REVIEW OF LITERATURE
2. REVIEW OF LITERATURE

Indeed, there is scanty and meagre information on the aspects relevant to the present investigation entitled, "Studies on formulation and evaluation of Home made weaning foods", in the scientific literature, and therefore, sincere efforts were made to review the scientific literature on the said subject, and systematically detailed in the present chapter.

2.1 Malnutrition:

There are some excellent books on malnutrition, learning and behaviour, infant nutrition in tropics and subtropics, malnutrition and diseases published by several pioneering nutritionists (WHO, 1963; Scrimshaw and Gorden, 1967; Gopalan, 1968; Proudfit and Robinson, 1978). Moreover, comprehensive studies on nutrition covering specially various aspects of malnutrition in infants are excellently reviewed by several authors (Scrimshaw and Behor 1964; Beaton and Mc Henro, 1964; Ebb, 1966; Waterlow and Rutihauer, 1974). It has been well established that syndrome analogues to both marasmus and kwashiorkor can be produced by appropriate and adequate dietary manipulations, and thus, these two distinct clinical syndromes may be atribute to protein calorie deficiency. Gopalan (1968) reported that the clinical pictures of classical marasmus and kwashiorkor on the basis of some of the biochemical and pathological characteristics of these syndromes. There are some reports (Truswell and Hansen, 1969; Grimble and Whitehead 1971; Seakins and Waterlow, 1972) wherein low serum albumin and altered amino acid pattern were related to protein depletion. Nevertheless, the faulty liver was considered as one of the reasons of failure of biosynthesis of proteins specially a part of lipoprotein, which was considered a pathway for fat transport out of the liver.
However, Gopalan (1968) reported that no quantitative or qualitative differences in the diet of children in a poor community were noticed who developed kwashiorkor and marasmus, and therefore, he opined that it is not the diet which determines the clinical picture but the way in which a child adopts or fails to adopt.

Waterlow and Payne (1975) suggested that a diet which is marginally deficient in energy and protein may cause syndromes of malnutrition. They specifically suggested that a child who happened to have a high energy requirement may develop marasmus while the kwashiorkor syndrome in a child would develop mostly due to a high protein requirements. They also claimed that protein and energy requirements are considered to be very important and vital, however, these characteristics are mostly governed by the quantity rather than quality of the food. There are several other factors which play very important role in developing the syndromes of kwashiorkor and marasmus for example disturbances in hormonal balances, age, acute infections etc. Similarly, Waterlow and Rutihauenser (1974) suggested that the prevalence of kwashiorkor differs in different countries with different dietary patterns and this may be attributed to aetiology.

Nevertheless, this clue has not been intensively studied and warrant systematic study in detail. Moreover, the other vital issue regarding the deficiency of vitamins and minerals in PEM is not investigated in detail because most of the reports have concentrated on intakes of energy and proteins. However, Ramdath and Golden (1989) stressed the importance not only on the intakes on vitamin A, C and E and β-carotene but also on dietary minerals such as selenium, manganese, copper, and and zinc which are known to be the essential components of key enzymes involved in metabolism particularly responsible for minimising free radical attack. According to Golden and Ramdath (1986), Kwashiorkor develops
when there is a relative deficiency in the protective pathways due to deficiency of various nutrients. Thus, protein-energy malnutrition is a multi-deficiency syndrome.

2.2 Malnutrition and infant mortality:

It is well established that the deficiencies of calories, proteins, vitamins, minerals and others have their individual or combined characteristics metabolic effects, in turn, resulted in the delay of the growth. The growth of the whole body, therefore, is a gamut process (McCance 1981). By and large, high infant and child mortality trends are proved to be very useful indicators to highlight the prevalence of malnutrition in developing countries. According to recent survey, it has been observed that the infant mortality per thousand live births is 50 and 74, respectively for Maharashtra and India, during the year 1993 (Anon.1994). Indeed the overall infant mortality rate per thousand live births for the country is declined from 105 and 129 in 1971 to 50 and 74 in 1993 for Maharashtra and India, respectively. It is evident from the above that a considerable improvement have been made by adopting some vital and genuine measures in arresting the infant death abuse, in the Maharashtra in particular and country in general. Nevertheless, the malnutrition in developing countries is secondary to poverty, poor hygiene, contaminated food, environmental factors, infections, dietary deficiencies and others.

Chene (1982) has excellently detailed the relationship between energy-protein malnutrition and subsequent risk of mortality among children. He has also suggested that poverty and malnutrition are massive and their prevention and control warrant highest priority through detail analysis.

