IMPACT OF BANANA BASED SUPPLEMENTARY FOOD ON THE NUTRITIONAL STATUS OF INFANTS

BY

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THESIS

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VELLAYANI, TRIVANDRUM

1992

DECLARATION

I here by declare that this thesis entitled "Impact of banana based supplementary food on the nutritional status of infants" 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 to me of any degree, diploma, associateship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled "Impact of banana based supplementary food on the nutritional status of infants" is a record of research work done by Smt. SUSAN JOSEPH.K under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma fellowship or associateship to her.

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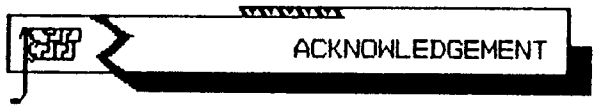

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INTRODUCTION

INTRODUCTION

Wide spread malnutrition prevalent in the world is largely attributed to social, cultural and economic factors. From the nutritional stand point the more vulnerable segments of the population are infants and young children and Protein Calorie Malnutrition (PCM) in these groups belonging to the poor socio-economic classes is a major public health problem.

Protein Calorie Malnutrition (PCM) is reported to be a major contributing factor for one third of all child deaths in the world , (UNICEF 1991). In India also Protein Energy Malnutrition (PEM) accounts for the higher infant mortality rate (95/1000 live births) than in industrialised countries (Bhat and Dahiya, 1985). Earlier studies conducted in India have revealed that the rate of growth of infants born to poor mothers, among whom successful breast-feeding is almost invariably practiced, is similar to the rates of growth observed in infants of well nourished mothers. This satisfactory rate of growth is reported to be seen up to the age of 4-6 months, beyond which period, infants belonging to undernourished mothers, tend to exhibit a slower rate of growth.

Devadas (1991) has reported that prolonged breast feeding practices coupled with delayed and inadequate supplementation may cause protein energy malnutrition among infants.

The solution for the problem of infant malnutrition therefore lies in supplementation or weaning ie, the process of getting the infant gradually accustomed to the full adult diet (Dube 1986). Gopaldas (1983) has stated that malnutrition can be solved by the judicious use of inexpensive foods which are available at the door steps of rural women.

A study on "Developing indigenous weaning food based on banana flour" was conducted as a Post Graduate Project from this Department during 1988. In the above study a banana based supplementary food was evolved through suitable laboratory analysis, animal experiments and acceptability studies. In the present study the "Impact of the above banana based supplementary food on the nutritional status of infants" is ascertained by accounting:

(i) the existing infant feeding practices prevalent in the area

(ii) the suitability of this supplementary food introduced in the dietaries of selected infants

(iii) the effect of the supplementary food on the nutritional status of infants monitored for six months.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Literature pertaining to the study entitled "Impact of banana based supplementary food on the nutritional status of infants" are reviewed under the following headings.

1. Prevalence and causes of infant malnutrition in India.
2. Process of weaning and low cost weaning foods.
3. Different types of weaning food developed by different institutions.
4. Popularisation of weaning food.

1. Prevalence and causes of infant malnutrition in India.

Infancy is the most critical and vulunerable period in childhood and it is during this period that a high incidence of mortality and morbidity is witnessed (ICMR,1984) , UNICEF (1987) has reported, that 11.5 million infants in the world, is currently dying each year due to malnutrition. UNICEF (1985) has also reported that infant mortality rate under one is 105 in India. According to Grant (1986), of about 34 million children born in South Asia each year, around 4 millions did not survive their first birthday.

Shukla (1982) has revealed that the overall child mortality in our country is the highest in the world being

18.7 percent of all deaths. Gopalan (1983), has reported that among developing countries, India deserved special attention since in this country the child population accounted for 40 percent of the population and they represented the most critical part of our human resources. Kakker et al. (1987) has also observed that in India, young children remained the most vulnerable group in the population with 40 percent of all deaths occuring in 0-4 years age groups. UNICEF (1990) in an analysis on children and women in India has reported that mortality rates of infants and children under 5 years still remained at levels which are unacceptably high. According to a report published by Ministry of Home Affairs Government of India (1983), in India IMR is although above 100/1000, varied from state to state with figures of above 160/1000 in Uttar Pradesh and around 40/1000 in Kerala.

Elsie Philip (1985), has stated that the reason for low infant mortality in Kerala was mainly due to expanded medical facilities, availability of immunization programme, utilization of health services, high literacy rate particularly among female and improvement in the socio-economic condition of the poorer section of the people. Kumar and Datta (1982) have reported that Infant Mortality Rate (IMR) is an important measure of health and development in a country. The infant mortality was not less than 40 per

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1000 live births as compared to 0.5 in a developed country like Sweden (Govt. of India, 1983). After conducting a comparative study between two different socially developed states like Kerala and Uttarpradesh, Santhi Ghosh (1986) has found that mortality among the 0-4 year female children was consistently higher in both Kerala and Uttarpradesh.

An annual report of World Health Organisation (1989), has revealed that the reason for infant deaths in the world each year was that, they were not immunized against killer diseases. UNICEF (1990) revealed a substantial decline in the infant mortality rate in India over the years and this achievement showed pronounced disparities between the states from 28 in Kerala to 123 in Uttarpradesh. Gupta and Walia (1980) have stated that the main causes of morbidity among infants in the rural areas of Punjab were due to skin infections, respiratory infections and ear discharge. Studies conducted in rural Ambala (Haryana) during 1980-83 and Kharagpur slums found that high share of infant mortality was mainly due to neonatal tetanus, diarrhoea, upper respiratory infection, fever, malnutrition and small size at birth. Gopalan (1983) have reported that in India 15.5 million young children, between the ages from birth to 5 years, died each year mainly as a result of malnutrition, diarrhoea, and respiratory diseases. According to UNICEF (1990) the causes of infant mortality

were community environment, availability of social amenities, house hold environment, physical, social and economic support, infant care at birth as well as at the pre-natal and post-natal stages. They also pointed out the other factors influencing infant mortality are nutrition of mothers, age at marriage and birth spacing. Garg (1981) has revealed that nearly one third of all infant deaths are caused by malnutrition.

Gopalan (1972) has reported that the high rates of infant and maternal mortality in our country stem chiefly from under nutrition. According to Devadas (1987) nearly 75 percent of infant mortality is attributed to malnutrition. Under nutrition is the contributing cause in one third of the million child deaths in the world (Grant, 1988). Nazeema Beevi (1989) reported that chief killers of this age group were severe forms of PEM such as Kwashiorkor and Marasmus and other non-nutritional diseases. According to Ghosh (1980) malnutrition and under nutrition were the important underlying causes of mortality in this country. According to Ravindran (1984) approximately half of the death in India among infants are directly due to severe malnutrition and fatal malnutrition. Shukla (1982) has stated that PCM is largely responsible for the high rate of mortality and morbidity among poor children. According to Bhargava, (1983) a shorter interval between successive

pregnancies is associated with a high infant mortality rate. Ghosh (1987) has reported that spacing between births not only affect mother's health but also had a profound effect on infant mortality. Leaving at least two years between one pregnancy and the next, can reduce the risk of an infants death by 50 percent or more (Grant, 1986).

UNICEF (1986) has reported that among poor communities infant mortality is typically twice as high, when the interval between births is less than two years. Kumar (1985) conducted a survey of 6000 women in India and found the infant mortality rate as 80 per 1000 where the interval between births was 3 to 4 years. The surveys conducted by National Nutrition Monitoring Bureau (NNMB, 1975) showed that nearly 2 to 3 percent of children between the ages of 1 and 3 years, belonging to poor sections of India suffered from extreme forms of malnutrition. Burnabes (1982) stated that millions of children suffering from malnutrition today lived in a state of poverty and risk of starvation. UNICEF (1988) has pointed out that 33 percent of children under five in India were suffering from mild to severe forms of malnutrition.

Chandra and Thayar (1985) had conducted an initial survey of 3082 children in Tamil Nadu and found that only 5 percent of the children surveyed were normal and 20 percent were in severe degree of malnutrition. Mandowara (1986)

have conducted studies at Chhotisadri (Rajasthan) and have revealed that 10.10 percent of children were having severe grades of protein energy malnutrition. Djazafery et al. (1983) found that 75 percent of the rural Iranian children suffered from mild to severe forms of PEM mostly during 2-3 years of age and the girls were the worst affected when compared to boys. Santhi Ghosh (1986) reported that malnutrition contributes to infectious diseases and infections in turn increase energy demands and decrease food absorption. Semawal et al. (1986) have observed that in Delhi urban slums, 45.1 percent of the children of one year old was under nourished. NIN (1975) has reported that the nutritional status of urban slum children of pre-school age in Delhi showed that nearly 82 percent had PEM, higher among girls than boys. Mortality rates as well as the incidence of infectious diseases and severe malnutrition are high among infants and young children of developing countries (Reynoldo and Robert, 1980).

Ramalinga Swamy (1980) has reported that between 2 to 4 percent children below the age of 5, living in rural areas suffer from mild to moderate degree of malnutrition as judged by growth failure. UNICEF (1985) has reported that in India during 1980-84, 33 percent under five, were suffering from moderate and severe malnutrition respectively. Field surveys carried out by ICMR (1984)

among four southern states in India have indicated that the very severe forms of the disease like Kwashiorkor and Marasmus were found among 2-3 percent of all children between the ages of 1-5 years. Results of a community survey had shown that over 50 percent of toddlers in the poor socio-economic group in India were anaemic while 70-80 percent of children suffered from various forms of growth retardation due to PEM (Usha and Beegum 1985). According to a survey conducted in India by Ravindran, (1979) at least 60 percent children from 1-6 years suffer from PCM and nutritional anaemia. A study conducted in Coimbatore by Devadas and Geetha (1986), revealed that the incidence of PCM was found to be 44 percent among pre-school children. Bhaskaran (1981) has stated that about one million children suffered from Vitamin.A deficiency in India at any point of time. According to an assessment of ICMR (1980) at least 30,000 children got blind every year due to Vitamin.A. deficiency. UNICEF (1990) has reported that in terms of age groups, the incidence of severe malnutrition appeared to be higher among children 0-3 years than in other groups in almost all states.

UNICEF (1990) has reported among infants calorie, protein malnutrition in the eastern states, Uttarpradesh, Madhyapradesh, and Kerala.

Prevalence of infant malnutrition in Kerala is reported to be 45.3 percent mild malnutrition, 33.5 percent moderate and 4.8 percent severe malnutrition (National Nutrition Monitoring Bureau, 1975).

Luwang (1980) conducted a study on prevalence of PEM among 508 pre-school children in a rural community of Manipur by cross sectional examination of weight. The overall prevalence of PEM was 65.7 percent while 26.8, 22.6. 11.2 and 5.1 percent grades of I, II, III and IV respectively.

Luwang and Singh (1981) have conducted a study on PEM among 300 under fives in a tribal population of Manipur using the criteria laid down by the Indian Academy of Paediatrics. Prevalence of PEM was 42.67 percent, 0.67 percent and 4 percent as mild, moderate and severe forms of disease respectively, PEM was highest in second year and lowest in first year. Vijayalakshmy et al. (1975) after studying 600 pre-school children registered in the Coimbatore Medical College have reported that the prevalence of malnutrition as five percent. Ramankutty et al. (1981) conducted a study on the pattern of malnutrition in two under nourished pre-school communities of Kerala and as per this survey prevalence of malnutrition was found to be fifty percent among boys and 57.2 percent among girls in non

coastal area while prevalence in coastal area, sixty seven percent for boys and 62.8 percent for girls. Maya and Viswesara (1983) conducted a study on nutritional status of pre-school children of rural and urban areas of Jaipur. Prevalence of malnutrition based on body weight as percentage of NCHS standards showed normal children as 16.7 percent, Grade I malnutrition 51.6 percent, Grade II 27 percent, and Grade III 4.7 percent. Severe forms were more common in females and rural children than males and urban children. A similar study conducted by Devadas et al. (1983) had revealed that of the 400 children surveyed, 104 were suffering from nutritional disease. Bhat and Saroj Dahiya (1985) conducted an investigation on 200 pre-school children of 1-5 years in Gangeva Village (Hissar district) and found that 15 percent of children suffered from third degree malnutrition, on the basis of body weight deficient for age and showed signs of severe PEM. Nazeema Beevi (1989) conducted a study on the nutritional status of pre-school children in the Pangappara Health Unit area found that 30.4 percent children of unskilled labourers were found to be malnourished. Only 6.55 percent of children of employed fathers were malnourished while 23.5 percent of children of skilled workers were malnourished. In a National Nutrition Monitoring Bureau Publication (1975) it was reported that Kerala is the state with the lowest intake of calories and

proteins, but the prevalence of malnutrition is much lower than in the other Indian states.

Etiologically the principal causes of PCM are due to deficient intake of proteins of good biological value, decreased absorption of proteins as in chronic diarrhoea and abnormal losses of protein during burns and haemorrage (Sharma and Mahajan 1987). Marasmus is due to a continued restriction of both dietary energy and protein as well as other nutrients. On the other hand Kwashiorkor is due to qualitative and quantitative deficiency of protein in which energy intake may be adequate (Singh and Shah 1990)

Shukla (1982) has stated that the main causes for malnutrition in India include non-availability of foods, poverty population growth, customs, socio-economic status like caste-system, false socio-economic status, education and influence of industrialisation, urbanisation and modernisation. Srikantia (1989) reported that PEM is the outcome of a complex interplay of several socio-economic and cultural factors. Gopalan (1984) has observed that about 44 percent of the pre-school population in India are estimated to suffer from moderate malnutrition which is associated with weight deficit and growth retardation. WHO (1979) has reported the determinants of malnutrition to be poverty, poor socio-economic status, inadequate food intake,

ignorance, false believes, traditions, caste, poor living condition, poor recreational facilities and faulty food habits. According to Krishnamoorthy (1983) parental literacy and percapita income of the family had an impact on the nutritional status of pre-school children. Devadas and Geetha (1986) pointed out a positive correlation between large number of siblings and severity of protien energy malnutrition. Koko (1987) reported that malnutrition and infant death are much higher in closely spaced pregnancies when compared with an interval of three to four years. Luwang and Singh (1981) have reported that with an increase of the sibling number of children on apparent increase of moderate and severe forms of Protein Energy Malnutrition was observed. Ali(1982) observed that among Hill Bhuniyas of Orissa, PEM was in the form of oedema, muscle wasting and moon face in children. He had also reported that Vitamin.A deficiency was generally found in the form of conjuctival xerosis, keratomalacia, and bitot spots, while riboflavin deficiency was in the form of angular stomatitis, cheilosis, glossitis and magenta tongue and vitamin.C was in the form of active or healed rickets in children. Luwang (1981) has reported that infectious diseases had significant association in the causation of PEM.

Edger Moks (1986) conducted a study at Costa Rica and observed the main cause of malnutrition as lack of food,

ignorance, and poverty. A report published by Indian Ministry of Health and family welfare (1981) has detailed that high prevalence of PEM and low birth weight is due to the poor immunization coverage and a heavy load of communicable diseases in the midst of poverty. A study conducted by Christian Medical College and Brown Memorial Hospital Ludiana (1986) found that among infants from the age group of 6 to 42 months, mostly female children were suffering from severe degree of malnutrition because the parents kept trying for more male children. In other areas of study it was due to the family size. According to studies conducted at NIN (1975) malnutrition and its causes is by a complex interaction involving food supply, income, health status, environmental condition, education, and other factors.

Satapathy et al. (1984) had revealed that lower socio-economic groups in Berhampur in South Orissa, 72 percent of the children were under nourished due to poor quality food and early weaning. Devadas (1983) has shown that breast milk can sustain growth and development only till 4 to 5 months of life beyond which in the absence of supplementation, growth slows down and malnutrition results.

Diarra and Diallo (1989) have reported that in Mali malnutrition in unweaned and weaned infants was 18.4

percentage and 9.2 percentage respectively. Srikantya (1989) have reported that two immediate causes are insufficient food intake and infective morbidity. Vinodini Reddy (1985) has reported that inadequate diet is the primary cause of infant malnutrition.

2. Process of weaning and lowcost weaning foods

Infant feeding practices are strongly associated with the culture of the society. Weaning is a crucial event in the life of an infant. Wharton (1980) have reported that use of foods inadequate in protein, energy, Vitamin. D, Vitamin.A or β-Carotene, iron, or zinc during this process can produce their respectively under nutrition syndromes in infants. In a report published by Ministry of Social Welfare (1981) infant food is defined as a complementary food, breast milk supplement, or weaning food represented as a partial or total replacement for breast milk. According to Devadas (1983) suitable weaning foods should be introduced to complement breast milk during first year of life.

One of the major issue concerning weaning is the age at which supplementation or complementary food should be introduced (Srikantya 1983).Accordingto Mitzner et al.(1984) complementation may be advisable as early as 2-4 months after birth depending upon the quantity of mother's milk,

baby's ability to suck, mother's health and mother's activities or her availability to breast feed.

Govindankutty (1984) has reported that after the age of 3 or 4 months, breast milk is not sufficient to satisfy the nutritional requirement of an infant. According to Kumari et al. (1985) breast milk was insufficient beyond four months of age and hence for prevention of infant malnutrition, introduction of weaning food should be encouraged by 4-6 months of life.

Srikantya (1983) has reported that supplementation to be initiated after the third month to prevent malnutrition and related complications due to infection and infestation. According to Devadas et al.(1984) from the fourth month of infancy along with breast milk the infants should be gradually introduced to liquid and supplementary food. A survey conducted by Kaur (1989) has revealed that most mother's in rural Ludhiana introduced milk supplementation before six months.

In many rural communities in India, weaning does not start until two years and in rare cases up to 4 years; where as in urban communities weaning often starts much earlier and additional foods are some times given when the infant is only a few months old (Dube 1986). Ramachandran(1984) has conducted studies among the more

traditional urban poor in Hyderabad and found that the introduction of semi solid supplementation begins by about 6 months after birth. A survey conducted at Kayamkulam and Sherthala municipalities of Kerala by Beegum and Prema (1984) has revealed that women in these two areas have introduced too many foods in the infant's diet before 6 months. It was also found that 25 percentage and 47 percentage of women in Kayamkulam and Sherthala have accepted commercial infant foods as substitutes for breast milk. Study conducted by Suja Thomas (1989) on the effect of birth order and spacing on the nutritional status of mother and pre-school children in Vellayani Trivandrum district, found that majority of the mother's had introduced supplementary foods from 0-3 months of age itself, while only 6.67 percent of the infants received supplementary foods from the 6-9 months of age.

