unorganised sector. The educational level and health profile with reference to anthrompometric measurement of the beneficiaries were also found uniform.

Assessment of food habits and nutrient intake revealed uniformity in the inclusion of different foods and nutrient availability from the diet. The feeding programme was conducted for six months. The impact of the food supplement on the beneficiaries of EG revealed an improvement in the anthrompometric measurements, clinical deficiency manifestations and blood profile with reference to haemoglobin, serum protein, serum albumin, serum iron and TIBC but this improvement was not observed among the CG beneficiaries.