Wharton (1986) reported that malnutrition and infection specially gastro-enteritis and the major causes for the child mortality in developing countries.
Wharton (1989) also opined that the occurrence of keratomalacia in kwashiorkor is a bad prognostic sign and is also associated with a much higher mortality rate in developing countries. Gopalan (1985) has excellently reviewed the nutritional status and infant nutrition in the country.

McLaren (1975) has also suggested that kwashiorkor is associated with acute infectious such as measles whereas marasmus is related to gastro-enteritis which tend to be chronic and recurrent.

Thus, it is well established that inadequate energy and protein intake, deficiencies of iron, zinc copper, vitamin A and D are the most commonly observed nutrient deficiencies during infancy.

Krishnamurthy (1986) has excellently detailed the theoretical considerations for the measurements of child survival and development in India. He has also opined that the infant mortality rate is a gamut process wherein the interaction of several factors such as socio-economic, biological environmental and infrastructural played very important role. He has attributed these factors to mostly the poverty of families, general backwardness and underdevelopment of areas and community. According to him, approximately 42% of deaths are among children particularly below the age of 5 years, out of which 50% of the deaths are in the age group of 0-12 months.

2.3 Infant Nutrition and Infant feeding practices:

It is well documented that the average growth of infants in weight and height is found to be satisfactory upto approximately the age of three months. However, it has been also reported that the normal growth of infants at the age of approximately three months known to be affected in developing countries and this may be attributed to insufficient food or increased exposure to infection. It is well known that human milk is
considered as the most suitable sole food for the new born infants, which satisfies the nutrient requirements, and in addition provide other vital factors which develop immunity in the infants against attack from various pathogenic microbes (Anand, et. al. 1991; Anon. 1992).

According to Victora et. al. (1987), breast milk alone cannot cater the nutritional requirements of the infant of the age group of 4-6 months. It has been also claimed that the adequacy of breast milk as a sole source of food for the young infant has been reported that the energy requirement per kilogram of body weight showed a decline between third and sixth month, followed by plateau until the ninth or tenth month, and subsequently it increases considerably. It is well documented that a velocity of growth substantially faster during the initial three months but subsequently growth stacks off after three months until the infant's weight was approximately backed to its original position.

According to Waterlow and Thomson (1979), the energy and protein requirements of infants have not changed considerably over the last two decades. The daily energy and protein requirements for infants between the age group of 0-6 months are 108 kcal/kg body weight and 2.0 gm/kg body weight respectively (ICMR, 1990).

Rao, (1983) reported that the quality and composition of breast milk produced by poor undernourished mothers compares well with well nourished women of affluent society. He also claimed that no significant differences in proximate nutrients (i.e. proteins and calories) were observed. The daily estimates of breast milk output are ranged between 400-750 ml. It is also estimated that 100 ml of breast milk provides 1 gm of protein and 65 kcal of energy.

Lonnerdal et. al. (1976) reported that the protein requirement can be met up to the sixth month while the energy requirement was found to be inadequate from the
sixth month of infant. However, he opined that the average intake of breast milk was found to be adequate in the third month, while it will be inadequate by 4 month of infant.

2.3.1 Breast feeding:

Jelliffe and Jelliffe (1979) reported that the breast milk has unique anti-infective properties and they attributed these properties to the presence of anti-infective factors in the human milk.

According to Waterlow and Thomson (1979), breast milk alone is not sufficient from about 3 months of age of infants, and this dietary insufficiency may lead to the adverse effects on the growth of infants. Moreover, the infection from the food source in impairing the growth of infants can not be ruled out.

Bhandari et al. (1983) claimed that the increased infant mortality rate in developing countries is not only due to poverty but also due to other attributes such as ignorance of the community regarding colostrum feeding and it's nutritional and medicinal value.

Goldberg et al. (1984) reported that the breast fed infants are at lower risk of death as compared to the infants fed artificially. Similar investigations have been carried out by Victora et al. (1987) regarding the breast feeding against infant deaths and infectious disease.

The role of colostrum was explained by Hadimani et al. (1990). They claimed that the colostrum has vital role to play in the growth of child and also it protects him from numerous infections as it contains higher concentrations of antibodies and immunoglobulins.

Thus, the importance and merits of breast feeding have been recognised as the vital need. In view of this, the policy makers in developing countries in general and
India in particular are being encouraged to propagate and promote breast feeding as an intervention to protect the infant's health. (Feachem and Koblinski, 1984; UNICEF, 1985).