According to Rao and Deosthale (1983) in rural India introduction of food supplements is usually delayed and in more than 90 percentage of the children, complete weaning takes place only towards the end of the thirdyear. It was also reported that by the age of twelve months almost all the infants were fully weaned. Semwal et al.(1986) studied the feeding and weaning practices of infant in Delhi Urban slums. It was found that for 43.3 percent of children, supplements were introduced at four months, while

in 23.3 percent prolonged breast feeding and delayed weaning at one year were practised. According to Samal (1984) in rural Orissa, semi solid foods were introduced around 13-18 months by 53.2 percent of the mother's. Survey conducted by Devadas and Geetha (1986) in Coimbatore revealed that only 9 percent of infants were breast fed beyond one year. It was also found that no special weaning foods were given and supplementary feeding started beyond seven months with cereals.

Rao (1989) reported that low-cost weaning foods is to be introduced to the infants from 4-6 months onwards based on the concept of multimixes. Kielman et al. (1982) had reported that nutritional supplementation to pre-school children can significantly reduce the mortality in this age group, especially those of the weaning age malnutrition supplementation may significantly lower malnutrition prevalence.

Protein calorie malnutrition has been an important cause of infant and child mortality in many developing countries and consequently major emphasis was placed on the processing and utilization for protein rich raw material for child feeding. Research in this area started after world war II and nutrition scientist were deeply involved in the selection of unexpensive and new sources of protein

(Subramaniam, 1980). From the point of view of custom, practice, feasibility and cost, it is obvious that it would be most convenient for the mother to feed the infant on early modified diet (Devadas, 1983). According to Devadas (1983) examples of easy adaptions of an Indian meal would be soft cooked cereal pulse kitcheries with generous addition of cooking oil (Gujarat) chapathi soaked and pulped in hot unspiced dhal, tea, milk, lassi or water (North and Central India) soft cooked rice combined with finely chopped and minced vegetables (North eastern states) steamed tapioca or rice combined with flaked fish (Kerala) or ragi balls pulped in sunspiced sambhar.

Similar low cost food mixes would combine at least some of the desired characteristics of high nutrient density, low bulk properties, utilisation of low cost and widely used cereals and pulses and traditional processing methods that have the potential of being easily adopted at home or village level.

(3) Different types of weaning food developed by different institutions

A variety of processed weaning foods and supplementary foods based on oil seeds, oil seed meals, cereals and legumes have been developed in India in the past three decades.

CFTRI Mysore (1970) has developed supplementary food named Miltone. The raw materials included were ground nut protein isolate, buffalo milk, water, glucose and vitamin-mineral mix. Feeding experiments with infants has shown that there feeds are as nutritious as milk and can be used as supplements for making up dietary deficiencies in infants (Swaminathan 1985). ICMR (1970) had developed WIN food using green gramdal flour (roasted) ground nut cake flour (roasted) and jaggery. Swaminathan (1970) developed a weaning food containing wheat flour, green gram, groundnut and sugar or jaggery. Devadas et al.(1971) had developed "Kuzhandai Amudhu" and the formulations were with jowar, bengalgram, groundnut, jaggery, ragi, maize, and green gram. Devadas et al. (1974) conducted a study to evaluate the protein quality through Protein Efficiency Ratio (PER), hepatic nirogen content and nitrogen balance of two selected vegetable protein mixes namely maize, green gram, ground nut and maize, bengal gram, groundnut, in comparison with skim milk. It was found that the vegetable protein mix based on maize, bengal gram and groundnut equalled that of skim milk while maize, green gram and groundnut mix was nearly the same or as efficient as the other two. Pasricha (1973) had developed a ready-to- mix powder and the main ingredients were cereal (wheat, Bajra, or Ragi), pulse (roasted bengal gram) oil seed and sugar. The

supplement is based exclusively on local resources. Central Food Technological Research Institute Mysore (1974) had developed energy food and the raw materials used were wheat flour, bengalgram flour, groundnut flour, and jaggery powder.

Kamalanathan et al.(1974) have studied the effect of the supplementary value of leaf protein and ground nut meal in the diet of pre-school children. A six month feeding trial was conducted and it was observed that both ground nut meal and leaf protein are equally good as supplements. In an attempt to further enhance the nutritive value of a combination of sunflower meal, maize and roasted bengal gram flour with sesame, Chandrasekhar and Kanjana (1975) tested the mix for its efficiency in promoting growth. It was observed that experiment group had registered higher values for increment in heights, weights and haemoglobin level when compared to their counterparts in control group.

Gopaldas et al.(1975) have developed Poshak. The main ingredients were cereal (Wheat, Maize, Rice or Jowar), pulse (Chena dal or mung dal), oil seed (groundnut) and jaggery in the proportion of 4:2:1:2 Rau et al.(1975) had developed extruded Ready To Mix which contained corn soya milk (CSM) and salad oil. Chandrasekahara et al.(1976) had developed KIF (Kerala Indigenous Food) which included

tapioca, rava, soya fortified bulgar wheat (SFB) and ground nut flour. Venkat Rao (1976) had formulated a weaning food composition with added sugar or malt extract; the composition include roasted ground nut cake flour, roasted bengal gram flour, rice flour, barely flour, hydrogenated ground nut oil, common salt, calcium carbonate ($CaCO_3$), tricalcium phosphate, vitamin premix and protein content. Child in Need Institute (CINI) have started the project on CINI NUTRIMIX since 1976, the major ingredients included were rice, mungdal and skim milk powder (UNICEF, 1977). ICMR (1977) has developed a ready - to consume mixture which included roasted cereal (cholam, maize, ragi or bajra) pulse (roasted or sprouted bengal gram or green gram) and oil seed (Ground nut or sesame cake flour). Eastham et al.(1978) hade studied a soyabean formula named as Prosokee.

Ralda and Wei (1980) have developed an infant weaning food a soyabean - banana food bars, which is pressed from soyabean - banana flakes. A soya-whey weaning food constituted by grinding the soya-whey mixture, oil and oil soluble vitamins was standardised by Kapoor and Gupta (1981). Inamder (1981) had developed malted and roasted, powdered multimixes of staple, wheat, bengalgram and ground nut in ratios 4:1:2, 8:1:1 and 8:1:0. The mix formulated in the ratio of 4:1:1 was the most acceptable.

Ahmed et al.(1981) had standardised a cereal-pulse based weaning food which were of high protein quality and which met approximately 1/3rd of the energy requirements of a one year old child. Gupta and Kaur(1982) formulated a weaning food containing potato, Soyabean, and skim milk in the ratio 65:20:15. Kerala Agricultural University (1983) had developed a weaning food based on locally available and traditionally accepted materials, such as banana flour, ragi flour, and fortified them by mixing soyabean and green gram flours.

Bushra et al.(1983) had developed a protein rich vegetable mix with rice, wheat, chick pea, milk and drum stick leafs. Changari et al.(1983) developed a weaning food with wheat flour and peanut flour. Balahar, blended and cooked mixture of corn soya and wheat soya serve as weaning foods for infants and toddlers (Gopal das 1983).

Devadas et al.(1984) developed several low cost indigenous diet combinations using rice and ragi as the staple and low cost indigeneous foods such as sweet potato, horsegram, sesame, ground nut, and amaranthus. Popowa (1985) formulated an infant food using cereals such as rice,oats and maize flour. Prasannappa and Jaganath (1985) formulated a weaning food with wheat, maize, ground nut meal, chickpea dal, and unrefined sugar and the weaning food was highly acceptable. Oyus.A.Oyeleke (1985) developed a

weaning food containing sorghum with skim milk powder. Sheela Prasad (1988) developed a weaning food of high biological value based on banana flour which was supplemented with different proportions of food articles such as sesame, horse gram, and skim milk powder. Jessy Philip (1988) developed a weaning food based on ragi flour which is nutritious low cost and acceptable and which is supplemented with green gram, sesame, tapioca and skim milk powder.

In a study by Chandrasekhar et al.(1988) a formulation was prepared from malted ragi + malted horsegram + roasted ground nuts in the proportion of 65:25:10. The results showed that malted mix has the potential of being produced locally and is adaptable for house hold consumption.

Nagammal (1989) formulated ragi biscuits using different proportions of various ingredients like groundnut, sesame, green gram, butter, skim milk powder and sugar besides ragi flour. These ragi biscuits were well acceptable by pre-school children.

Milk substitutes based on ground nuts and soya bean fortified with vitamins and minerals have been found to promote growth in children (Subbulakshmi, 1990). Enriched tapioca macaroni, utro macaroni and nutro biscuits are other

few vegetable protein weaning mixes developed. National Institute of Nutrition (1981) has developed weaning foods like bajra infant food, Sajina and Gehuna, and these mixes are also found to be nutritionally good in that they are capable of improving the nutritional profiles of children.

(4) Popularisation of Weaning foods

Jelliffe (1967) was one of the first to popularise the concept of multimixes. Chaudari (1964) demonstrated that a cooked triple mix of chickpea flour, local greens, jaggery (2:1:1) was well tolerated by children suffering from severe protein energy malnutrition. ICMR (1974) conducted a supplementary feeding cum nutrition education programme covering 2540 children under 3 years old to demonstrate the beneficial effects of supplementary feeding on the health of the children. A significantly lower prevalence of severe forms of PEM was reported in the experimental areas.

Kielmann et al (1982) has stated that the nutrition supplementation to pre-school children can significantly reduce the mortality especially those of the weaning age and overall growth of the children can be improved by nutritious supplementation. King et al. (1967) has evaluated the response of pre-school children to high intakes of cereal - beans mixture and the results indicated

that all the mixtures significantly increased weight over the standard, skin fold thickness, serum protein, and serum albumin. Swaminathan (1975) had made an evaluation on supplementary foods based on oilseeds for infants and the results indicated that supplementary foods based on oil seeds are effective in improving the nutritional status of an infant. Desikachar (1983) developed a formula based on maize, ragi, and green gram and tested on six month old babies in hospitals and found a good growth promoting value.

Effect of low cost supplementary foods on nutritional status of pre-school children was studied by Ninave and Shastri (1987) and the results indicated that there was a clear cut change in physical activity, mental alertness and biochemical parameters. Dumn et al.(1967) conducted feeding trials with Indian multipurpose food on pre-school children for more than six months and it was found that the average growth in both height and weight was greater in the experimental group.

Devadas et al.(1984) conducted a feeding trials on infants by giving lowcost indigeneous diets based on rice and ragi for a period of four years, and the results showed that height, weight, arm and chest circumferences and the clinical picture of these children were better than those controlled counter parts. Puri et al.(1983) observed that

after conducting the feeding experiment with a supplementary food, the children filled these calorie gap by gaining body weight. In an experiment on infants in the age group of six months to one year food formulation based on germination of soya-bean flour, rice flakes flour, banana flour and germinated green gram flour, when fed for a period of two months resulted in body weight gain from 400 grams to 1 Kg in infants. Nutricion (1989) conducted feeding studies on infants by giving about 30 kilo calories per kilogram body weight and found a gain in body weight for all the infants.

Kamalanathan et al (1970) conducted a study at a balawadi where supplementary food were provided to children and found an improvement in height, body weight and haemoglobin content. Chanda (1980) reported that in the slum areas of Calcutta where pre-school children were fed with supplementary food showed a decrease in the number of children in third degree malnutrition after participation in the programme. Joginder Singh et al.(1980) by conducting a feeding trial with a maize based skim milk supplementary food among pre-school children showed a gain in weight more than 25 per cent compared to those fed on maize alone. ICMR (1984) based on the studies conducted at Hyderabad found that supplementary food based wheat flour, green gram mix given to pre-school children showed higher mean values of heights and weights.

Kaur and Bhat (1979) studied the effect of a supplementary feeding programme on the nutritional status of the pre-school children the the study indicated that the experimental group had an improved clinical picture at the end of the feeding trial, showing an increase in height, weight arm circumference and haemoglobin levels.

A study conducted by Indo-Dutch Project for child welfare (1977) at Hyderabad after giving a supplementary food called Hyderabad mix found that there was an increase in weight at the end of fourth week, reduction of oedema fluid from first week, improvement in mental changes, and subsidence of diarrhoae and puffiness of face in the second week.

Nagammal (1989) conducted a study on the impact of a ragi based food supplement on the nutritional status of pre-school children in the rural areas of Trivandrum District and found that there was an increase in the weight for age profile of the experimental group children.

Field trials on a weaning food based on ragiflour proved that the food mix was well acceptable to the children and mother's (Jessy Philip 1988). Similar results were obtained for a weaning mix of banana flour evolved by Sheela Prasad (1988).

MATERIALS AND METHODS

MATERIALS AND METHODS.

A study on the "Impact of banana based supplementary food on the nutritional status of infants" was under taken.

(a) to assess the existing infant feeding practices prevalent and to locate the defects.

(b) to introduce a banana based supplementary food in the dietaries of selected infants.

(c) to study the effect of the above supplementary food on the nutritional status of the infants.

I. Area of study.

The Area around Vellayani campus which belong to Kalliyoor Panchayat was selected for the study.

II. Plan of action.

Plan of action of the present study comprised

(1) A base line survey among selected families to elicit information on the socio-economic background, food consumption pattern and existing infant feeding practices.

(2) Selection of six month's old infants of the same socio-economic and health background for the experimental and control group.

(3) Preparation of banana based supplementary food at the laboratory for the field experiment to be conducted for six months.

(4) Conducting a feeding trial among infants to test the acceptability of the banana based supplementary food before starting the experiment.

(5) Conducting the feeding experiment for six months at the field level.

(6) Recording anthropometric measurements at regular intervals.

(7) Conducting clinical studies once in a month with the help of a qualified physician for a continuous period of six months from the starting of the field trial.

III Conduct of the study

(1) Selection of samples for baseline survey

Seventy five families with at least one child below the age of one, were selected for the study based on a pilot survey among the families.

(2) Methods selected for the study

The data were collected from mothers by interview method through house visits. Interview method was adopted of face to face verbal exchange. More over this is a systematic method through which a person can enter more or less imaginatively into the inner life of a comparitive stranger (Devadas and Kulandaivel 1975)

(3) Development of tools

To elicit information regarding the socio-economic background, food consumption pattern and existing infant feeding practices of the families suitable questionnaire was developed. The schedules developed were framed in such a way to collect details regarding the socio-economic status, size and composition, dietary habits, infant feeding practices, introduction of supplementary foods, age of weaning, restriction of foods to infants during special conditions like illness etc. The questionnaire was pre-tested and is presented in Appendix-I

(IV) Selection of the infants for experimental and control group

(a) Selection of anganwadi

A list of anganwadies available at a radius of eight kilometers of the campus was prepared. There were eight anganwadies under the Kalliyoor Panchayat of which, one anganwadi was selected where in most of the mother's of the selected families had enrolled as beneficiaries of the ICDS feeding programme. The mother's were asked to bring their infants to the anganwadi so that on-the-spot feeding could be conducted at anganwadi by the investigator.

(b) Selection of infants

Regularity in attendance of the mother's; similarity in socio-economic background and age from 6 to 7 months for infants were the criteria for the selection of the sample. Fifteen infants acted as experimental group and fifteen infants of the same economic group acted as control.

(V) Arrangement for the conduct of feeding trials

(a) Fomulation of banana based food supplement

A weaning food using banana flour as a base

formulated and standardised by Sheela Prasad (1988) was used for the feeding trial in the present study. The ingredients selected for the weaning food in the above experiment were based on the local availability, nutritional value, economic significance, shelf life qualities, acceptability, easiness for processing and digestability. Accordingly banana flour, sesame, horsegram, and skim milk powder in the proportion 30:20:30:20 respectively which has got the highest digestability and biological value and protein efficiency ratio were chosen as the multimix in the present study.

(b) Preparation of the multimix.

For the preparation of the multimix, banana (Nendran) was purchased from the local market. The unripe banana fruit was peeled and then sliced and dried at an oven temperature of 60° C. When the fruit was completely dried it was powdered and sieved following the procedure recommended by Snehalatha (1985).

Horsegram obtained from the local market was cleaned of impurities washed in water and soaked for eighteen hours. It was then sprouted following the

procedure recommended by Rajalekshmi (1974). The soaked grains were tied in a moist muslin cloth kept on a plate and covered with a large inverted pan so as to keep the temperature uniform. The germinated grain was then dried in the sun, roasted, milled and sieved.

Good quality (white) sesame was purchased from the local market and was cleaned to remove all the impurities it was then dried, roasted and powdered.

The above three powdered ingredients were roasted separately and skim milk powder were mixed in the weighed quantities as per the recommended combination.

During the experimental period, every month 90 kilo grams of multimix was prepared by the investigator by processing 42 kilograms of banana flour, 30 kilograms of horse gram powder and 18 kilograms of sesame powder.

(c) Conducting feeding trials among infants.

Quantity of the weaning food per infant was calculated based on the body weight of the infants as per ICMR recommended allowance. One third (1/3rd) of the total protein requirement was met per serving of the weaning food. Detailed calculation of the required quantity of weaning food/infant is given in Appendix II.

The weaning mixture was prepared in the form of a porridge sweetened with sugar one part of the weaning formula was mixed with three parts of hot water to make a bland porridge. The weaning formula was prepared at anganwadi and was served to the infants as on the spot feeding.

Before starting the actual feeding experiment acceptability of the weaning mixture by the experimental group children was conducted for a period of seven days. Responses of the young children could not be accurately, recorded using a score card and hence it was left to the discretion of the investigator to decide if a child "liked" or "disliked". For this each child was fed a teaspoon full of the porridge by the mother and his reactions to the food was observed and recorded as pleasant or unpleasant expression. The pleasant expression may denote acceptance while the unpleasant expression a refusal. His acceptance was further checked by noting whether he voluntarily opened his mouth for a second mouthful of the food, this was also recorded. This acceptability trial with the weaning formula among experimental group children was continued for a period of one week and assured that no digestability disturbances or discomfort was caused to the infants due to the new food introduced.

(1) Feeding Trial

Fig. 1.

(VI) Ascertaining the nutritional status of the infants throughout the trial.

When the infant of the experimental group became accustomed with the weaning food after one week ,the supplementary feeding was conducted for six months. Everyday the porridge was prepared at the angawadi and was fed to the infants by the mother's under the direct supervision of the investigator (Fig.1). Records of the daily attendance and food intake was maintained. Before starting the feeding experiment anthropometric measurements were taken for both the experimental and control group infants. Anthropometry has been accepted as an important tool for assessment of nutritional status, particularly of growing children by Vijayaraghavan (1987). According to Chen et al , (1978) anthropometric measurements are internationally accepted system for classifying protein energy malnutrition and it will accurately portray the nature, severity and prevalence of the problem. In this study the crown heel length, body weight, mid arm circumference, head and chest circumference were measured and the procedure for taking these body measurements is given in Appendix III.