Breast feeding trends among poor and well to do mothers in Singapore were reviewed (Anon 1987). It is concluded that poor and well-to-do mothers differ substantially in their infant feeding practices with wealthier women, generally favouring breast feeding. As a result only one infant in ten is presently breast fed for a period of 3 months or more.

Infant feeding practices of 6149 mothers in Kenya, Mexico and Malasiya are reported by Diamond and Ashworth (1987). A high proportion of mothers initiated breast feeding in each country regardless of social class. Most Kenyan mothers continued to breast feed for at least 12 months. In Mexico and Malaysia, however, breast feeding is discontinued relatively earlier especially among urban mothers.

The association between breast feeding, nutritional status and survival was studied by Briend and Bari (1989) for 2 years of period. It is concluded that breast feeding improves survival but not nutritional status of 12-35 months old children in Bangladesh.

Hull et. al. (1989) found that attitudes of mother towards breast feeding were positive but content advice was incorrect. Only 54% mothers thought that breast feeding should be initiated immediately after delivery. Most of them did not know about reasons of insufficient breast milk output.

Benal et. al. (1993) administered a questionnaire on 1500 mothers for studying effect of socio-cultural factors on duration of breast feeding. They found that giving colostrum, demand feeding, night feeding, feeding with both breasts, rooming-in and planned pregnancy had a positive effect on the duration of breast feeding. Negatively
associated factors were prelacteal foods, smoking, mothers education, paid maternity leave, etc.

Das et al. (1994) reported the knowledge, attitudes and practices of Bangladesh mothers regarding breast feeding and weaning. They observed that 84 per cent mothers knew that the colostrum is good for health, of infants. 40 per cent of mothers were aware that breast feeding should be started within 1/2 an hour of birth but most of them were not knowing that how long it should be continued. Most of the mothers had no correct knowledge that oil should be added to prepare energy dense weaning diet.

Hassan et al. (1994) studied infant feeding practices. Regardless feeding index of the baby, 25 per cent of mothers had no plan and 31 per cent of mothers planned to start breast milk. In practice only 11.5 per cent could start breast milk. 85 per cent are prelacteal feeds, as suggested by health staff, however, only 02 per cent mothers were advised properly on discharge of infant feeding practices.

Breast feeding practices of Hissar district were studied by Bhat and Kheterpal (1983). They found that the prelacteal food given to baby varies. Feeding sugar or jaggery water was very common (53.3 per cent). Feeding Janet-ghuti, omum-sugar water, etc. was common. All mothers breast fed their children for five times a day or even more than that when the child is below 6 months of age. Breast feeding was continued for 2 years and above by 40.8 per cent mothers, however, 35 per cent mothers breast fed their children for 1-2 years of age, whereas 21.7 per cent mothers breast fed their baby until next pregnancy.

Anand and Singh (1986) found that only 51.2 per cent of 90 mothers surveyed, followed breast feeding, out of them 13.6 per cent were working mothers, however 27 per cent mothers experienced lactation failure.
Ray and Reddy (1988) studied urban slum community near Varanashi and reported that 85 per cent mothers start breast feeding on third day, 10 per cent on second day and 1.7 per cent on fourth day of delivery. The common reason for delayed initiation was told as lack of milk formation during first few days. Colostrum is discarded by most mothers thinking that it is harmful for babies.

Breast feeding pattern of mothers at Delhi was evaluated by Singhal and his co-workers (1989). It is reported that all mothers were of the view that breast milk is best. Staff nurses (20 per cent), para-medical workers (28.1 per cent), 45.2 per cent rural mothers and 42.2 per cent urban mothers were knowing about the quality and importance of breast milk.

Hadimani, et.al. (1990) studied the colostrum feeding practices as influenced by ordinal position and literacy level of mother in the Karnataka State. The association between maternal education and feeding by mothers increased from 8-36 per cent in first and second ordinal position of child, respectively. Most of the mothers (73.6 per cent) started breast feeding after three days as they believe that it is unhygienic, dirty product, harmful and poisonous. It was observed that prelacteal foods given were sugar, water, honey, etc.

Breast feeding practices, beliefs and taboos in Karnataka were studied by Shariff and Farsana (1990). Prelacteal feeds given were purgative castor oil and salts by 42.8 per cent rural and 10.4 per cent of urban mothers. Natural foods and top milk were given more in rural (23.7 per cent) than in Urban area (7.9 per cent).

Pant and Chothia (1990) assessed the knowledge of higher income group mothers from urban Baroda related to breast feeding. Results of the study indicated that only half of the mothers breast fed their babies on first day of delivery. Breast feeding is
stopped when the child is 3-6 months. Old reasons for stoppage of breast feeding were commonly told as insufficient breast milk output, later difficult to obtain leave (working mothers) etc. The effectiveness of educational programme for promotion of colostrum feeding was observed on second day (44.3 per cent) and third day (35.5 per cent). However, 2.6 per cent mothers initiated it on fourth day. 88.2 per cent did not feed colostrum despite of constant motivation from last trimester of pregnancy. The reasons for not feeding colostrum were religious (63.6 per cent), it is thick (12.8 per cent) unclean (11.8 per cent) and so it is removed to make sucking easy for the baby (11.8 per cent). Prolonged breast feeding was observed in lower economic strata.

Subbulakshmi et al. (1990) found a significant difference in rural and urban areas regarding colostrum feeding practices. Developmental programmes like ICDS and others also showed significantly beneficial effects on colostrum feeding. Moreover, general awareness of mothers, joint family systems and hospital delivery were noted to have positive influence on colostrum feeding. Religion did not show any effect on practice of feeding colostrum. Reasons for discarding colostrum by mothers were reported as elder's advice, dai's guidance, bad for child, no any specific reason, etc.

2.3.2 Weaning:

According to American Academy of Paediatrics (1978), breast feeding is found to build very important immunologies in an infant. Moreover when the requirement of child/infant exceeds to the supply of material milk, supplementary feeding is necessary. Indeed, weaning is a gradual process during which the breast milk is progressively replaced by a mixed diet.
Age of Weaning:

The age of weaning varies among societies substantially. Wharton (1989) reported that the weaning is generally initiated before six months of age in Europe and North America.

The weaning is believed to be influenced by socio-cultural and economic circumstances, for example, an infant is normally breast fed until the mother's next pregnancy in some cultures of different community of people.

Joint Expert Committee on Nutrition (FAO / WHO, 1973) has recommended the weaning after 4 months which is also advocated by DHSS (1988). Similarly, Ray and Reddy (1988) suggested weaning age as 5-6 months.

Van Steenbergen *et.al.* (1991) reported that the human milk production found to reach a maximum between 4 to 6 months after the infant's birth. According to them, introduction of weaning is a must as the infant's nutritional requirements can not be met by breast feeding alone.

When complementing is begun too late, there is a risk of arresting the child's development and laying the way for chronic malnutrition. There is no international rule regarding weaning age, but the age of 4-6 months is recommended (RICC, 1992).

Malnutrition problem can be significantly reduced almost two folds in weaned children as compared to unweaned children. Thus, weaning should be advocated, however, breast milk should not be discontinued abruptly.

Cohen *et.al.* (1994) in their detailed intervention study conducted in USA, concluded that breast fed infants self-regulate their total energy intake when the other foods are introduced. As a result, there is no advantage of introducing complementary
foods before 4-6 months, whereas, there may be disadvantage if there is increased exposure to contaminated weaning food.

2.3.2.2 Weaning dilemma:

Human milk does not provide enough energy to meet requirements of an infant of 4-6 months age, and, therefore, there is risk of malnutrition. Thus, the introduction of weaning foods is highly essential and vital, however, it should be kept in mind that there should not be any infection, because it is well established fact that nutrient-infection leads to malnutrition in children (Rowland 1978; Underwood 1985). Moreover, according to Hendric and Salma (1992), too early initiation of weaning causes risk of diarrhoea and food allergies may be due to introduction of external foreign materials in immature digestive tract of children.

2.3.2.3 Requirements at weaning:

Waterlow and Thomson (1979) investigated in detail the energy and protein requirements of many infants in some of the developing countries, and found that the growth of the infants was adversely affected. They have attributed the retardation of growth mostly to insufficient food or infection caused by advocacy of supplementary foods to the infants. Thus, they claimed that the exclusive breast feeding should not be recommended dogmatically. These observations were also substantiated by the DHSS (1988), wherein, they have reported that introduction of solid food varies from one individual infant to other.

Hendric and Salma (1992) reviewed the nutrient requirements of infants during weaning. They claimed that breast milk volume becomes inadequate at 3-6 months (700-970 ml / day). Hence, nutrients of public health concern after 3rd months of infant's life are carbohydrates, fats (energy), proteins, zinc, iron, vitamin D and vitamin A. They
also opined that protein requirements per kilogram of body weight is estimated as 1.3 gram.