According to Swamination (1986) clinical examination is the most important part of nutritional

(2) Measuring Crown heel length (Height)

(3) Measuring Weight

Fig. 2

Fig. 3.

(4) Measuring Chest circumference

(5) Measuring Head circumference

Fig. 4.

Fig. 5.

(6) Measuring Mid arm circumference

Fig. 6.

(7) Conducting Clinical Examination

Fig. 7.

Fig. 8.

assessment as direct information of signs and symptoms of dietary deficiencies prevalent are obtained . In the present study the investigator with the help of a qualified physician assessed the clinical symptoms of malnutrition among experimental and control group infants before starting the actual feeding trial. The clinical examination was conducted every month for the infants belonging to the experimental group. The proforma prepared and used for clinical assessment and anthropometric measurements is presented in Appendix IV.

Anthropometric measurements and clinical assessment of all infants were carried out for every month for a period of six months when the experimental group were provided with the multimix (Fig. 2 to 8)

(VII) Statistical treatment of the data collected

Data collected were statistically treated as detailed below.

(i) The significance of the increase in anthropometric measurements and the nutritional status of the experimental group after the experiment was ascertained by using the paired t-test formula.

$$t_{n-1} = \frac{|\bar{d}|}{Sd/\sqrt{n-1}}$$

(ii) A comparison of the nutritional status of the experimental group and control group on the basis of variation in anthropometric measurements were ascertained using the student's t-test

$$t_{2(n-1)} = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\frac{S_1^2 + S_2^2}{n-1}}}$$

(iii) A comparison of anthropometric measurements of the experimental group with ICMR standards (1989) were compared and ascertained by using student's t-test formula.

$$t_{n-1} = \frac{|\bar{x} - a|}{S/\sqrt{n-1}}$$

RESULTS

RESULTS

Results of the present investigation entitled "Impact of banana based supplementary food on the nutritional status of infants" are presented under the following headings.

I. Family back ground of the selected infants.

II. Nutritive value of the banana based supplementary food.

III. Acceptability of the banana based supplementary food.

IV. Conduct of the feeding trial.

V. Growth pattern of the infants given the banana based supplementary food.

I. Family back ground of the selected infants.

Families of 75 infant's were selected at random and the mother's of all these 75 infant's were interviewed to get information on their family back ground. All the 75 families earned their livelihood from occupations such as agriculture (53.4 percent) stone breaking (17.3 percent) coir work (13.3 percent), business (5.3 percent), and government job (10.7 percent)

Family particulars like religion, caste, family size, educational status of parents and economic status, were collected to ascertain the socio-economic back ground of the families.

Table-1
Social Status of the families

mily size			Educational status of father						Educational status of mother					
all mily -4) bers	Large Family (5-10) members	Total	Illi-tera-te	Prim-ary	Mid-dle	High sch-ool	Col-lege	Total	Illi tera te	Prim-ary	Mid-dle	High sch-ool	Col-lege	Total
7 7)	36 (48)	53 (70.7)	- -	3 (4)	8 (10.7)	22 (29.3)	20 (26.7)	53 (70.7)	-	1 (1.3)	7 (9.3)	40 (53.3)	5 (6.7)	53 (70.7
0 3)	10 (13.3)	20 (26.6)	-	-	-	11 (14.6)	9 (12)	20 (26.6)	-	-	3 (4)	10 (13.3)	7 (9.3)	20 (26.6
-	2 (2.7)	2 (2.7)	-	-	1 (1.3)	1 (1.3)	-	2 (2.7)	-	-	2 (2.7)	-	-	2 (2.7
27 1)	48 (63.9)	75 (100)	-	3 (4)	9 (12)	34 (45.2)	29 (38.7)	75 (100)	-	1 (1.3)	12 (10)	50 (66.6)	12 (16)	75 (100)
20	12	32	-	-	-	20	12	32	-	-	-	28	4	32
26.7)	(16)	(42.7)				(26.6)	(16)	(42.6)				(37.3)	(5.3)	(42.6
7 (9.3)	36 (48)	43 (57.3)	-	-	8 (10.6)	31 (41.3)	4 (5.3)	43 (57.3)	-	-	-	38 (50.6)	5 (6.6)	43 (57.3
27 36)	48 (64)	75 (100)	- -	- -	8 (10.6)	51 (67.9)	16 (21.3)	75 (100)	-	-	-	66 (88)	9 (12)	75 (100)

Numbers in paranthesis indicates percentage

Table-2 Composition of the families surveyed

Size of the family	sex	Number of persons	Total
Number of adults above (18 years)	Male	90 (22.78)	190 (48.1)
	Female	100 (25.31)	
Number of adolescents (11-17 years)	Male	4 (1.01)	10 (2.53)
	Female	6 (1.51)	
Number of children between(6-10 years)	Male	8 (2.03)	45 (11.4)
	Female	37 (9.4)	
Number of children between (3-5 years)	Male	25 (6.33)	70 (17.72)
	Female	45 (11.33)	
Number of children below (3 years)	Male	22 (5.6)	80 (20.25)
	Female	58 (14.7)	
TOTAL		395 100	395 (100)

Numbers in parentheses indicates percentage.

Table .3 Economic status of the families.

Particulars of Income level	Number	Percentage	Income from Agriculture	Rearing domestic animals.	Business earnings	Production Receipts from properties	Agriculture & domestic animals.	Total
500 - 800	43	57.3	20 (26.6)	5 (6.6)	5 (6.6)	3 (4)	10 (13.3)	43 (57.3)
801 - 1100	10	13.3	5 (6.6)	5 (6.6)	-	-	-	10 (13.3)
1101 - 1400	5	6.7	5 (6.6)	-	-	-	-	5 (6.6)
1401 - 1700	5	6.7	5 (6.6)	-	-	-	-	5 (6.6)
1701 - 2000	4	5.3	2 (2.7)	2 (2.7)	-	-	-	4 (5.3)
2000 and above	8	10.7	6 (8)	2 (2.7)	-	-	-	8 (10.6)
TOTAL	75	100	43 (57.3)	14 (18.6)	5 (6.6)	3 (4)	10 (13.3)	75 (100)

Numbers in parentheses indicates percentage

Table-4 Monthly expenditure pattern for non-food items of the families with family size

Particulars	SMALL FAMILIES				LARGE FAMILIES			
	Monthly expenditure range (in percent)				Monthly expenditure range (in percent)			
	0-10	11-20	21-30	Total	0-10	11-20	21-30	Total
Clothing	20 (74.1)	7 (25.9)	-	27 (100)	25 (52.1)	23 (47.9)	-	48 (100)
Shelter	27 (100)	-	-	27 (100)	10 (20.8)	35 (72.9)	3 (6.3)	48 (100)
Education	19 (70.4)	8 (29.6)	-	27 (100)	40 (83.3)	3 (6.3)	5 (10.4)	48 (100)
Health	21 (77.8)	6 (22.2)	-	27 (100)	10 (20.8)	30 (62.5)	8 (16.7)	48 (100)
Transport	10 (37.1)	17 (62.9)	-	27 (100)	3 (6.3)	20 (41.7)	25 (52)	48 (100)
Recreation	10 (37)	-	-	10 (37)	10 (20.8)	2 (4.2)	-	12 (25)
Savings	15 (55.6)	-	-	15 (55.6)	5 (10.4)	-	-	5 (10.4)
Debts	5 (18.5)	-	-	5 (18.5)	-	30 (62.5)	-	30 (62.5)
Others	9 (33.3)	18 (66.7)	-	27 (100)	-	40 (83.3)	-	40 (83.3)
Repaying of loans	5 (18.5)	20 (74)	-	25 (92.5)	-	15 (31.3)	-	15 (31.3)

Numbers in Parentheses indicates percentage

Table-5

Monthly expenditure pattern for food items

Monthly Income	Family size								Grand total
	Small				Large				
	Range of monthly experditure (in percent)								
	41-50	51-60	61-70	Total	41-50	51-60	61-70	Total	
500-800	-	10 (37.1)	-	10 (37.1)	-	20 (41.7)	-	20 (41.7)	30 (40)
801-1100	-	2 (7.4)	-	2 (7.4)	4 (8.3)	6 (12.5)	-	10 (20.8)	12 (16)
1101-1400	-	-	3 (11.1)	3 (11.1)	-	2 (4.2)	2 (4.2)	4 (8.3)	7 (9.3)
1401-1700	-	5 (18.5)	-	5 (18.5)	-	-	6 (12.5)	6 (12.5)	11 (14.7)
1701-2000	1 (3.7)	2 (7.4)	-	3 (11.1)	-	-	3 (6.3)	3 (6.3)	6 (8)
2000 and above	-	-	4 (14.8)	4 (14.8)	-	-	5 (10.4)	5 (10.4)	9 (12)
Total	1 (3.7)	19 (70.4)	7 (25.9)	27 (100)	4 (8.3)	28 (58.4)	16 (33.4)	48 (100)	75 (100)

Numbers in parentheses indicates percentage

comparatively less than the small families of the same socio-economic back ground.

As revealed in the table-6, rice, tapioca, vegetables and fish were found to be the major items in their daily diets.

Daily meal pattern of the families revealed that, in general, the families (80 percent) were habituated to three meals per day.

In the intra family distribution of foods, preference was given to the head of the family by 66.7 percent of the families, being the earning member. In this regard, preference for members of vulnerable condition was given only by eight percent of the families surveyed.

An enquiry on the first foods given to the new-borns, revealed that majority of the mother's (74.7 percent) were in the habit of giving gold and wayampu on the first day itself. Water with honey (21.3 percent), water with sugar (2.7 percent) and water alone (1.3 percent) were given to infants by other mother's. All the mother's were in the habit of giving breast milk to infant's from the first day onwards.

As revealed in table-7, infants for the first six months were fed from breast for more than six times a

Table - 6 Frequency of the use of different food items by the families.

Components in a balanced diet	Daily	More than 3 days in a week	Less than 3 day in a week	Once in a week	Once in a month	Never	Total
Cereals							
Rice	75 (100)	-	-	-	-	-	75 (100)
Pulse							
Bengal gram	7 (9.3)	-	17 (22.7)	35 (46.7)	16 (21.3)	-	75 (100)
Roots and tubers							
Tapioca	32 (42.6)	-	-	23 (30.7)	20 (26.7)	-	75 (100)
Other Vegetables	40 (53.3)	35 (46.7)	-	-	-	-	75 (100)
Leafy vegetables	-	5 (6.7)	30 (40)	-	40 (53.3)	-	75 (100)
Fruits							
Banana	20 (26.6)	38 (50.7)	-	17 (22.7)	-	-	75 (100)
Milk and Milk products							
Milk	75 (100)	-	-	-	-	-	75 (100)
Flesh foods							
Fish	75 (100)	-	-	-	-	-	75 (100)
Nuts and oil seeds							
coconut	36 (48)	16 (21.3)	-	23 (30.7)	-	-	75 (100)

Numbers in parentheses indicates percentage.

Table-7

Infant feeding schedule

Months	Frequency of feeding per day			
	6 times	5times	4 times	3 times
First 4	75 (100)	75 (100)	-	-
5 - 6	70 (93.3)	2 (2.7)	3 (4)	-
7 - 8	-	45 (60)	20 (26.7)	10 (13.3)
9 - 10	-	43 (57.3)	18 (24)	14 (18.7)
11 - 12	-	-	68 (90.6)	17 (9.3)
13	-	-	70 (93.8)	5 (6.7)

Numbers in parentheses indicates percentage

day. Supplementary foods like cow's milk and artificial milk when introduced, frequency of breast feeding was found to be reduced, the variation being 6 feedings to 3 feedings per day. Table further reveals that the mother's were in the habit of breast feeding their babies even after completing one year.

Another notable feature in this regard is that number of breast feeding was reduced by increasing the interval between two feeds and as revealed in the table-8, interval between two feeds increased from half an hour to two hours per day as age advanced from 6 months to one year.

Reasons for reducing the frequency of breast feeding was reduction in the secretion of breast milk (74.7 percent) disinterest of the infant (24 percent) and mother's employment outside home (1.33 percent).

As revealed in tabe-9 rice, wheat, ragi, bengal gram, potato, tapioca, leafy vegetables, banana and papaya were introduced in the infants diet during the third and last trimester of the year. Milk was given from 6 months onwards. 82.7 percent of the mother's were advised by older members of family regarding the introduction of supplementary food during infancy, while 17.3 percent of mother's got similar advise from neighbours.

Table-8

Interval between the feeds

Months	Feeding Interval			
	Half hour	One hour	Two hours	More than two hours
First 5 months	75 (100)	-	-	-
6 - 7	-	75 (100)	-	-
8 - 9	-	55 (73.3)	15 (20)	10 (13.3)
10 - 11	-	35 (46.7)	28 (37.3)	50 (66.7)
12 - 13	-	-	25 (33.3)	43 (57.3)

Numbers in parentheses indicates percentage

Table-9 Types of foods introduced to the infants

Food items	Months		
	6	7 - 9 months	9 - 12 months
Cereal			
Rice	-	30 (40)	45 (60)
Wheat	-	25 (33.3)	50 (66.7)
Ragi	75 (100)	-	-
Pulses			
Bengalgram	-	40 (53.3)	35 (46.7)
Roots & tubers			
Potato	-	20 (26.7)	55 (73.3)
Tapioca	-	30 (40)	45 (60)
Leafy vegetables	-	-	75 (100)
Fruits			
Banana	-	50 (66.7)	25 (33.3)
Pappaya	-	-	75 (100)
Milk	75 (100)	-	-

Numbers in parentheses indicates percentage

Too spicy foods and heavy foods like egg and ground nut were not given to the infants. Foods like dal, animal foods, spicy foods and left over foods were not given to sick infants.

Artificial feeding with other milks were introduced to all the infants surveyed. All the mother's were fully aware of the importance of the care to be taken during feeding with respect to the cleanliness of the bottle and rubber nipples, temperature of the milk, disadvantage of air bubble formation, the way in which the infant is to be held during feeding and the importance of washing infants mouth after feeding.

II. Nutritive value of the banana based supplementary food.

While preparing banana based supplementary food 33 grams of sugar for every 100 grams of multimix was added to enhance the taste . Nutritive value of the banana based supplementary food was calculated using the Food Composition Table of ICMR (1989).

Table-10

Nutritive value of the banana based supplementary food (100 grams)

Food items included.	Qty (gms)	Calories. (K.Cal)	Protein (gm)	Calcium (mg)	Iron (mg)	Vitamin.A (I.U)	Vitamin C (mg)
Banana	20	30.6	0.26	2.0	0.12	0	0.2
Sesame	14	78.8	2.56	203	1.47	2.1	-
Horsegram	20	64.4	4.4	57.4	1.68	0.36	0.2
Skim milk powder	13	46.4	4.9	178.1	0.182	-	0.65
Sugar	33	131.34	0.033	3.96	-	-	-
Total	100	351.5	12.2	444.5	3.5	2.46	1.05

As revealed in the table-10, the banana based supplementary food is found to be nutritious with calories, proteins, and calcium.

III. Acceptability of the banana based supplementary food.

Out of 75 infant's 15 infant's with similar socio-economic and health background were selected for feeding trial and 15 infants of the same socio-economic back ground were selected as control.

Table-11

Age and sex-wise distribution of infants.

Age (Months)	Experimental group			Control group.		
	Male	Female	Total	Male	Female	Total.
Six	8	4	12	8	4	12
Seven	1	2	3	1	2	3
Total	9	6	15	9	6	15

As revealed in Table-11, 15 infants each selected for the experimental and the control groups were within the age group of six to seven months. In each group 9 infants were males and 6 were females.

During the seven to ten day pre-testing period, all the infant's identified for the feeding trial were given the banana based supplementary food to test its acceptability. mother's were also given training to prepare the porridge with hot water into semisolid consistency the mother's were permitted to taste the porridge and feed the infants. From the observation of the investigator, it was seen that, though during the first two or three days, all did not consume the food completely, by the end of the week they were found to consume the entire quantity.These observations were good proof for the acceptability of the banana based supplementary food.

IV. Conduct of the feeding trial.

Feeding trial was conducted at the anganwadi centre adjacent to the institution.

The infants were given banana based supplementary food for six days in a week and the trial was carried for a period of six months.

Table-12

Attendance of the infants of the experimental group

Particulars.	Sex			
Attendance (100 percentage)	Boys		Girls	
	Number	Percent	Number	Percent
90-99 percent	8	88.8	5	83.3
80-89 percent	1	11.2	1	16.7
Total	9	100	6	100

As depicted in the table-12, majority of the infants had attended the feeding trial regularly.

Table-13

Average daily intake of banana based supplementary food given to the infants during feeding trial

Period of study.	Bodyweight in range (Kg)	Mean body weights of infants (Kg)	Quantity of banana based supplementary food given (gm)
1	6.0-7.5	6.7	35.5
2	6.5-8.5	7.4	39.7
3	6.8-9.3	8.2	43.2
4	7.5-9.8	8.7	46.1
5	8.3-9.8	9.1	48.4
6	9.3-10.5	9.7	51.5

As revealed in the table-13, the average daily intake of the banana based supplementary foods was directly related to the body weight of the infants.

The contribution of banana based supplementary food, in meeting the protein calorie requirement of the infant in the initial period was worked out and details are presented in Table-14.

Table-14

Contribution of banana based supplementary food, in meeting the protein calorie requirement of the infant

Particulars	Nutrients available from banana based supplementary food (35.5g)	Requirement of infants as per RDA	Percentage met from banana based supplementary food
Calories (K.cal)	124.9	637	19.6
Protein(g)	4.3	11.1	38.7

As revealed in the Table-14, 19.6 percent of calorie requirement and 38.7 percent of protein requirement of the infants are met from banana based supplementary food.

V. Growth pattern of infants

Infants of the experimental as well as control groups were weighed and their crown heel length (Height) were recorded regularly everymonth through out the experimental period. The head and chest circumference and mid arm circumference were also measured initially and regularly there after for the experimental period.

Mean weights, and heights of infants of the experimental group and control groups in the beginning of the feeding trial are presented in (Table-15), it revealed

that the mean heights and heights of the infants belonging to the experimental group, were on the higher side, when compared to the control groups.