According Waterlow and Thomson (1979), the requirements of protein and energy for the infants of age group between 4 to 6 months are 1.56 - 1.38 gm/Kg. body wt/day, and 102 - 95 KCal / kg body wt, respectively.

2.4 Weaning practices:

The weaning practices of Bangla deshi families were studied extensively by Jones (1987). Late weaning was observed with inappropriate weaning foods, low in iron and protein; predominant milk drinking with late conversion from bottle to cup and very late progression to family meals. Thus, infant's diet is found inadequate in total energy, protein and vitamin D were found marginally sufficient. Iron deficiency anaemia, growth failure and rickets are commonly seen which were found in Caucasians seemed to follow DHSS guidelines for weaning.

Diarra et al. (1989) studied weaning practices adopted by 800 mothers. The nutritional status of children was estimated from weight to height ratios of children of 0-36 months of age. They claimed that infant's age, subsequent pregnancy, and breast biting were found to be the main reasons for weaning.

The most common supplementary foods given to infants was top milk drawn from buffalo or cow reported in the studies of Rewa (Gurudeva, et.al. 1982) and Delhi (Ghosh, et.al. 1976). They also reported that increased level of maternal literacy favours a decrease in the dilution of top milk. The use of top feeds is started at the age of 19-24 months of age in urban community of Delhi.
They also reported that the care eliciting behaviour to give food, oral contact and psycho-physiological interactions and, in turn, the bonding and maternal response have a synergistic effect.

According to Bhandari (1983), the mortality and morbidity of infants in developing countries particularly in India are found to increase not only due to poverty but also due to the ignorance of mothers regarding the importance and nutritional functionality of colostrum. In the light of the above facts, the breast feeding has contributed a great deal in a gamut of developments in infancy. It also has nutritional immunological, biochemical and anti-economic advantages.

It has been proved beyond doubt that breast milk is the best for the infant, however, it has been pondered on the facts that whether the breast feeding can be advocated to infants for a prolonged period. It is well known from the scientific literature that the breast milk may not be sufficient alone to cater the needs of the the infants to achieve a reliable physical and mental growth, and therefore, weaning may be advocated or human milk may be complemented and progressively may be replaced or substituted by a variety of liquids, semisolids, and solid foods to effect a smooth and adaptable shift to a mixed diet. Thus, weaning is a very crucial event in the life span of an infant. However, the least pathologic effects that can be encountered at weaning include malnutrition, specially undernutrition and overnutrition. Moreover, inappropriate quality and quantity of some liquid or semisolid or solid diets may exhibit some syndromes, for example, the weaning foods which are high in energy, proteins or minerals may exhibit syndromes of overnutrition, and therefore, it seemed worthwhile to alert parents and health practitioners to advocate or recommend weaning foods at the correct time to avoid the dangers of an imaginary or badly formulated weaning foods. It is well recognised that there is a lack of
readily available information on the formulation and preparation of weaning foods. It is well known that streptococci was responsible to cause infection in infants when the breast feeding was advocated either in the country or elsewhere. Nevertheless, the possibility of transmission of tuberculosis via the milk to the breast fed baby can not be ruled out if the mother suffers from casealing granuloma of the breast. In other words, the human breast milk feeding has been documented to be the best suited for achieving the physical and mental health of infants. Indeed, the human milk has the capacity to protect infants against gastro-intestinal infections. It has also a contraceptive effect and facilitates / promotes bonding between mother and child. It has been established that the breast fed infants in India are having lower risk factor of death as compared to the infants who are artificially fed. It is well established that colostrum feeding plays a very unique and vital role in the growth of infant. It is also claimed that it protects infants from various infections. It is well recognised that the first milk secreted by the mother post partum during the first two days after birth of the infant is the colostrum. The physicochemical attributes revealed that it is thick, bright, yellowish fluid relatively less in volume and low in energy, however, it is believed to be rich in macromolecules specially proteins (i.e. immunoglobulin and lactoferrin). It has been also reported that it is richer in some of the vitamins and minerals as compared to mature breast milk. It is evident from the scientific literature that the colostrum feeding by Indian mothers is generally avoided as it is influenced by attitudes, misbeliefs and customs of the various communities of the different geographical regions.