Table-15

Initial mean weights and heights of infants of the experimental and control groups

Anthropometric measurements.	Experimental group No=15		Control group No=15	
	Male N=9	Female N=6	Male N=9	Female N=6
Height (Cms)	64.3	63.6	62.5	63.3
Weight (Kg)	6.3	6.1	6.1	6.1

Anthropometric measurements taken at the final month of the experiment of the two groups were compared with the internationally accepted standards. A comparison of height and weight data of the infants belonging to two groups with the NCHS standards as detailed in the table-16, had depicted that the heights and weights of the infants of both sexes belonging to the experimental group were better than those of infants included in the control group. Compare to male infants, female infants, in the two age groups, had obtained higher values for weight and height except in the case of female infants in 6 months category with regard to weight.

Table-16

A comparison of Height and Weight of infants of the experimental and control groups with NCHS standard

Months	Parameters	Experimental group	Standard value (cms and Kg)	Control group
Six (male)	Height (cms)	69.6 (91.5)	76.1	66.5 (87.3)
	Weight (Kg)	9.8 (96.1)	10.2	8.03 (78.7)
Seven (male)	Height (Cms)	70 (90.7)	77.2	62.5 (80.9)
	Weight (kg)	9.5 (100)	9.5	7.5 (78.9)
Six (female)	Height (cms)	68.3 (91.9)	74.3	67 (90.1)
	Weight (kg)	9.6 (92.3)	10.4	8 (76.9)
Seven (female)	Height(cms)	71.4 (94.5)	75.5	66.6 (88.2)
	Weight (Kg)	9.8 (100)	9.8	8.4 (85.7)

Numbers in parentheses denotes percentage

An evaluation of weight and height for age is considered as useful one for determining prevalence of malnutrition. Indicators developed by the Indian Academy of paediatrics (1987) was used for comparison.

Table-17

Nutritional evaluation of infants belonging to the experimental and control groups (weight for age)

Grades of Malnutrition	Details	Experimental group No=15		Control group No=15	
		Initial	Final	Initial	Final
		Number	Number	Number	Number.
Grade-I	71-80% weight for age	7 (46.7)	-	9 (60)	5 (33.3)
Normal	Above 80% weight for age.	8 (53.3)	15 (100)	6 (40)	10 (66.7)

Numbers in parentheses denotes percentage.

From the table-17, it is clear that on completion of the experimental period all the infants in the experimental group were falling under normal category, while 66.7 percentage of infants under control group were in normal category. However before starting the experiment, 46.7 percent of infants in the experimental group and 60 percent of infants in the control group were identified under Grade-I malnutrition.

Table-18

Nutritional evaluation of infants belonging to the experimental and control groups (Height for age)

Grades of Malnutrition	Age of the infants (Months)	Experimental group No = 15				Control group No = 15			
		Male		Female		Male		Female	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final
Normal	6	5 (33.3)	8 (53.3)	4 (26.7)	4 (26.7)	3 (20)	5 (33.3)	2 (13.3)	4 (26.7)
	7	1 (6.7)	1 (6.7)	2 (13.3)	2 (13.3)	–	–	2 (13.3)	2 (13.3)
Short	6	3 (20)	–	–	–	5 (33.3)	3 (20)	2 (13.3)	–
	7	–	–	–	–	1 (6.7)	1 (6.7)	–	–

Numbers in parentheses denotes percentage

Data pertaining to the nutritional evaluation of infant's belonging to experimental and control groups on the basis of height for age is presented in table-18. Mc.Laren's classification (1987) is used for comparison.

From the table-18, it is evident that the percentage of normal infants were more in the experimental group compare to control group in the initial stage of the experiment. However, irrespective of the group, number of infants identified under "Short" was reduced on completion of the experiment.

Waterlow's classification, based on these two indices, were expected to give a picture of the type of malnutrition present. Hence the data of the two groups were compared with the standards suggested by Waterlow (1987).

As revealed in the table-19, all the infants in the two groups were found to be normal.

Table-19

Type of malnutrition present based on Waterlow's classification

Sex	Grades of Malnutrition	Experiment group No=15		Control group No=15	
Male	Normal	9	(60)	9	(60)
Female	Normal	6	(40)	6	(40)

Numbers in parentheses denotes percentage

Body mass index of the infants belonging to the two groups were worked out and the details are presented in Table-20. The data is presented in Appendix-V.

Table-20

Weight/Height^2 ratio of the infants belonging to the experimental and control group

Grades of malnutrition	Experiment group No=15				Control group No=15			
	Initial		Final		Initial		Final	
	Number	percent	Number	percent	Number	percent	Number	Percen
Normal (>0.0015)	11	73.3	15	100	12	80	15	100
Moderate malnutrition (0.0013-0.004)	4	26.7	-	-	3	20	-	-

As revealed in table-20, 26.7 percent of the infants of the experimental group and 20 percent of the control group were depicting symptoms of moderate malnutrition. On completion of the experiment all the infants in the two groups were found to become normal.

The anthropometric measurements suggested for ascertaining the amount of subcutaneous fat present as an

indicator of calorie reserves in the body,and comparision with ICMR standards (1989) is included in the Table-21.

Table-21

Comparison of Head, Chest and Mid arm circumferences of infants in experimental group and control groups with standard values the age groups of (6-7 months)

Parameters	Sex	Expriment group	Standard value	Control group
Head circum-ference	Male	44.5	47.1	42.9
	Female	43.9	46.9	43.0
Chest circum-ference	Male	47.1	47.8	43.9
	Female	45.3	47.5	43.6
Mid arm circum-ference	Male	16.0	14.0	13.5
	Female	16.6	13.5	13.3

As revealed in the table-21, the experimental group had higher values for all the anthropometric measurements.

Mean values of anthropometric parameters in the experimental group of 6-7 months was compared with ICMR standards and was statistically tested for its significance and the details are presented in Table-22.

Table-22

Mean values of Anthropometric characters in the Experimental group of infants of the age group of 6-7 months

Parameters	Sex	Experiment group	Standard value	t-value
Head circumference	Male	44.5	47.1	6.54*
	Female	43.9	46.9	8.57*
Chest circumference	Male	47.1	47.8	1.01*
	Female	45.3	47.5	2.60*
Mid arm circumference	Male	16.0	14.0	4.62*
	Female	16.6	13.5	7.85*

* Significant at 5 percent level

As revealed in the Table-22, all the anthropometric parameters were significantly lower than that of ICMR standards.

Head circumference/Chest circumference ratio and Mid arm circumference/Head circumference ratio were worked out with the above anthropometric measurements and the details are presented in tables 23 and 24. The data are presented in Appendix VI and Appendix VII.

As revealed in Table-23, the initial stage of the experiment, 13.3 percent and 33.3 percent of the infants belonging to the experimental and control groups respectively were malnourished. On the completion of the

Table-23
Head / Chest circumference ratio

Groups	PARTICULARS			
	< 1 normal		≥ 1 malnourished	
	Number	Percent	Number	Percent
Experiment				
Initial	13	86.7	2	13.3
Final	14	93.3	1	6.7
Control				
Initial	10	66.7	5	33.3
Final	11	73.3	4	26.7

Table-24

Midarm circumference / Head circumference ratio

Groups	PARTICULARS									
	≥ 0.35 Obese		0.31-0.34 Normal		10.28-0.30 Mild malnutrition		0.25-0.28 Moderate malnutrition		≤ 0.25 Severe malnutriton	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Experiment										
Initial	4	26.7	5	33.3	5	33.3	1	6.7	-	-
Final	10	66.7	5	33.3	-	-	-	-	-	-
Control										
Initial	-	-	4	26.7	11	73.3	-	-	-	-
Final	-	-	11	73.3	4	26.7	-	-	-	-

experiment, many of the infants became normal and the percentage was reduced to 6.7 percent in the experimental group and 26.7 percent in the control group.

As revealed in the Table-24, 33.3 percent of the infants in the experimental group and 73.3 percent of the infants in the control group were found to suffer from mild malnutrition. One infant in the experimental group was depicting the symptoms of moderate malnutrition. On completion of the experiment all the infants in the experimental group became normal while in the case of control group many of the infants (26.7 percent) remained in the mild malnutrition state.

Data on the mean increase in anthropometric parameters of infants of the two groups for all the deviations viz ; Weight, Height, Head circumference, Chest circumference and Mid arm circumference were statistically treated and the details are presented in Table-25 and the individual values are given in Appendix VIII and IX.

Table-25

Mean Anthropometric measurements of infants of the experimental and control groups

Parameters	Groups	Mean	SD	t-value
Weight (Kg)	Experiment	9.7	0.33	19*
	Control	8.03	0.42	
Height (Cms)	Experiment	69.5	1.38	5*
	Control	66.3	3.2	
Head circumference (Cms)	Experiment	44.4	1.1	3.7*
	Control	42.4	2.5	
Chest circum - ference (Cms)	Experiment	46.3	2.3	1.9^{NS}
	Control	43.8	2.6	
Mid arm circum- ference (Cms)	Experiment	16.2	1.2	9.6*
	Control	13.3	1.1	

* Significant at 5 percent level

NS Not Significant

As revealed in the Table-25, there was a significant increase in the anthropometric measurements such as weight, height, head circumference and midarm circumference at 5 percent level. However chest circumference measurements did not indicate a significant variation.

The anthropometric measurements recorded for six months for the infants of the experimental group alone were statistically treated to find out the impact of the supplementary food on the health status of the infants.

Table-26

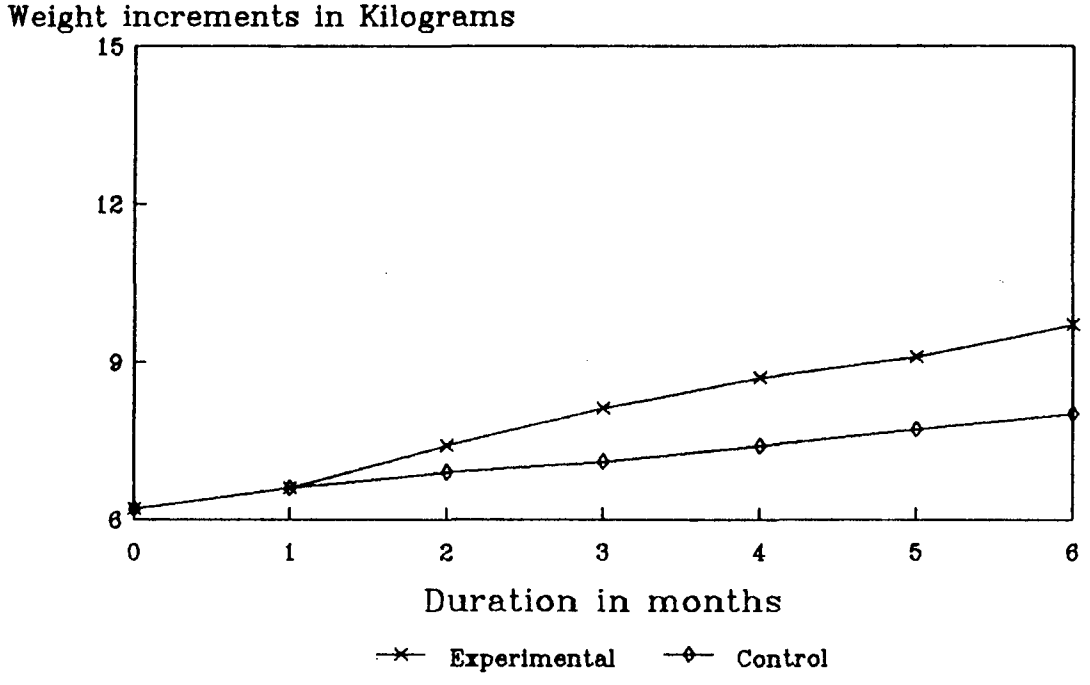
Influence of the banana based supplementary food on the anthropometric measurement of the infants of the experimental group

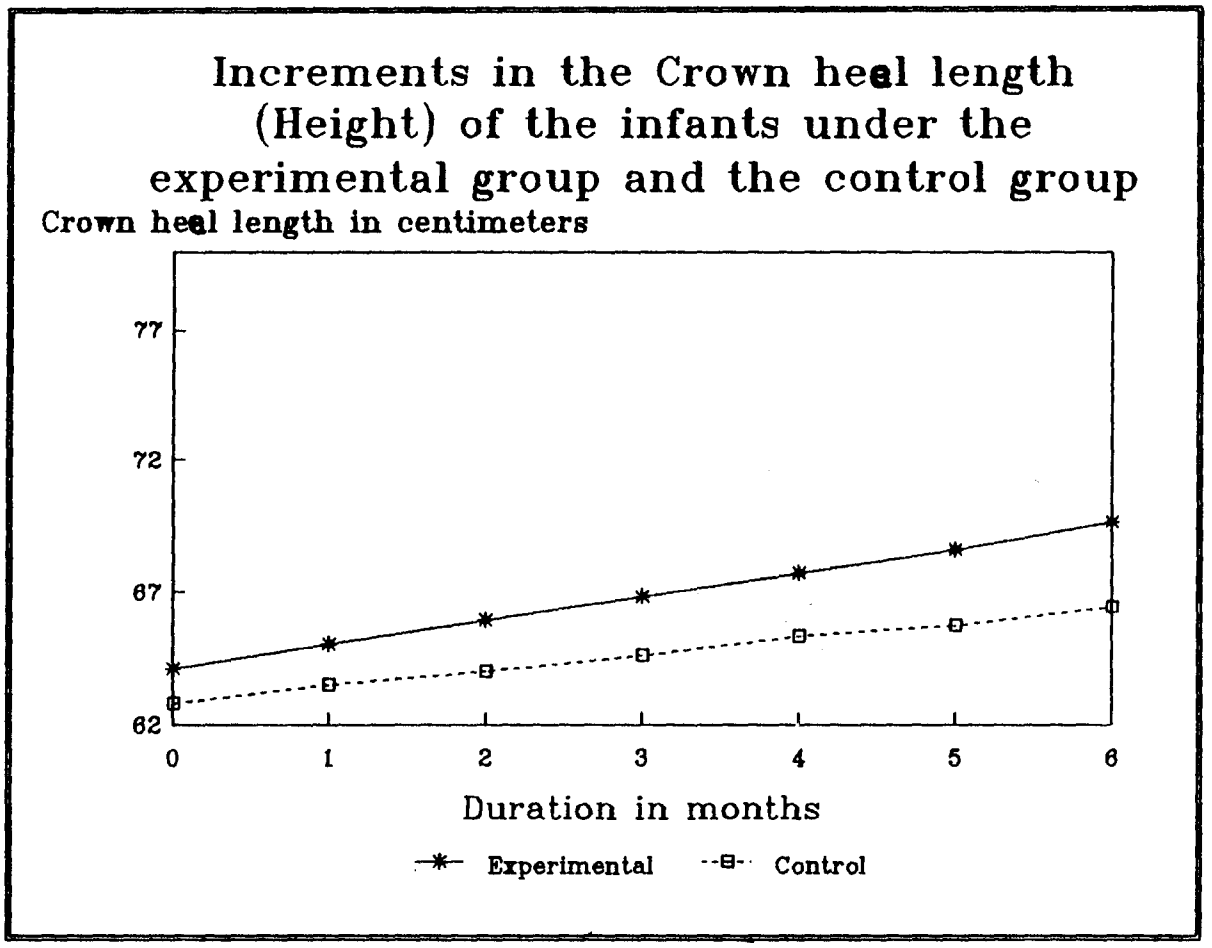
Parameters	Experimental group		
	Mean ($\bar{d}$)	SD	t-value
Height (Crown heel length)	5.4	0.67	29.8*
Weight	3.4	0.21	59.9*
Head circumference	2.8	0.86	12.04*
Chest circumference	2.4	0.65	13.7*
Mid arm circumference	2.8	0.83	12.5*

Significant at 5 percent level

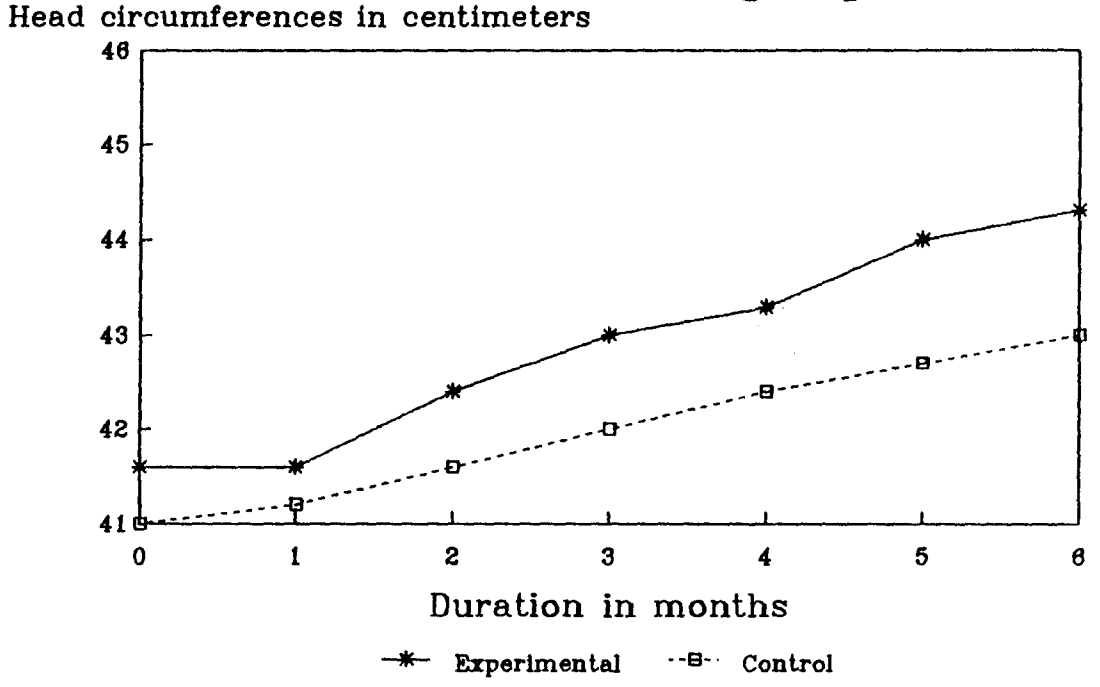
As revealed in the Table-26, all the anthropometric measurements such as height, weight, head, chest and mid arm circumferences were found to be significantly increased during the 6 months of the experimental period. Figures 1 to 5 further explains the progress attained.

Increments in the Weight of the infants under the experimental group and the control group

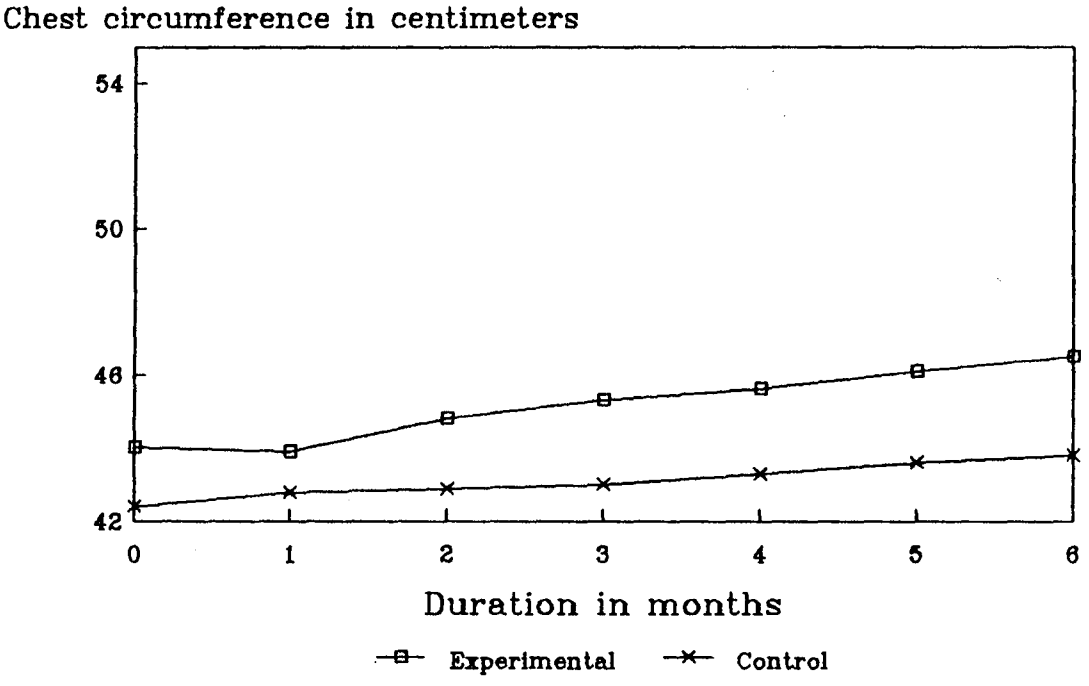



Increments in the Crown heel length (Height) of the infants under the experimental group and the control group
Crown heel length in centimeters
77
72
67
62
0
1
2
3
4
5
6
Duration in months
Experimental
Control

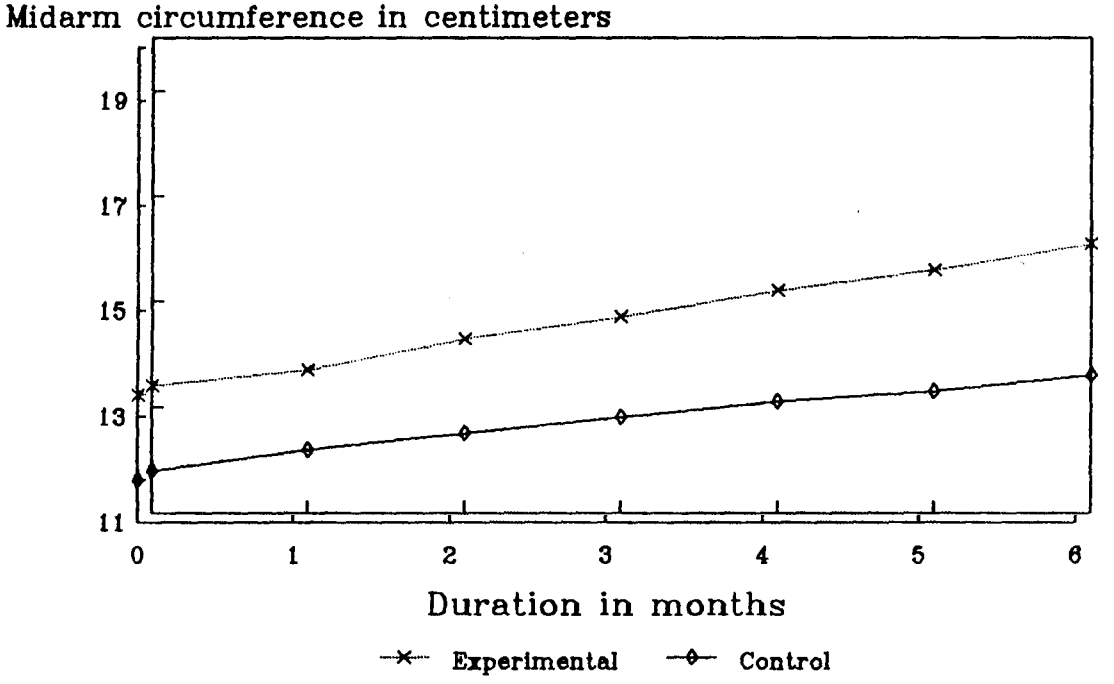
Increments in the Head circumference of the infants under the experimental group and the control group



Increments in the chest circumference of the infants under the experimental group and the control group



Increments in the Midarm circumference of the infants under the experimental group and the control group



The nutritional status of the experimental group was ascertained on the basis of the increase achieved by each infant for the five anthropometric measurements monitored.

Table-27

Nutritional status of infants of the experimental group

Group	Number	Mean($\bar{d}$)	SD	t-value
Experiment group	15	30.7	4.96	22.9*

* Significant at 5 percent level

As presented in the Table-27, there is a significant increase at 5 percent level in the nutritional status of the experimental group on the basis of the progress attained for all the five parameters.

The clinical assessment of the infants belonging to the two groups were conducted in the beginning of the experiment.

Table-28

Initial clinical status of two groups of infants

Clinical signs	Groups			
	Experiment(No=15)		Control (No=15)	
	Number	Percent	Number	Percent
Sparse hair	4	26.7	10	66.7
Discolouration of hair	3	20	9	60
Oedema	5	33.3	10	66.7
Anaemia	15	100	15	100
Cheilosis	2	13.3	11	73.3

As presented in the Table-28, clinical signs prevalent among the infants in the two groups, were sparse hair, discolouration of hair, oedema, anaemia, and cheilosis. Compared to the infants in the control group, the experimental group of infants were heal and less number were affected by these clinical signs. However all the infants in the two groups were having anaemia.

The clinical examination was conducted each month for the infants of the experimental group.

Table-29

Initial and final clinical status of experimental group of infants

Clinical signs	Experimental group (No=15)			
	Initial		Final	
	Number	Percent	Number	Percent
Sparse hair	4	26.7	-	-
Discolouration of hair	3	20	-	-
Oedema	5	33.3	-	-
Anaemia	15	100	4	26.7
Cheilosis	2	13.3	2	13.3

As revealed in Table-29, the clinical signs such as sparse hair and discolouration of hair were completely disappeared. The prevalence of anaemia and cheilosis though present were observed only in less number.

DISCUSSION

DISCUSSION

The study on the Impact of Banana Based Supplementary food on the nutritional status of infants is from certain observations made among a group of infants who were fed a banana based supplementary food for six months. Supplementary feeding pattern introduced to infants is found to be influenced by socio-economic background of a family. Hence information related to the socio-economic and dietary background of selected families (75) were also collected prior to the conduct of the experiment.

Families surveyed were selected from the under previlged section of the community belonging to two major religions namely Hindus and Christians. As per records of 1981 Census, families belonging to the under previlged section of the community were invariably large families with less education and the findings of the present study is also inline with the above observation.

The present study further reveals that the education level of women, in general, were lower than that of their male counterparts in the family and this observations also is inline with the findings of earlier studies conducted (Vijayanunni, (1982); Suja Thomas, (1989); Sandhya,(1989) and Sujatha,(1990)

An analysis of the composition of the family surveyed had revealed that child population is more when compared to the adult population. Similarly the female population is comparitively greater than the male population. The studies conducted among the rural families in Trivandrum district by (Suja Thomas, 1989; and Lysamma Cherian; (1992) had also depicted similar observations.

The economic status and size of the family were found to be two factors influencing the health status of its members and the allocation of income for various household expenditures. Studies conducted by [Florence Verghese, (1989); Nagammal,(1989) SujaThomas (1989) had also noted similar relationship.

Surveys conducted in different States in the country by Rao and Gopalan (1971) had indicated that the percentage expenditure on food will increase as the income level of the family decreases. Similarly studies conducted by (Florence Verghese, (1989); Leena, (1990) had revealed that large families were found to spend comparitively less amount for various food items when compared to small families, even though both these families belong to similar socio-economic background. These observations were noted in the present study also.

Surveys conducted by NNMB (1984) in Kerala had depicted that the rural families in our state are not in the habit of including all the food components specifically required for a balanced diet. Families surveyed in the present studies were also found to include only cereals and fish as essential ingredients in their daily menu. The frequency of the use of vegetables, roots, fruits, and coconut were also varying according to the type of daily menu. Food substances like green leafy vegetables and pulses were found to be included only occasionally. Nagammal, (1989);Sujatha, (1990); Lysamma Cherian, (1992) also observed similar trends in the dietary pattern of the families of agricultural labourers and families engaged in stone breaking on contract basis.

Information collected on the infant feeding practices in the present study revealed that prolonged breast feeding and late introduction of supplementary foods during infancy were the customs of their families. The infants were found to be given feedings with long intervals. According to Srikantaya,(1983) signs of malnutrition begins to manifest during the late infancy period and ultimately resulted in long term deficiency in physical, mental and total development of our children. World Health Organisation (1984) has reported that increase in infant malnutrition is mainly due to the poor infant feeding

practices. Chaudhary (1984) had also stated that energy intake of infants are inadequate due to decreased intake of human milk with an insufficient intake of complementary foods. Nazeema Beevi (1989) has reported that dietary inadequacies due to poverty, non availability of food and ignorance are the main causes of infant malnutrition. In a survey conducted among rural families in Trivandrum district, she has observed that these infants are often weaned from breast to a predominantly starchy adult diet and are thus predisposed to malnutrition and high mortality.

Weaning is a process in which infants are gradually shifted from liquid foods like breast milk and substitute milk preparations to cooked solid foods (Geervani,1983). As observed in the present study during weaning period, all types of adult foods are introduced in the infant's dietary regimen. Animal foods, spicy foods and pulses were found to be eliminated in their dietary pattern.

Bhandari and Mandowara (1985) have reported that prevalence of infant mortality is mainly due to prolonged breast feeding practices coupled with delayed and inadequate food supplementation. As Devadas (1983) has pointed out supplements are introduced only in the second year due to the belief that other foods are not essential as long as the child receives breast milk. Devadas and coworkers (1983)

had also shown that breast milk can sustain growth and development only till 4 to 5 months of life beyond which in the absence of supplementation growth slows down and malnutrition results.

The solution for the problem of infant malnutrition therefore lies in supplementation or weaning ie; the process of getting the infant gradually accustomed to the full adult diet (Dube, 1986)

In a supplementary feeding, protective foods of animal origin such as milk, meat, fish and egg are expensive and beyond the reach of the common man. Hence the infant malnutrition can be solved by the judicious use of inexpensive local foods and the nutritional status of the infants could be improved considerably if the mothers could be persuaded to feed their infants larger quantities of food available especially cereal legume formulation.

The present study is also an endeavour to introduce a banana based supplementary food, which satisfies the requirements of weaning mix, in the infants diets. The weaning recipie is found to be with the derived characteristics of high nutrient density, low bulk property low cost and locally available foods, processed by traditional methods which can be easily adopted at the home.

The feeding trial was conducted for six months on fifteen infants, nine males and six females. The banana based supplementary food (35.5 grams to 51.5 grams) was fed to every infant for six days in a week. Majority of the infants were found to be very regular in attending the feeding programme. The banana based supplementary food added about 124.9 calories and 4.3 grams of protein, meeting 19.6 percent of calorie requirement and 38.7 percent of protein requirement of the infant. An equal number of infants with similar body measurements were grouped as control samples. Studies conducted by Bhandari and Mandowara (1985) have reveaed that adequate supplementary feeding started at the appropriate month (4 to 6 months) providing required calories, vitamins and minerals promoted growth in normal infants.

Normal nutrition implies regular continuous growth. The growth chart is a very good tool as proof monitor of growth and identifies growth faltering, the earliest sign of inadequate nutrition as visible to mother and the health worker. In the past 5 to 10 years growth monitoring has become one of the most attractive nutritional and health measurements amongst primary health care activities.

So in the present study, regular measurement of growth was ensured by ascertaining the variation in anthropometric measurements such as weight, height, chest, head and mid arm circumferences. Both age dependent and age independent criteria were considered while assessing the growth status of the infant. Moreover it was realised that significant differences in growth were not likely to emerge between the experimental and control groups of infants for a relatively brief period of 24 weeks. Hence the anthropometric data were subjected to more than one type of statistical analysis to establish the extent to which maintenance of growth achieved in the experimental group.

The most popular age dependent criteria are weight for age and height for age. A comparison between experimental and control groups revealed 100 percent shift for weight for age from Grade I Malnutrition to Normal state in the case of experimental group. In the case of control group the shift was at a slower pace. By the end of 6 months, 33.3 percent of infants were remaining in the Grade I malnutrition stage. According to Scrimshaw, et al. (1967); Nelson, (1969) and Christakis, (1972) deviations in weight for age are considered to be the most sensitive indicators of an infant's and a toddler's growth performance and nutritional status. In the present study even though there is no significant difference in the rate of

progression or regression of weight for age in both the groups, significant difference was observed on earlier studies conducted to ascertain the impact of feeding programmes, (Hofvander and Eksmyr, (1971); and National Institute of Nutrition, (1969). In the Poshak project, after seven months study the increase in weight for age was not significant (Gopal Das, et al. 1975). In the present study all infants belonging to the two groups were in the category of "Progressed". Jelliffe (1966) has pointed out that a shift in weight for age is a better guide in assessing the nutritional status than absolute weight increments which vary individually with age. Bearing this in mind, the nutritional status of each infant in the present study was assessed by observing the change which had occured in his weight for age during the study period and the infant was classified according as per the norms suggested by Gopal Das (1983) If a child's weight was 60 percent of ICMR standard for his age at the beginning of the experiment and if he had gained enough to weigh more than 65 percent of the ICMR standard for his age, he was considered to have progressed. If he weighed between 55 and 65 percent of the standard he was considered to have remained stationary. If at the end of the study he weighed less than 55 percent of ICMR standard he was considered to have regressed.

Similarly an assessment of height for age also revealed similar trends with slight variation. Except three male infants, all the infants in the experimental group were shifted to Normal condition on completion of the experiment. In the case of control group, more than 13.3 percentage of infants did not reach normal condition even after six months. According to ICMR, (1972), Gopaldas et al (1975), Scrimshaw et al.(1967) National Institute of Nutrition, (1973), and Swaminathan, (1973); a well accepted procedure for evaluating the impact of supplementary feeding is to measure absolute weight gains and significant growth differences in the intervened target group as compared with age matched non intervened controls. In the present study there was significant increase in all anthropometric measurements except chest circumference.

Besides ascertaining the growth measures, type of malnutrition prevalent among the two groups of infants were also ascertained and compared with standards suggested by Waterlow's (1987). However the infants in the two groups were found to be normal. According to Visweswara Rao and Singh, (1970); weight in Kg divided by Height in Cm^2 ratio is normally about 0.0015 + or - 0.0001 for infants. The ratio is reduced if the weight of the infant decreases to a greater extent in proportion to his height. If the ratio falls below 0.0013 it indicates the presence of low weight

for height or under nutrition. When the ratio of weight/height^2 was applied in the present experiment, trends similar to those for height alone were seen.

Besides the age dependent criteria,age independent criteria like weight / height^2, head circumference, chest circumference, midarm circumference/ head cirucumference were also ascertained.

Measurement of head circumference, chest circumference, and midarm circumference may reveal the protein and calorie deficiency state of the infant reflecting indirectly on the body constitution with reference to fat content in the soft tissues. Data on initial and final assessment further strengthens the point that infant who are mildly malnourished in the beginning of the experiment became normal on completion of the experiment.

A comparison of the morbidity status of the infants of the two groups had also depicted lowest number of episodes among the infants belonging to the experimental group. The clinical symptoms related to PEM were detected among the two groups in the beginning of the experiment. Clinical assessment conducted through out the experimental period revealed a remarkable reduction in the morbidity state of the infant except for anaemia and cheilosis.

The six month feeding trial on selected infants with banana based supplementary food has established the importance of this food mix as a suitable weaning food, which can be safely introduced in the infants' diets during the later part of infancy.

SUMMARY

SUMMARY

A study on the "Impact of banana based supplementary food on the nutritional status of infants" was conducted among infants.

Infant feeding practices are said to be influenced by the socio-economic, cultural background of a community and introduction of newfoods for infants are much influenced by these factors. Hence the socio-economic, and dietary background of the selected families (75) from the same area was ascertained to determine the feasibility of introducing a new supplementary food.

Families surveyed were found to be large ones from the socially and economically under previleged sections of the two major religions like Hindus and Christians. Male members of the families in general were better educated. In these families higher concentration of child population and female population were observed.

Food expenditure was in proportion to the income of these families. Cereals and fish were the common items in their daily menu. Vegetables, roots, fruits and coconut were used more frequently than foods like green leafy vegetables and pulses. Infants were devoided of all types of adult foods, animal foods and too spicy foods.

An assessment of the infant feeding practices revealed prolonged breast feeding, a late introduction of supplementary foods, and long intervals between feeds, and an urgency for the introduction of nutrition lowcost supplementary food in the infants diets.

The banana based weaning food used in the present experiment is highly nutritious one with 351.8 calories and 12.1 proteins/100 gram and which can be prepared at the household level. It is composed of bananaflour, sesame, horsegram and skim milk powder in the proportion of 30:20:30:20. The feeding experiment was conducted for 6 months with 15 infants in the experimental group and 15 infants of similar were selected as control. During the six months period the health status of the infants were ascertained through periodical monitoring of weight, height, chest, head, and mid arm circumferences.

Infants of both sexes belonging to the experimental group were better than those of control group with regard to their heights and weights. Evaluation of weight for age and height for age of the two groups revealed a shift from Grade-I malnutrition to normal. However, in the control group a shift was at a slower pace.

An assessment of weight/height^2 ratio of the infants of the two groups revealed better health status in all the case of the infants belonging to experimental group.

Data on Head/Chest circumference ratio, the Mid arm circumference/Head circumference ratio also indicated an improvement in the health status after the experiment.

A comparison of the two groups on all anthropometric measurements revealed that the improvement in mean height, crown heel length, head and mid arm circumferences of the infants of the experimental group were significantly better than that of their counter parts in the control group.