Thus, breast feeding plays an important role in infants to have healthy mental and physical growth and also development as it possess specific psychological, emotional and physical care, nutrition and defence against infection.
Supplementary milk feeding was generally started to the infants below 3 months of age in urban and rural areas, to the extent of 65 and 57.8 per cent respectively in the state of Jammu (Sharma, et.al. 1972). However, it was observed that the supplementary feeding of milk to infants of age group between 3-6 months was found to vary considerably.

According to Rao (1983), none of the infants received supplementary foods before the age of 3 months. But it was noticed that majority (86 per cent) of the infants received supplements by the age of 1.5 years. About 22.1 per cent of infants received supplements between 3 and 6 months. More than half (65.4 per cent) of children studied had supplements by the time they are an year old. The introduction of supplementation earlier than the age of 6 months may be advisable only in societies where mothers are educated and have the means to provide supplementary foods in adequate quantities under hygienic conditions.

2.4.1 Breast Feeding and weaning practices:

Abroad:

Infant feeding practices of urban low income group in Ibadan were studied by Omotola and Akinyele (1985). They reported that about 80 per cent of infants were breast fed within 48 hours of delivery but most of the mothers claimed to have discarded colostrum produced in the first 24 hours of post partum. Those who were not breasted immediately were fed on glucose water and herbal preparations until they were put on to the breast. Breast feeding in most of the cases was on demand. At the age of six months, average 98 per cent of infants found to receive supplementation. Bottle feeding was the method of choice for liquid supplementation.
Broca et al. (1989) surveyed the breast feeding practices in Madagascar country and found that the duration of breast feeding was ranged from 5.3 months to several months. Eggs are introduced too early by 60% mothers. There was no significant difference in the use of different food groups in breast fed and non breast fed infants. Fruits and vegetable were also found to be introduced incorrectly.

John Knodel et al (1990) reported that there are number of social and economic forces operating in Thailand that have encouraged reduction in breast feeding and undoubtedly underlie the earlier decline. Plain water was given to baby in between 0-3 months of age. 52 per cent mothers gave solid foods before 3 months of age whereas altogether 91 per cent mothers gave any food or liquid other than water at 4-7 months of age.

Das et al. (1994) assessed the breast feeding practices of 0-2 year children in Bangladesh. It was observed that exclusive breast feeding rate was 37%, out of which 14.55 and 51 percent were in urban slum and rural areas respectively. The overall bottle feeding rate was 57 per cent. The results also revealed that the continued breast feeding rates were 89 and 67 per cent at one and two years respectively. They also reported that the exclusive breast feeding rates were inversely and bottle feed rates were directly proportional to mother's education.

One hundred and three infants of 6-12 months were studied by Kabir (1994). They found that most of the parents were illiterate (92-94 per cent). 98 per cent babies were given breast feeding. However, it was noticed that the colostrum was rejected by 48 per cent only. 19 per cent infants were put on to the breast on very first day of birth. Sugar-water and honey were the principal prelacteals offered by 89 per cent mothers. Exclusive breast feeding for 4-6 months was observed in only 21 per cent
cases. It was also reported that weaning was too early unduly delayed in 64 per cent cases. 46 per cent could not offer commercial weaning foods. Parents used low energy foods such as barely, suji, rice paste and banana for weaning in 83 per cent cases.

2.4.2 Weaning practices in:

India:

Like several other developing countries, the trend of bottle feeding was increased in India whereas, breast feeding was a traditional approach to infant feeding (Walia, et.al. 1974). They also reported that matriculated mothers and mothers belonging to higher income groups of Chandigarh and Aligarh introduced supplementary feeds relatively earlier than others.

Geervani (1983) investigated the various constraints in the weaning practices in India. The breast feeding and weaning practices of urban housewives in Srinagar were investigated by Ganjoo and Rowlands (1988). They surveyed 125 mothers and it was observed that breast feeding was followed in 89 per cent illiterate and 54 per cent literate mothers. The also claimed that socio-economic status of mothers was found to influence the breast feeding adversely. Literate level did not affect the age of introduction of foods. They reported that 15.5 per cent were exclusively top fed, whereas 24.5 were partially breast and top fed. According to them, the breast feeding was found to be maximum (80 per cent) and minimum (48 per cent) where the parent were literate and illiterate respectively.

2.4.3 Weaning practices in:

Maharashtra:

The effect of socio-economic level on the infant feeding practices in Maharashtra was reported by Dodd and Dutta (1988). They claimed that infants of
higher income groups were weaned earlier as compared to middle and lower income groups. But none of the groups had started weaning before 4 months of age. The reason for weaning in higher and middle income group was insufficient breast milk, whereas, the reason laid down by lower income group was, "The child is old enough to eat solid foods/subsequent pregnancy". Commercial foods like Farex, and Cerelac were introduced by most of the HIG and MIG mothers. However, LIG mothers started giving home food preparations. Most of the mothers were advised by mother-in-laws regarding weaning.

Kamat et.al (1990) observed that 12 per cent mothers did not give any feeding from birth till the 3rd day in Mumbai. Whereas, the rest of the mothers used prelacteal food like water, glucose water, milk etc. Breast feeding was continued till 4-6 months by most of the mothers. 50 per cent mothers gave dal and rice while 25 and 15 per cent mothers offered fruits and biscuits, respectively. Commercial weaning foods were used by only 0.5 per cent mothers. These results were also substantiated by Vali and Sharma (1994).

2.5 Weaning Food:

For arresting the malnutrition after the age of 4 months of child, it is necessary to develop and adopt well known appropriate processing techniques or technologies so that the developed weaning food can be easily prepared by mothers at home avoiding all possibilities of infection. Thus, weaning food which was prepared will be well accepted by children and also it will be suitable for local food habits. Different authors have reported about deveopment of weaning foods in India and elsewhere (Kansal and Choudhary 1981; Chandrasekhar and Balsubramaniyam, 1982; Malleshi and Desikachar 1982; Devdas et.al. 1984; Gopaldas et.al. 1987; Mann and Sharma 1989; Mehata et.al. 1989, Reddy et.al. 1990; Rathod and Udiapi 1991; Ashturkar et.al. 1992;
2.5.1 Weaning foods developed abroad:

Malting and roasting of cereal and legume blends have been found to enhance the digestibility and flavour. Moreover, it was observed that there was a considerable reduction in viscosity of the weaning foods during processing. Brandtzæg et al. (1981) confirmed that if the microbiological quality of germinated flour was found to be questionable, then the gruels can be subjected to boiling temperature.

Nout (1987) reported that weaning food made out of germinated cereal and pulse flour blends was found to be most acceptable to infants. According to them, germination of sorghum found to reduce the consistency of the gruel. Moreover, the nitrogen, iron, and also in vitro protein digestibility were found to increase during processing. Ramakavelo (1987) also used sprouted sorghum in the preparation of weaning gruels.

Mosha and Lorri (1987) concluded that the use of bulk reduced weaning foods of high nutrient density could eventually improve the nutritional status of young children and raise the nutrient intake. They found that addition of 5 per cent of germinated sorghum flour to the total ungerminated sorghum was found to decrease the viscosity of gruel from 9000 cp to 1000 cp within 5 minutes at 40 °C. Thus, the germinated sorghum flour was successfully used in weaning gruels.
The nutritional characteristics of weaning foods developed from germinated cereals and legumes were studied by Marrero, *et al.* (1988). They found that cereal-legume flours blends (70:30) gave efficient complementation of the amino acids to meet FAO reference pattern. Rice base formulations had better chemical score. During germination of rice and mung, the nutrients like mineral and vitamins were found to increase considerably. They also reported that germination of mung bean and rice for 48 and 72 hr, respectively was found to reduce the bulk of the gruel. They also claimed that rice gave higher nutrient density than corn formulation.

Improvement of family diet to benefit infants of weaning age was suggested by Galinod (1989). He found that the mixtures of potato, cereal and legume were more acceptable. Marrero and his coworkers (1991) investigated in detail the effect of germination on the nutritional attributes of flours and also the gruels. Germination, drying, dehusking, roasting and cooking were found to reduce antinutritional factors from food materials significantly. Anti-trypsin activity in cooked gruel was found to be almost nil whereas phytohaemagglutinin activity was virtually eliminated. The presence of phytates and tannins was nonsignificant. Improvement in *in vitro* protein digestibility was more pronounced in cooked gruels than in flours. 10 days feeding experiment showed good tolerance by infants.

*Moussa et al.* (1992) suggested that germination was a good option for reducing the bulk density of weaning foods, prepared out of cereals and legumes. Biochemical evaluation revealed that germination of wheat increased the protein and fat. Moreover, it was observed that complex carbohydrates were degraded into simple sugars during germination. However, no change was observed in lentil cereal based weaning foods. Malted, popped and roller dried wheat and chick pea blends were evaluated by
Livingstone et al. (1993). Wheat was dry heated, parboiled, popped in hot sand and blended with popped chickpea flour to prepare popped weaning foods. Toasted, debranned wheat and dehusked chickpea flours were mixed to get roller dried weaning foods. Formulations contained 60 per cent protein. Cooked paste viscosity of all malted formulations was significantly lower than popped and roller dried formulations. The biological value (BV) and true digestibility (TD) of malted foods were considerably higher than other formulations.