Clinical examination of the infants of the two groups were conducted intially and the medical check up for experimental group infants were periodically conducted during the experimental period. The results indicated that clinical symptoms such as sparse hair, discolouration of hair, oedema, anaemia, and cheilosis were present in the beginning in the two groups. After the experiment in the experimental group these many of the clinical symptoms completely disappeared except anaemia and cheilosis. However, the percentage of infants affected by these symptoms were reduced after the experiment.

Hence it can be concluded that the banana based supplementary food used as the feeding experiment of the present study can be recommended as a supplementary food for infants during weaning period.

REFERENCES

REFERENCES

Ahmed,R.V;Lowgreen, M; Veladrde,N and Abrahamson,L (1981).Study on home prepared weaning foods for consumption in Bangladesh with special reference to protein quality. Etiology of food and nutrition.11(2):93-102.

Ali, A (1982). Diet pattern and nutritional status of the Hill Bhuniyas - A primitive tribal of Orissa. A report on the workshop as child nutrition in tribal areas. Jabalpur. 21(24):100-127.

Beegum,J and Prema, L (1984). Impact of a campaign on better infant feeding practices conducted at Kayamkulam and Sherthala municipalities. M.Sc.Diploma (FS&N) dessertation submitted to the KAU,Vellayani, Trivandrum. 90.

Bhandari,B and Mandowara,S.L (1985).Evaluation of delivery of nutrition and health services in an ICDS Block. Indian Paediatrics. 22.579-582.

Bhargava,I (1983). Integrated approach to maternal and child health and family planning.Indian Paediatrics. 20(6): 395-400.

Bhaskaran (1981). Nutrition Blindness in nutrition disabilities, NIN,ICMR.21.

Bhat,C.Mand Dahiya,S(1985). Nutritional status of pre-school children in Gangwa village of Hissar district. Strategies to overcome. The Indian Journal of Nutrition and Dietetics. 22.206.

Burnabes,G(1982). Nutrition and child care amongst Ethopian refugees in Eastern Sudan. Journal of Tropical Paediatrics. 21(4):120.

Bushra,R;Baquer,K.S and Ataur,R.M(1983) Evaluation of protein rich vegetable food from indigenous sources on a weaning food.Asian Journal of Clinical Sciences.4(1):57-66.

Census series of Kerala(1981). Women in Kerala,S.G.P.Press, Government of Kerala, Trivandrum.89.

CFTRI, Mysore(1970). Report of a workshop on weaning foods.88.

CFTRI, Mysore (1974). Report of a workshop on weaning foods.35.

Chanda,R (1980). The Integrated Child Health Schemes. An integration of a pre-school nutrition programme with health education services.The Indian Journal of Nutrition and Dietetics17:84-87.

Chandra,P and Puspavally Thayar.T (1985).Nutrition Assessment in ICDS Project IX, Madras (urban) presented in proceedings of the Annual Conference of Women Doctor's Association of Tamil Nadu and Pondichery.41.

Chandrasekhar,U and Kanjana,C (1975).Evaluation of protein quality of a mix based on sunflower meal through rat assay and growth studies. The Indian Journal of Nutrition and Dietetics. 13.135.

Chandrasekhar,U;Nandini,S and Devadas,R.P (1976). Protein quality and acceptability of CARE'S. Kerala Indigenous Foods. The Indian Journal of Nutrition and Dietetics.13(1):82.

Chandrasekhar,U;Bhooma, N and Reddy, S (1988). Evaluation of malted weaning foods. The Indian Journal of Nutrition and Dietetics.25.37-43.

Changari,K.J;Tidar,A.L;Parvez,I and Sanuna,M.(1983). Nutritional and organoleptic evaluation of wheat bread supplemented with peanut flour.Pakisthan Journal of Scientific and Industrial Research.26:87-90.

Chaudari,R.N(1964). Home made vegetable protein food in the treatment of Kwashiorkor,Journal of Indian Medical Association.42(5):40-50.

Chaudary, R.H(1984). The duration of breast feeding adequacy in a rural area of Bangladesh. Food And Nutrition Bulletin. 6(1)44-49.

Chen,L.C;Chaudhary,A.K.Mand Huffman,S.L (1978). Classification of enrgy-protein malnutrition by anthropometry and subsequent risk of mortality. International Centre for diarrhoeal disease research, Dacca, Bangladesh. 24.

* Christakis,G (1972).Nutritional Assessment in Health programmes 38. Based on Proceedings of the Conference on Nutritional Assessment held on Oct.18-20 and sponsored by the American Public Health Association,INC.81.

Christian Medical College , Ludhiana (1986). A longitudinal study of morbidity in children in a rural area of Punjab. Indian Journal of Paediatrics. 47 :217-219.

Deborah,A;Zachariah,P.B.S and Cowan,B (1986). Limitations of a comprehensive Health care programme in combating malnutrition in an urban slum area in Punjab,India. Department of Christian Medical College and Brown Memorial Hospital, Ludiana (Punjab). Indian Paediatrics.10(1):18.

Desikachar, H.S.R (1983). Production of weaning foods suitable for mass production and consumption in developing countries. Report on weaning foods,UNICEF Regional office for south Central Asia,New Delhi. 118-125.

Devadas,R.P (1971). Strategies to overcome the protein calorie gap.The Indian Journal of Nutrition and Dietetics. 10(8):1-7.

Devadas,R.P (1983). Report of Workshop on weaning foods held at the College of Home Science. APAU,UNICEF.82.

Devadas,R.P (1987). Dietary supplement and vitamin.A nutrition of rural children. The Indian Journal of Nutrition and Dietetics.24(1):342-344.

Devadas,R.P. and Kulandaivel, K (1975). In : Hand book of Methodology Research. Sri. Ramakrishna Mission, Vidyalaya Press, Coimbatore.45.

Devadas,R.P and Geetha G (1986). Prevalence of malnutrition, morbidity pattern and nutritional status of 0-6 years old children in Coimbatore The Indian Journal of Nutrition and Dietetics. 23(3):148-157.

Devadas,R.P and Saroja,S (1987). Dietary supplement and vitamin A, nutrition of rural children.The Indian Journal of Nutrition and Dietetics.24(1):237-244.

Devadas,R.P;Jamala,S;Suha Chandrasekhar and Nirmala.K.Murthy (1971). Nutritional evaluation of maize based indigenous infant food,`Kuzhandai Amudhu'. The Indian Journal of Nutrition and Dietetics.11(5):257.

Devadas,R.P; Murthy,N.K and Roshan,A (1974).Evaluation of a weaning mixture based on local foods. The Indian Journal of Nutrition and Dietetics.11(4):209.

Devadas,R.P;Usha Chandrasekhar and N.Bhooma (1984). Nutrition outcomes of a rural diet supplemented with low cost locally available foods, VIII. Impact on pre-school children from a tribal community. The Indian Journal of Nutrition and Dietetics. 21 :315-321.

Devadas,R.P; Premakumari;S, Geetha G and Aruna.C (1983). Prevalence of nutritional and non-nutritional diseases among 0-6 years old children and their nutritional status. The Indian Journal of Nutrition and Dietetics.20: 1-9.

* Diarra,M.M and Diallo T.F (1989).Methods of weaning infants in Bambara Boze and Peulh ethinic groups in the Samsanding district, Segou Mali Nutrition Abstracts and Review (series.A),60(3):210-213.

Djazafery,A;Barzagar,M.A and K.Keighobadi (1983). Assessment of nutritional status of pre-school children in Mahabad rural areas. Journal of Tropical Paediatrics.29:329-332.

Dube,A.K (1986).Weaning and weaning foods,Nutrition.20(3):23-30.

Dumn,M.E; Rao,B.R.H; Jesudasan, G and Benjamin,V (1967). Indian Multipurpose food and supplemented groundnut protein isolate compared as supplements for pre-school children.The Indian Journal of Nutrition and Dietetics. 8(12):235.

Eastham,E.J; Lichauco,T;Grady,M.S and Allan Walker.W (1978). `Soya-bean'. Journal of Paediatrics. 93:561-56.

Edger Moks (1986). The recognition of new infant health para designs in developing countries. The Indian Journal of Paediatrics.53:741-746.

Elsie Philip,E. (1985). Why infant mortality is low in Kerala. The Indian Journal of Paediatrics. 52 : 439-443.

Florence Varghese (1989). Food consumption and energy expenditure pattern of employed home makers in organised sector in Trivandrum District. M.Sc.(FS&N) thesis submitted to the KAU,Vellanikkara, Trichur (Unpublished thesis).137.

Garg (1981). Ministry of Social Welfare.The Indian child. 28(6):37.

Geervani.P (1983). Present weaning practices, constraints for supplementation and the scope of modifying adult diet for Indian feeding. Report office for South Central Asia,73 Lodhi Estate,New Delhi,52-77.

Ghosh.S (1980). Paediatrics in child health. In profile of the child in India, Ministry of Social Welfare, Government of India, New Delhi.76.

Ghosh.S (1987). Women's role in health and Development. Health for the millions.13(1&2):2-7.

Gopalan.C (1972). Nutrition and Development of Nutrition. The Indian Journal of Nutrition and Dietetics.20 : 4-5.

Gopalan.C (1983), "The Chief Killers in India". Focus on health in Hungry children. A challenge to the world's Conscience.14.

Gopalan.C (1984). Weaning -Concepts and practice, An analysis of the situation of children in India.57.

Gopaldas.T (1983). Effective strategies in young child feeding. Proceedings of 14th international Congress of Nutrition.601-604.

Gopaldas,T;Srinivasan,N;Varadarajan,I;Shingivekar,A.G;Seth,R;Mathur, R.S and Bhargava,V (1975). Project Poshak,Volume-I, CARE India, New Delhi.58.

Govindankutty, V (1984). Children's health tomorrow'swealth, Kerala Medical Journal.25(4&5): 110-113.

Government of India (1983). Infant mortality rates. Indian Journal of paediatrics. 23(6):50-60.

Grant (1986). Nutritional problems of India.Prentice Hall of India Private Limited, New Delhi.28-40.

Grant (1988).The state of World's children. Division of Information and Public affairs,UNICEF House,3U.N.Plaza, New York.2.

Gupta,K.B and Walia, B.N.S (1980). A longtitudinal study of morbidity in children in a rural area of Punjab. Indian Journal of Paediatrics.47(12):217-219.

Gupta,S.K and Kaur, B (1982). Utilisation of potato for weaning food manufacture. Journal of Food Science and Technology. 19 (1):23.

* Hofvander,Y and Eksmyr,R (1971).An applied Nutrition program in an Ethopian rural community. The American Journal of Clinical Nutrition.24(10):578.

ICMR (1970). Gandhigram Institute of Rural Health and Family Planning. Studies on weaning and supplementary foods. ICMR Technical Reports•Series. No.27.48.

* ICMR (1972) Final Report of Rural Health Research Centre, Narangwal. Interactions of Nutrition and Infection. Field Project of the Johns Hopkins University,School of Hygiene and Public Health, Baltimore, Maryland,USA.18.

ICMR (1974). Studies on pre-school children. Report on the working party of the ICMR. ICMR Technical Reports• series.No.26.10.

ICMR (1977), Studies on weaning and supplementary foods, ICMR Technical Reports•Series No.27.12.

ICMR (1980). Nutrition and Community Bulletin of Publication and Introduction, ICMR, New Delhi.10:15.

ICMR (1984). Studies on weaning and supplementary foods. Reports of the working party of the Indian Council of Medical Research, New Delhi.27:18-36.

ICMR (1989), Nutritive value of Indian Council of Medical Research.94.

Inamdar, F (1981). Studies on low cost malted ready-to-eat mixes for pre-school children. Department of Foods and Nutrition,M.S. University, Baroda.38.

Indian Acadamy of Paediatrics,IAP (1987). Growth and development of Indian infants and children, Technicl reports• Series. No.18:41.

Indian Ministry of Health and Family Welfare (1981). Child in India. A statistical profile, Government of India.130.

Indo-Dutch Project for child Welfare (1977). Supplementary foods for combating child malnutrition in India. Food and Village Technology,UNICEF South Central Asia Region, New Delhi.77:33-37.

* Jelliffe,D.B (1966). The Assessment of the Nutritional status of the community. WHO, Geneva, the Monograph Series. No.53:164.

Jelliffe,D.B (1967). Approaches to village level infant feeding. Multimixes as weaning foods. Journal of Tropical Paediatrics.13(1):46.

Jessy Philip (1988). Developing indigenous weaning food based on Banana flour, M.Sc (FS&N) thesis submitted to the KAU, Vellanikkara, Trichur (unpublished thesis).26.

Joginder Singh;Susy Koshy; Agarwal,K.N; Lodha, M.L; Singh, N.N and Seth, A.S.(1980). Relative efficiency of opaque-2 maize in the growth of pre-school children. The Indian Journal of Nutrition and Dietetics.17(9):130.

Kakker,S; Hooda.A; Jain,R; Kapoor,A.C and Vidyasakar (1987). Nutritional status of pre-school children in rural Hisar.The Indian Journal of Nutrition and Dietetics. 24(11):204.

Kamalanathan,G;Devadas,R.P and Karuppiah,P (1974). Supplementary value of leaf protein and groundnut meal in the diet of pre-school children. The Indian Journal of Nutrition and Dietetics.12:(7).203.

Kamalanathan,G ;Nalinakshi, G and Devadas,R.P (1970). Effect of a blend of protien foods on the nutritional status of pre-school children in rural balawadi. The Indian Journal of Nutrition and Dietetics.7(5):288-292.

Kapoor,C. M and Gupta,S.K (1981).Soya-whey weaning food-I Method of manufactue. Journal of Food Science and Technology. 18(2) 55-58.

Kaur,P (1989). Rural Women in Ludhiana (Punjab) Kurukshetra. 337(10):3-5.

Kaur,P and Bhatt,C.M (1979). Effect of supplementary feeding on the nutritional status of pre-school children. Indian Paediatrics.16:1091-1096.

* Kielman,A; Ajello,C and Kielman,N (1982). Nutrition intervention, an evaluation of six studies. Stud.Fam Plann.13:246-257. In Nutritional implications of food aid: an annotated bibliography (1985) FAO, Food and Nutrition Paper.33:26.

Kerala Agricultural University (1983). Suitability of different varieties of banana preparation of banana flour. Research report.137.

* King,K.W; Fougere,W; Foucould,J;Dominique,G and Beghin,I.D (1967). Response of pre-school children to high intake of cereal-bean mixtures. Nutrition Abstracts and Reviews.37:201 & 853.

Koko,U (1987). Children's health:tomorrow's wealth. Indian Journal of Paediatrics. 54(1):33-34.

Krishnamoorthy.V (1983). Gandhigram India-Non formal education some reflection. International Education of Kalaniketan Publishers.1(1):8-10.

Kumar,S (1985), Role of Community participation in care of rural children. Swasth Hind.29(11):268-271.

Kumar,V and Datta (1982).Reduction of Infant Mortality in India. Indian Journal of Paediatrics.49:777-778.

Kumari,S; Preethi,P.K; Mehra,R and Sehgal,M (1985). Breast feeding:Physical growth during infancy. Indian Journal of Paediatrics.52(414):73-77.

Leena.P. Joseph (1990). Influence of dietary habits on Atherosclerosis, M.Sc (FS&N) thesis submitted to the KAU, Vellanikkara, Trichur (unpublished thesis).132.

Luwang,N.C (1980). Protein energy malnutrition among pre-school children in rural Community of Manipur. Indian Journal of Paediatrics. 20(30):100-105.

Luwang,N.C and Singh,P.I (1981). Protein energy malnutrition amongst the underfaces of a hill tribal population of Manipur. The Indian Journal of Nutrition and Dietetics.18(4):139-143.

Lysamma Cheriyan (1992). Food Consumption and energy expenditure pattern of agricultural labourers of Trivandrum District, M.Sc.Home Science (FS&N) thesis submitted to the KAU, Vellanikkara,Trichur (unpublished thesis).131.

Malena,R.N and Mayers,J (1972). Weight,height and limb circumference in American Negro Children.Journal of Tropical Paediatrics and Enviornmental Child Health. 18:280-281.

Mandowara; S.L (1986). Monitoring of Children of Severe grade protein energy malnutrition in ICDS Block, Chhoti Sadri (Rajasthan) unpublished.113.

Mayachaudhary and Viswesara Rao,K (1983).Nutritional status of pre-school children and associated factors. The Indian Journal of Nutrition and Dietetics.20(2):18.

Mayers,J (1972). Human Nutrition.Its physiological, medical and social aspects. Charles,C; Thomas Illinors,U.S.A.257.

Mc.Laren's (1987),Project Poshak, :I,CARE India, New Delhi.58.

Ministry of Home Affairs.Government of India (1983). Infant mortality rates. Indian Journal of Paediatrics. 23(6):20-22.

Ministry of Social Welfare (1981). Report of the working group on production and marketing of infant foods. Government of India.1-27.

Mitzner,K;Serimshaw,N and Morgan,R (1984). Improving the nutritional status of children during the weaning period. A manual for policy makers, programme planners and field workers.2-67.

Nagammal.K (1989). Impact of Ragi based food supplement on the nutritional status of selected pre-school children. M.Sc (FS&N) thesis submitted to the KAU, Vellanikkara, Trichur (unpublished thesis).155.

Nazeema Beevi,P(1989). A study on the Nutritional Status of pre-school children in the Pangappara Health Unit Area. M.D (Community Medicine) thesis submitted to the University of Kerala (unpublished thesis).64.

* Nelson,W.E (1969),Text book of Paediatrics, Ninth edition, W.B.Saunders Company,London.42.

NIN (1969), Field Studies: Effect of dietary supplements on the growth of pre-school children.Annual Report. Hyderabad.100.

NIN (1973). Field Studies: Supplementary feeding programmes for pre-school children, Annual Report,Hyderabad.105.

NIN (1975).Report for the year 1975:8.

NIN (1981). Nutrition News.2(5):12.

Ninave Lata and Shastri,P.M (1987). Study of dietary pattern and effect of low cost supplementary foods as nutritional status of pre-shool children in urban slums community. Proceedings of Nutrition Society of India.33(9):100-106.

NNMB (1975). Report of the year.Community awareness and participation in mid-day meal programme.76(1):18.

NNMB (1984).Average food intake of food stuffs in low income group,Report on urban population ICMR.19-27.

* Nutricion (1989). Improvement of family diet to benefit infants of weaning age.Nutrition Abstracts and Review (Series A).60(5):260.

Oyus.A.Oyeleke (1985). Sorghum-skim milk powder weaning food. The American Journal of Clinical Nutrition.23:749-753.

Pasricha,S (1973). Possible Calorie intake in young children fed ceral based diets. The Indian Journal of Nutrition and Dietetics.10(3):282.

* Popowa,V(1985). Infant foods using cereals as raw materials, Getreide Mehl Brot.39(1):21-23.

Parasannappa,G and Jagannath,K.S (1985). A nutritious food supplement for feeding programme. Nutrition Reports International.31(1):191-197.

Puri,R;Chawla,P and Bhardwaj,M (1983).An evaluation of the supplementary feeding programme sponsored by Indian Council of Child Welfare Chandigarh. The Indian Journal of Nutrition and Dietetics.20(7):226-236.

Rajalekshmi, R (1974). Legumes, Oilseeds. In Applied Nutrition, III Edition, Oxford & IBH publishing company.28.

Ralda,E.D and Wei,L.S (1980).Soya-banana food bar fabrication.ASAE Paper.80(7):6019.

Ramachandran,P (1984). Lactation Studies with relevance to codes. Proceedings of the Nutrition Society of India.33.

Ramalinga swamy (1980). Nutritional changes in the eighties. Swasth Hind.107.

Ramankutty,V;Rema,S and Soman,C.R (1981). Pattern of malnutrition in two undernourished pre-school communities in Kerala. Indian Association of Biomedical Science.1(2):55.

Rao,M.N (1989). Breast feeding and weaning,Proceedings of the Nutrition Society of India.35(8):118.

Rao,D.S.S and Deosthale,Y.G (1983). Mineral Composition for ionisable iron and soluble zinc in malted grains of pearl millet and ragi. Food Chemistry.11:217-223.

Rao,V.K and Gopalan,C (1971).Family size and Nutritional status, Proceedings of the First Asian Congress of Nutrition, NIN. Hyderabad.341.

Ravindran (1979). Reaching the deprived child Social Welfare. 25(10):6.

Ravindran (1984). Villages.The root of malnutrition, Kurukshetra. 33(2):12-14.

Rau,P;Prabhavathi,T and Naidu,A.N.(1975). Acceptability trials with extruded food. The Indian Journal of Nutrition and Dietetics.48(12):320.

Report of the Tamil Nadu Nutrition Project (1973). Nutrition Intervention; A study of 'Take Home' dry food as a distribution System,1, CANTOR/ATAC, Madras.125.

Reynoldo Martorell and Robert.E.Klein (1980).Food supplementation and growth rates in pre-school children. Nutrition Reports International.2(3):447.

Samal,G.C (1984). Infant feeding and rearing practices in a rural community of Western Orissa Indian Paediatrics.21(4): 319-321.

Sandhya,V.Kamath (1989). Influence of Nutritional status on intelligence of children in NES block, Trivandrum. M.Sc(FS&N) thesis submitted to the KAU, Vellanikkara, Trichur (unpublished thesis).108.

Santhi Ghosh (1986). Health for all by 2000-Myth or reality. Indian Journal of Paediatrics.53:691-697.

Satapathy,R.K;Sarangi,B and Das,D.K (1984). A community survey of Infant feeding practices in Berhampur, South Orissa, Indian Paediatrics.21:207-212.

* Scrimshaw, N.S; Ascoli,W; Kevany;Flores,J.J;Iscava,S.J and Gordan,J.E (1967). Guatemalan Villages, 1959-64, III. Field proceedings collection of data and methods of measurement. Archives of Environmental Health.15(6):81.

Semawal,O.P; Seth,V and Pal,M (1986). Impact of urbanisation on infant feeding and weaning in Delhi urban slums. Proceedings of the Nutrition Society of India, NIN, Hyderabad.32(10):139.

Sharma,G and Mridula Mahajan (1987). Biochemical assessment of protein calorie malnutrition. The Indian Journal of Nutrition and Dietetics.24(7):199.

Sheela Prasad (1988). Developing Indegenous Weaning Food Based on Banana flour, M.Sc(FS&N) thesis submitted to the KAU, Vellanikkara, Trichur (unpublished thesis).55.

Shukla,P.K (1982). Nutritional problems of India. Prentice Hall of India Private Limited, New Delhi.28-40.

Singh,J and Shah,K(1990).Protein energy malnutrition The third world syndrome, CARE Magazine.33-35.

Snehalatha,R.N (1985). Effect of varying period of germination on the bioavailablity of iron from Ragi (Eleusine Coracana).Nutrition Reports International.31(3):567-571.

Srikantaya,S.G (1983). Supplementary feeding programmes. Some issues. Proceedings of the Nutrition Society of India.1-27.

Srikantaya,S.G (1989). Aetiology of protein energy malnutrition during childhood and its management. Proceedings of nutrition Society of India.35(14):10-12.

Subbulakshmi,G (1990), High density foods for the prevention of malnutrition. Proceedings of the National symposium cum workshop on child nutrition.113.

Subramaniam,N. (1980). Technology of Vegetable protein foods. Journal of Food Science and Technology.17:71-76.

Suja P.Thomas (1989). Effect of birth order and spacing on the nutritional states of mother and child M.Sc(FS&N) thesis submitted to the KAU, Vellanikkara, Trichur (unpublished thesis).148.

Sujatha,A.S (1990). Food consumption and Energy Expenditure pattern of self employed women in unorganised sector. M.Sc(FS&N) thesis submitted to the KAU, Vellanikkara, Trichur (unpublished thesis).107.

Swaminathan,M,C (1970). Calorie intake of pre-school children when fed ad.libitum. The Indian Journal of Nutrition and Dietetics.7(12):46-57.

Swaminathan,M,C (1973).Evaluation of supplementary feeding programmes of the Nutrition Society of India.15:116.

Swaminathan,M,C(1975). Supplementary foods based an oil seeds for infants and children. Journal of Scientific and Industrial Research. 34(16):329-335.

Swaminathan,M (1985). Advanced text book on food and nutrition. BAPCCO publishers Company.2:551.

Swaminathan,M. (1986). Principles of Nutrition and Dietetics. The Bangalore printing and Publishing Company Limited.339.

UNICEF (1977). Weaning-concepts and practice- An analysis of the situation of children in India.57.

UNICEF (1985). The State of World's children. Division of Information and Public Affairs, UNICEF House, 3 U.N.Plaza, New York.28-40.

UNICEF (1986). Population:less deaths-less births The State of World's children. Division of Information and Public Affairs, UNICEF House, 3 U.N.Plaza, New York.78.

UNICEF (1987). The State of World's children. Division of Information and Public Affairs, UNICEF House, 3 U.N.Plaza, New York.87-102.

UNICEF (1988). Child Survival and Development. Breast feeding. Annual Report. State of World's Children. Division of Information and Public Affairs, UNICEF House, 3 U.N.Plaza, New York.20-30.

UNICEF (1990). The State of World's children. Division of Information and Public Affairs, UNICEF House, 3 U.N.Plaza, New York.19-31.

UNICEF (1991). The State of World's Children. Division of Information and Public Affairs,UNICEF House,3 U.N. Plaza, Oxford University Press.87-102.

Usha,A and Beegum,M (1985). Nutritional status of children attending the U.A.S. School. The Indian Journal of Nutrition and Dietetics.22(7):221.

Venkat Rao,S; Vijalekshmi,D; Somakurian; Prasannappa,G; Chandrasekhar,H.V; Swaminathan,M and Chandrasekhara, H.K (1976). Nutritional value of weaning foods and malted milk powder. Journal of Food Science and Technology.13(4):28-35.

Vijayalakshmy,P; Shanmuga, Saraswathi,P and Devadas,R.P (1975). Nutritional background of selected pre-school children treated in the paediatric out-patient. Department of the Coimbatore Medical College Hospital. The Indian Journal of Nutrition and Dietetics. 12:383-387.

Vijayanunni,M. (1982). Census of India . Series - 10, Kerala Part II - B, Primary. Census Abstract.5-7,12-13.

Vijayaraghavan,K (1987).Anthropometry for assessment of nutritional status. Indian Journal of Paediatrics.57(4):511-520.

Vinodini Reddy (1985). Relationship between diarrhoea and malnutrition. Indian Journal of Paediatrics.52:463-467.

Visweswara Rao,K and Singh.D (1970). An evaluation of the relationship between nutritional status and anthropometric measurements. The American Journal of Clinical Nutrition.23(10):83-87.

Waterlow's (1987). Nutrition Monitoring and Assessment, New Delhi, Oxford Press,Bombay,Calcutta,Madras.185.

* Wharton.B (1980). Weaning and child health. Annual review of nutrition. Nutrition Abstracts and Reviews (Series A). 60:6.

WHO (1979). The health aspect of food and nutrition-Manual for developing countries in the Western Pacific region 3rd edition. 10-20.

WHO (1984). Measuring changes in Nutritional Status,Geneva.3-13.

WHO (1989). State of world's Health in 1989, The Indian Journal of Nutrition and Dietetics.27(2)171-174.

Zerfas,J.A. (1975). The insertion tape. News circumference tape for use in nutritional assessment. American Journal of Clinical nutrition. 28 (7) :782-787.

* Original not seen

APPENDICES

APPENDIX-I

KERALA AGRICULTURAL UNIVERSITY

QUESTIONNAIRE TO ELICIT INFORMATION REGARDING THE SOCIO-ECONOMIC BACKGROUND, FOOD CONSUMPTION PATTERN AND INFANT FEEDING PRACTICES OF THE COMMUNITY. "IMPACT OF BANANA BASED SUPPLEMENTARY FOOD ON THE NUTRITIONAL STATUS OF INFANTS"

SECTION-A

Name of the investigator : ---------- Block:----------

Serial Number : ---------- Panchayat:----------

Place : ----------

1. Name of the respondent (Mother) : ----------

2. Address : ----------

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3. Religion : ----------

4. Caste : ----------

5. Type of family : ----------

6. Occupation of the head of the family : ----------

7. Type of food consumed : ----------

Family Details

8. Total number of members in the family. : ----------

1) Number of adults (above 18 years) : ----------

2) Number of adolescents: (11-17-years) ----------

3) Number of children between(6-10-years) : ----------

a) Male : ----------

b) Female : ----------

4) Number of children between (3-5years) : ----------

a) Male : ----------

b) Female : ----------

5) Number of children below 3 years. : ----------

a) Male : ----------

b) Female : ----------

Occupational Status

9. Number of earning members in the family : ----------

10. Occupation of the head of the family : ----------

11. Occupation of the respondent : ----------

12. Total family income (in rupees per month) : ----------

13. Other sources of income if any : ----------

14. If yes, sources from

1.Agriculture : ----------

2.Domestic animals : ----------

3.Business earnings : ----------

4.Receipts from properties (land, building) : ----------

5.Income from investments : ----------

6.Other earnings : ----------

7.Total income from these sources (in rupees per month) : ----------

Educational Status

15. Father : ----------

16. Mother : ----------

17.Monthly expenditure pattern (in rupees per month)

1.Food : ----------

2.Clothing : ----------

3.Shelter : ----------

4.Education : ----------

5.Health : ----------

6.Transport : ----------

7.Repaying loans : ----------

8.Recreation : ----------

9.Savings : ----------

10.Others : ----------

: ----------

18. Frequency of the use of different food materials

Cereals

1.Rice : ----------

2.Wheat : ----------

3.Rava : ----------

4.Ragi : ----------

5.Maida : ----------

Pulses

6.Bengal gram : ----------

7.Black gram : ----------

8.Cowpea : ----------

9.Red gram : ----------

Roots and Tubers

10.Potato : ----------

11.Tapioca : ----------

12.Yam : ----------

13.Colocasia : ----------

14.Carrot : ----------

15.Beetroot : ----------

16.Other vegetables : ----------

17.Leafy vegetables : ----------

Fruits

18.Banana : ----------

19.Pappaya : ----------

20.Guava : ----------

21.Orange : ----------

Milk and Milk products

22.Milk : ----------

23.Curd : ----------

24.Butter Milk : ----------

25.Butter : ----------

26.Cheese : ----------

Meat

27.Chicken : ----------

28.Mutton : ----------

29.Duck : ----------

30.Beef : ----------

31.Fish : ----------

Egg

32.Hen : ----------

33.Duck : ----------

Nuts and oil seeds

34.Ground nut : ----------

35.Gingelly seeds : ----------

36.Coconut : ----------

37.Cooking oils : ----------

38.Sugar and Jaggery : ----------

39.Processed foods : ----------

40.Bakery foods : ----------

19. Meal pattern of the family : ----------

20. Preference in serving food : ----------

21. Meal pattern of the infant : ----------

SECTION-B

22. Food first introduced to the neonate : ----------

23. Did you breast fed your infant : ----------

24. Howmany time do you feed your baby : ----------

1. 1st month : ----------
2. 2nd month : ----------
3. 3rd month : ----------
4. 4th month : ----------
5. 5th month : ----------
6. 6th month : ----------
7. 7th month : ----------
8. 8th month : ----------
9. 9th month : ----------
10. 10th month : ----------
11. 11th month : ----------
12. 12th month : ----------
13. 1-3 years : ----------

25. Interval between feeds

1. 1st month : ----------
2. 2nd month : ----------
3. 3rd month : ----------
4. 4th month : ----------
5. 5th month. : ----------
6. 6th month : ----------
7. 7th month : ----------
8. 8th month : ----------
9. 9th month : ----------
10. 10th month : ----------
11. 11th month : ----------
12. 12th month : ----------
13. 1 to 3 years : ----------

26. Reasons for not breast feeding : ----------

27. If the child is not breast fed what type of milk is given : ----------

28. Number of feeds introduced

1. 1st month : ----------
2. 2nd month : ----------
3. 3rd month : ----------
4. 4th month : ----------
5. 5th month : ----------
6. 6th month : ----------

7. 7th month : ----------

8. 8th month : ----------

9. 9th month : ----------

10. 10th month : ----------

11. 11th month : ----------

12. 12th month : ----------

13. 1-3 years : ----------

29. If the child is breast fed along with breast milk what type of milk is given : ----------

30. Number of feeds introduced : ----------

1. 1st month : ----------

2. 2nd month : ----------

3. 3rd month : ----------

4. 4th month : ----------

5. 5th month : ----------

6. 6th month : ----------

7. 7th month : ----------

8. 8th month : ----------

9. 9th month : ----------

10. 10th month : ----------

11. 11th month : ----------

12. 12th month : ----------

13. 1-3 years : ----------

31. If the child is breast fed how long did you breast fed : ----------

32. At what period the breast feeding is withdrawn : ----------

Weaning

33. From which month foods other than milk was introduced to the infant : ----------

34. Type of food introduced

Cereals

1. Rice : ----------
2. Wheat : ----------
3. Rava : ----------
4. Ragi : ----------
5. Maida : ----------

Pulses

6. Bengal gram : ----------
7. Black gram : ----------
8. Cowpea : ----------
9. Red gram : ----------

Roots and Tubers

10. Potato : ----------
11. Tapioca : ----------
12. Yam : ----------
13. Colocasia : ----------
14. Carrot : ----------

15. Beetroot : ----------

16. Other Vegetables : ----------

17. Leafy vegetables : ----------

Fruits

18. Banana : ----------

19. Pappaya : ----------

20. Guava : ----------

21. Orange : ----------

Milk and Milk products

22. Milk : ----------

23. Curd : ----------

24. Butter milk : ----------

25. Butter : ----------

26. Cheese : ----------

Meat

27. Chicken : ----------

28. Mutton : ----------

29. Duck : ----------

30. Beef : ----------

31. Fish : ----------

Egg

32. Hen : ----------

33. Duck : ----------

Nuts and oil seeds

34. Ground nut : ----------

35. Gingelly seeds : ----------

36. Coconut : ----------

37. Sugar and jaggery : ----------

38. Processed foods : ----------

39. Bakery foods : ----------

35.Reasons for giving : ----------

36.Due to the introduction of supplementary foods have you reduced the frequency of breast feeding : ----------

37.If yes, what is the reasons : ----------

38.Do you avoid any special foods for your weaning infant : ----------

39.If yes, what type of foods do you avoid : ----------

40.Reasons for avoiding : ----------

41.Do you restrict the food for the infants during sickness : ----------

42.Foods restricted during fever : ----------

43.Foods restricted during diarrhoea : ----------

44.Foods restricted during Jaundice : ----------

45.Foods restricted during Measles : ----------

46.Foods restricted during vomiting : ----------

47.Foods restricted during Asthma : ----------

48.Who influence the food habits of your child : ----------

49.Who is giving the meal for the infant : ----------

50.If the mother is sick/busy who is giving the food: ----------

51.Whether the food giving persons wash their hands before handling foods.: ----------

52.Do you use bottles for feeding your infant : ----------

53.If yes do you boil the bottle every day : ----------

54.Do you boil the rubber nipples every day : ----------

55.Do you use detergents in washing the bottle and nipple : ----------

56.Before preparing the bottle feed do you wash your hands : ----------

57.If yes, washing is done with : ----------

58.Before giving the milk will you boil the milk: ----------

59.What is the temperature of milk during feeding : ----------

60.While bottle feeding whether air bubbles are formed inside the bottle : ----------

61.How the bottle feeding is done : ----------

62.Do you give commercial milk powder to the baby : ----------

63.Do you follow the measurements given in the tin : ----------

64.Do you follow the guidelines given in the tin for preparing the Lactogen: ----------

65.After each feeding do you wash the baby's mouth : ----------

APPENDIX-II

Calculation of the quantity of weaning food per serving (1/3rd of the protein requirement)

Protein requirement for infants from 6-12 months. 1.65/Kg body weight (ICMR)

Weight of the infant = 6 Kg

Total protein requirement /day = 6 x 1.65

= 9.9 g/day

1/3rd requirement = $9.9 \times \frac{1}{3}$ = 3.3 g

Protein content of the weaning food/100 gm = 10.29g

Therefore quantity of weaning food required to meet 3.3 gms of protein.

$$= \frac{3.3 \times 100}{10.29} = 32.06$$

= 32 gms/serving

APPENDIX-III

1. Procedure for Weighing the infant

A spring balance was used to take the weight of the infant. It was hung and the child was made to sit on it with minimum clothing and the weight was recorded in kilograms with an accuracy of 0.1 kg.

2. Procedure for measuring head circumference

For taking head measurements, the child's head was steaded and the greatest circumference was measured by placing a soft fiber glass tape firmly round the frontal bones just superior to the supra orbital, ridges, passing it round to the head at the same level on each side and laying it over maximum occipital prominence at the back. Measurements were made to the nearest 0.1 cm (Mayers, 1972)

3. Procedure for measuring mid arm circumference

Mid arm circumference of the child was measured with an insertion tape at the level mid way between the acromion and olecranon process with the arm hanging freely relaxed, with the tape applied at right angles to the long axis of the humerous (Malena and Mayer 1972). Zerfas (1975) reported about insertion tape as a new circumference tape for use in nutritional assessment. Measurements were made to the nearest 0.1 cm.

4. Procedure for measuring chest circumference

Chest circumference of the infants were also taken with the fiber glass tape. The measurement is taken at the level of Xiphisternum and in a place at right angles to the vertebral column below the inferior angle of the scapula. Sufficient tension was applied to enable the tape to test against the perimeter of the thorax without slipping.

Chen et al.(1978) pointed out that weight /age and arm circumference /age were the strongest indices used to determine protein energy malnutrition.

5. Procedure for measuring the Crown heel length (Height)

The infant is laid on the wooden length board on a flat surface. The head is kept in position firmly against the fixed head part with legs keeping vertically. The kneals are extended by pressure with the help of an assistant. The upright steading foot is moved to obtain firm contact to the head and the length is measured by using a fibre glass tape fixed on the wooden board. Measurements were made to the nearest 0.1 cm.

APPENDIX-IV

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF AGRICULTURE, VELLAYANI, TRIVANDRUM

NUTRITIONAL ASSESSMENT SCHEDULE

NATIONAL INSTITUTE OF NUTRITION

State: District: Date:

Taluk: Village: Block:

Serial No. Family No:

Name of the subject :

Sex : Male/Female

Name of the Father/Guardian :

Occupation :

Income(per year) :

Date of birth :

Age : Years Months

Source : Present/record

Breast fed/BF+Supplements/NOT BF/Pregnant/lactating

Anthropometry

Height (cms) Head circumference (cms)

Weight(Kgs) Chest circumference(cms)

Fat fold circumference (cms)

Clinical Examination.

1. Hair sparse
2. Discoloured
3. Easily plucked
4. Moon face
5. Parotid enlargement (bilateral, painless)
6. Oedema
7. Emaciation
8. Marasmus
9. Conjunctival Xerosis
10. Bitot's spot
11. Corneal Xerosis/Keratomalacia
12. Corneal opacity
13. Night blindness
14. Photophobia
15. Anaemia
16. Nasolabial dysebacia
17. Angular stomatitis
18. Cheilosis
19. Red and raw tongue
20. Tongue:- Papillae - atrophic
21. Papillae - hypertrophic
22. Pellagara
23. Crazy dermatosis
24. Pigmentation at Knuckles/fingers/toes
25. Phrynoderma
26. Koilonychia
27. Gums-spongy bleeding
28. Craniotabes
29. Epiphyseal enlargement
30. Beading of ribs
31. Knock-knee/bow legs
32. Frontal- parietal boosing
33. Teeth caries
34. Mottled enamel
35. Enlargement of liver
    Soft:
    Firm:
    Hard:
36. Thyroid enlargement
37. Others

For children below five years only.

APPENDIX-V

Weight / Height^{2} Ratio

Serial No	Groups	Month 1	2	3	4	5	6
1.	Experiment	0.0016	0.0017	0.0018	0.0019	0.0019	0.0020
	Control	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018
2.	Experiment	0.0016	0.0016	0.0018	0.0019	0.0019	0.0019
	Control	0.0018	0.0019	0.0019	0.0019	0.0020	0.0020
3.	Experiment	0.0015	0.0017	0.0018	0.0019	0.0020	0.0020
	Control	0.0016	0.0016	0.0017	0.0018	0.0020	0.0019
4.	Experiment	0.0018	0.0018	0.0018	0.0018	0.0019	0.0021
	Control	0.0016	0.0017	0.0017	0.0018	0.0018	0.0018
5.	Experiment	0.0016	0.0018	0.0019	0.0019	0.0020	0.0020
	Control	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
6.	Experiment	0.0014	0.0015	0.0015	0.0016	0.0018	0.0021
	Control	0.0014	0.0014	0.0015	0.0016	0.0016	0.0016
7.	Experiment	0.0017	0.0018	0.0019	0.0020	0.0020	0.0021
	Control	0.0016	0.0017	0.0016	0.0017	0.0017	0.0016
8.	Experiment	0.0013	0.0014	0.0016	0.0018	0.0018	0.0019
	Control	0.0016	0.0017	0.0017	0.0017	0.0018	0.0019
9.	Experiment	0.0014	0.0016	0.0017	0.0017	0.0018	0.0020
	Control	0.0018	0.0018	0.0019	0.0019	0.0019	0.0019
10.	Experiment	0.0016	0.0017	0.0018	0.0017	0.0019	0.0019
	Control	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018
11.	Experiment	0.0016	0.0017	0.0018	0.0018	0.0019	0.0019
	Control	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018
12.	Experiment	0.0014	0.0015	0.0015	0.0016	0.0017	0.0018
	Control	0.0016	0.0017	0.0018	0.0018	0.0019	0.0019
13.	Experiment	0.0015	0.0015	0.0017	0.0017	0.0017	0.0019
	Control	0.0014	0.0015	0.0016	0.0015	0.0015	0.0015
14.	Experiment	0.0016	0.0017	0.0019	0.0020	0.0020	0.0020
	Control	0.0014	0.0014	0.0015	0.0014	0.0015	0.0015
15.	Experiment	0.0015	0.0017	0.0020	0.0020	0.0020	0.0020
	Control	0.0016	0.0016	0.0017	0.0018	0.0017	0.0019

APPENDIX-VI

Head/Chest circumference Ratio

Serial No	Groups	Month 1	2	3	4	5	6
1.	Experiment	0.89	0.92	0.90	0.91	0.91	0.89
	Control	0.98	0.98	0.99	0.98	0.98	0.98
2.	Experiment	0.94	0.94	0.95	0.95	0.98	0.96
	Control	0.97	0.98	0.98	0.98	0.97	0.98
3.	Experiment	1.01	1.02	1.02	1.02	1.02	1.02
	Control	0.99	0.99	0.99	1	0.99	0.99
4.	Experiment	1.04	1.04	1.04	1.05	1.05	1.05
	Control	1.03	1.04	1.04	1.04	1.04	1.04
5.	Experiment	1.04	1.04	1.04	1.04	1.05	1.05
	Control	0.96	0.97	0.98	1.02	1.02	1.02
6.	Experiment	0.83	0.84	0.85	0.85	0.85	0.85
	Control	0.93	0.97	0.97	0.98	0.98	1
7.	Experiment	1.01	1.02	1.02	1.03	1.03	1.04
	Control	0.96	0.97	0.99	0.99	1	1.01
8.	Experiment	0.98	0.88	0.90	0.90	0.92	0.91
	Control	0.97	0.96	0.96	0.97	0.97	0.97
9.	Experiment	0.98	0.97	0.97	0.97	0.97	0.97
	Control	0.97	0.97	0.97	0.97	0.97	0.97
10.	Experiment	0.97	0.97	0.97	0.97	0.95	0.97
	Control	0.98	0.98	0.98	0.98	0.98	0.98
11.	Experiment	1.05	1.06	0.95	0.95	0.93	0.93
	Control	0.96	0.96	1.01	1.01	1.01	1.02
12.	Experiment	0.91	0.89	0.88	0.89	0.89	0.9
	Control	1	1.01	1.02	1.01	1.01	1.01
13.	Experiment	0.96	0.94	0.95	0.95	0.97	0.97
	Control	0.85	0.86	0.86	0.87	0.87	0.88
14.	Experiment	0.86	0.86	0.88	0.88	0.88	0.91
	Control	0.85	0.85	0.86	0.87	0.87	0.87
15.	Experiment	0.82	0.84	0.85	0.85	0.85	0.85
	Control	0.96	0.96	0.97	0.97	0.97	0.97

APPENDIX-VII

Mid arm circumference/.Head circumference Ratio

Serial No	Groups	Months 1	2	3	4	5	6
1.	Experiment	0.28	0.28	0.29	0.30	0.31	0.33
	Control	0.31	0.31	0.33	0.33	0.34	0.34
2.	Experiment	0.38	0.38	0.39	0.39	0.38	0.39
	Control	0.29	0.29	0.30	0.31	0.32	0.33
3.	Experiment	0.36	0.35	0.36	0.37	0.37	0.37
	Control	0.26	0.27	0.27	0.28	0.28	0.29
4.	Experiment	0.29	0.30	0.32	0.33	0.35	0.35
	Control	0.29	0.31	0.31	0.32	0.32	0.33
5.	Experiment	0.30	0.31	0.33	0.33	0.34	0.34
	Control	0.30	0.30	0.30	0.31	0.31	0.31
6.	Experiment	0.30	0.31	0.31	0.32	0.32	0.33
	Control	0.30	0.31	0.31	0.32	0.32	0.33
7.	Experiment	0.33	0.34	0.34	0.34	0.34	0.35
	Control	0.33	0.33	0.33	0.33	0.33	0.33
8.	Experiment	0.27	0.29	0.29	0.32	0.32	0.34
	Control	0.29	0.29	0.29	0.29	0.30	0.31
9.	Experiment	0.34	0.35	0.36	0.38	0.39	0.39
	Control	0.32	0.32	0.33	0.33	0.33	0.34
10.	Experiment	0.36	0.37	0.36	0.37	0.37	0.38
	Control	0.28	0.28	0.29	0.29	0.29	0.30
11.	Experiment	0.34	0.35	0.36	0.36	0.37	0.37
	Control	0.28	0.28	0.29	0.30	0.30	0.30
12.	Experiment	0.31	0.32	0.32	0.33	0.34	0.35
	Control	0.27	0.27	0.28	0.28	0.29	0.29
13.	Experiment	0.37	0.38	0.39	0.40	0.40	0.40
	Control	0.31	0.32	0.32	0.32	0.32	0.32
14.	Experiment	0.34	0.37	0.36	0.36	0.37	0.37
	Control	0.30	0.30	0.30	0.30	0.30	0.31
15.	Experiment	0.30	0.31	0.31	0.32	0.32	0.33
	Control	0.29	0.29	0.29	0.29	0.30	0.31

APPENDIX-VIII

Monthly rate of increase in the Anthropometric Measurements of infants in the experimental group

ANTHROPOMETRIC MEASUREMENTS																													
ight (cms)				Weight (kg)						Head circumference (cms)						Chest circumference (cms)						Midarm circumference (cm)					
Months				Months						Months						Months						Months					
3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
67.5	68	69	70	7	7.8	8.5	9	9.5	9.8	40.1	41.5	41.8	42	42.8	43.1	45	45	46	46	47	48	11.5	11.8	12	12.8	13.5	14.5
65.8	66	68	69	6.5	7	8	8.5	8.8	9.5	40.5	42	43	43.9	45	45.1	43	44.5	45	45.8	45.8	46.5	15.5	16	17	17.5	17.5	18
66.5	67.8	68.5	71.7	6.5	7.8	8	8.8	9.5	9.5	41.5	42	42.8	43	43.5	43.5	41	41	41.8	42	42.5	43	15	15	15.5	16	16.5	16.5
66	67	67.8	68	7.5	7.5	8	8.5	9	9.8	43	43	44	44.5	45	45	41	41	42	42	43	43	12.5	13	14.5	15	16	16.5
66.5	67.9	68.9	70.5	7	8	8.8	8.8	9.5	10	44	44.5	45	45	46.5	46.5	42.	43	44	44	44.5	44.5	13.5	14	15	15	16	16
65.5	66.5	67.3	68.0	6	6.5	6.8	7.5	8.3	9.8	40.3	41.5	42	42	42.5	42.5	48.5	49	49	49.5	49.5	50	12.3	13	13	13.8	13.8	14
65	66.8	67.9	68	7	7.5	8.3	9	9.5	10	42	43	43	44	44	45	41.5	42	42	42.5	42.5	43	14	14.5	14.5	15	15	16
68	68.5	69	70	6	6.5	7.5	8.8	9	9.8	40.3	41	42.5	43	44	44	41	46.5	46.8	47.5	47.5	48	11	11.9	12.5	13.8	14	15
64.8	65	66.8	67.5	6	7	7.8	8	8.8	9.3	41.9	42	42.3	42.5	43	43.5	44	43	43	44.5	46	46.5	14.5	15	15.5	16.5	17	17
66.8	67.5	68.9	69.9	7.3	8.5	9	9.5	9.8	10.5	44	44.5	45	45	46	47	45	45.8	46	46	48	48	16	16.5	16.5	16.8	17	18
69.5	70	70.5	71	7.3	8	8.8	8.8	9.5	10	43.5	44	44	44	45	45	42.5	43.3	43.8	43.8	44.5	44.5	15	15.8	16	16	16.8	17
68.8	69.5	70	70.5	6.5	7	7.5	7.8	8.5	9.3	41.9	42	42.3	42.5	43	43.2	46	47	47	47.3	47.8	48	13	13.5	13.8	14	14.8	15
67.5	68.9	69.5	70.5	6.5	7	8	8.5	8.5	9.5	41.5	42	42.8	43.3	44.8	45	43	44.5	45	45.8	45.8	46.5	15.5	16	17	17.5	17.5	18
68.5	69	69.5	70.5	7.3	8	9.3	9.8	9.8	10	41.5	41.5	42.8	43	43.5	44.9	47.8	48	48.5	48.8	49	49	14.3	15.5	15.5	15.8	16	16
64.8	65.5	66.8	67.5	6	7	8.5	8.8	9	9.3	40	41.5	42	42	42.5	42.5	48.5	49	49	49.5	49.5	50	12.3	13	13	13.8	13.8	14

APPENDIX-IX

Monthly rate of increase in the Anthropometric Measurements of infants in the control group

ANTHROPOMETRIC MEASUREMENTS																													
ight (cms)				Weight (kg)						Head circumference (cms)						Chest circumference (cms)						Midarm circumference (cm)					
Months				Months						Months						Months						Months					
3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
63.3	63.5	63.8	64	6.3	6.8	6.8	7	7.3	7.5	42.5	42.7	43	43	43	43	43	43.3	43.3	43.7	43.7	43.7	13.3	13.3	14.2	14.5	14.8	14.8
60.8	61.5	62	63.5	6.8	7	7.3	7.5	7.8	8	41.3	42	42.3	42.3	42.8	43	42.5	42.8	42.8	43	43.8	43.8	12.3	12.5	12.8	13.3	14	14.3
61.5	61.8	62	62.3	6	6.3	6.5	6.9	7	7.5	41	41.3	41.5	41.8	42	42.5	41.3	41.5	41.8	41.8	42.3	42.9	11	11.3	11.5	11.8	12	12.5
67	67.3	67.8	68.8	7	7.8	8	8.3	8.5	8.5	43.8	44.3	44.8	45	45.3	45.3	42.3	42.5	42.8	43	43.3	43.5	13	13.8	14.3	14.5	14.9	15
65.5	66.8	67.5	68	7	7.3	7.3	7.8	7.9	8.3	41.3	42.5	43	44.5	45	45.3	43	43.5	43.5	43.5	43.8	44	12.3	13	13	13.8	13.8	14
67	67.9	68	69	6.3	6.5	7	7.5	7.8	8	40	40.3	40.5	41.8	42	42.8	43	41.5	41.9	42.5	42.6	43	12	12.3	12.8	13.5	13.5	13.9
68.9	70	70.5	71.8	7.5	7.8	8	8.5	8.5	8.5	41.5	41.9	42.9	43	43.8	44.5	42.8	42.9	43	43.3	43.5	43.8	13.5	13.8	14	14.1	14.5	14.8
61.3	61.8	61.8	62	6.4	6.6	6.8	6.8	7.1	7.5	40.4	40.5	40.7	40.8	40.9	41	41.6	41.8	41.8	41.9	41.9	42	11.9	12	12	12.1	12.5	12.8
66	66.8	67	68	7.9	8	8.3	8.5	8.8	8.8	42.5	42.5	42.8	43	43.3	43.5	43.3	43.5	43.9	44	44.2	44.8	13.8	14	14	14.3	14.5	14.9
62.5	62.8	62.9	63	6.3	6.5	6.8	6.9	7.3	7.5	40.4	40.7	40.7	40.9	41.2	41.5	41.2	41.4	41.5	41.7	41.9	42	11.4	11.6	11.7	11.9	12	12.3
64.5	64.8	65	65.2	6.3	6.6	6.9	7.2	7.5	7.9	41.1	41.9	42	42.3	42.5	43	40.4	40.5	40.8	41	41.2	41.5	11.8	12	12.4	12.7	12.9	13
62.3	63	63.8	64	6.1	6.5	7	7.5	7.9	8	40.1	40.5	41	41.5	41.8	42	40	40	40	41	41.3	41.5	10.8	10.9	11.4	11.8	12	12.3
67.5	68.9	70	70.9	6.3	6.8	7.3	7.5	7.8	8	41.5	42	42.5	43	43.5	44	48.8	48.8	49	49.3	49.5	49.8	12.9	13.3	13.8	13.8	13.9	14
70	70.8	71	71.5	6.9	7	7.4	7.5	7.9	8	41.3	41.8	42	42.5	43	43.5	43.5	48.5	48.8	48.9	49.2	49.5	12.5	12.6	12.6	12.8	13	13.3
61	62	63.5	64	6	6	6.5	7	7.2	8	40	40.5	40.7	40.8	40.9	41	41	41.6	41.8	41.9	41.9	42	11.9	12	12	12.1	12.5	12.8

IMPACT OF BANANA BASED SUPPLEMENTARY FOOD ON THE NUTRITIONAL STATUS OF INFANTS

BY

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ABSTRACT OF A THESIS

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ABSTRACT

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A study on "Impact of banana based supplementary food on the nutritional status of the infants" was conducted among selected fifteen infants using a supplementary food based on locally available food articles like banana, sesame, horsegram and skim milk powder in the proportion of 30:20:30:20. Prior to the experiment a survey was conducted to ascertain the feasibility of introducing such supplementary food among the rural families.

The survey conducted among seventy five families selected from under previleged section of the community revealed that they were large families with more women and children. Education level was low for these families. Diets consumed by these families were with little variety.

Data on infant feeding practices revealed that infants were put on prolonged breast feeding with long interval between feeds. Type of food given to the infants were not nutritious. This indicates that there is urgency for introduction of such supplementary food. The present feeding trial was conducted for six months with fifteen infants in the experiment group. A comparison of the anthropometric measurements like heights and weights revealed a favourable trend towards the experimental group. Data on Height for age profile, and Weight / Height^2,

Head/Chest circumference ratio, Mid arm circumference/Head circumference ratio and clinical record also indicated favourable trends in the case of infants belonging to experimental and control group. An assessment of anthropometric measurements of the infant of experimental group indicated a significant increase when compared to the control group.

Hence, it can be concluded that the banana based supplementary food tried in the above feeding trial is found to be suitable one for popularising as a supplementary feed for the infant.