Asiedu et al. (1993) did not find much effect on proximate composition after sprouting jowar and maize, but they found that the gross energy of cereals was found to increased considerably due to germination. They also insisted the need of combining some legumes with jowar/maize porridges which were commonly used as weaning gruel in African countries. Santos, et al. (1993) studied the effects of extrusion on the protein quality of rice-mung bean-milk (70:25:5) formulations. They concluded that presence of milk during extrusion decreased the growth promoting value of the weaning food. Thus milk should be added to the rice-mung bean mixture after the extrusion.

Idowu et al. (1993) reported nutritional and sensory qualities of weaning food prepared from pregelatinized maize-sweet-potato mixture. These weaning foods were also fortified with soybean and peanut flours. The to malted weaning food significantly increased the osmolarity of the weaning gruel (Wahed et al. 1994).

2.5.2 Weaning foods developed in India:

A weaning food developed from ragi and green gram was studied by Malleshi and Desikachar (1982). This developed weaning food showed less nutrient content as compared to proprietary weaning foods, however, the higher amylase activity and calorie content were noticed.
Gopaldas et al. (1982) found that roasting was found to be superior over malting. According to them, malted multi-mix showed a shelf-life of 7 days whereas roasted multi-mix was safe up to 28 days. Chandrasekhar and Balsubramanyam (1982) studied life of weaning food. Weaning foods packed in 300 gauge LDPE pouches and stored well in tin containers upto 5 months at room temperature without developing any off flavour or rancidity.

Malted weaning foods were formulated using malted sorghum, maize, wheat and green gram (Desikachr, 1983). According to him, a traditional reprocessing of weaning food gave good aroma, reduced viscosity and increased calorie density.

Malted weaning food was developed by Malleshi and Amla (1987). They found that finger millet and mung bean in 70:30 proportion, resulted in higher PER, TD, BV and NPU as compared to proprietary weaning foods.

Viscosity units 3000-6000 cp was reported as spoonable and drop batter consistency. Roasting in traditional iron pan was found to lower amylase activity drastically. (Gopaldas, 1987).

A malted weaning food was developed by Chandrasekhar et al. (1988) from locally available food grains i.e. ragi, horse gram and roasted groundnut. Results revealed that amylase activity was higher at 10 and 15 per cent concentration. Storage study revealed that malted weaning food was acceptable even after 45th days of storage. They also reported that feeding of malted weaning food to infants showed significant increase in height and weight but no significant increase was found in arm circumference.

Mehta (1989) reported that addition of slurries of green gram dal flour to the maize slurries have resulted considerable reduction in viscosity. She also claimed that these dry powders in aluminum, tins and polythene bags at room temperature were safe
these dry powders in aluminum, tins and polythene bags at room temperature were safe during storage for 30 days without organoleptic, chemical and microbiological attributes.

Malleshiet al. (1989) reported that the malted weaning food which was stored in flexible pouches at 30°C and 92 per cent relative humidity was found to possess good shelf life (i.e. 5 months).

By using roasting, malting, puffing and fermentation, Reddy et al. (1990) developed four weaning food mixes and found that addition of spinach in mixes was not much acceptable. All weaning mixes were stored well in tin containers for four weeks without affecting their organoleptic characteristics.

Malted weaning foods over raw or commercial weaning products were recommended by Kulkarniet al. (1991). Rathod and Udupi (1991) found that the addition of amaranth leaves improved acceptability of malted roasted and puffed weaning mixes.

Gupta and Sehgal (1992) prepared weaning foods from bajra, barley, green gram, amaranth grain and jaggery. Household methods were applied for roasting and malting of these grains.

Roasting and malting processes were applied to wheat, bengal gram, groundnut and formulations were reported by Dahiya and Kapoor (1993). The formulations developed indicated the moisture, protein, energy, ash, fiber, iron and calcium content within the prescribed ranges of ISI for processed weaning food. They claimed that these supplements meet 1/3 of RDA per day for children of 1-3 year age.

Gahlawat and sehgal (1993) studied that effect of roasting and malting on antinutritional present in weaning foods.
2.6 Anthropometry and weaning foods:

The pattern of growth and the physical state of the body though genetically determined, were profoundly found to influence by diet and nutrition. Hence, anthropometry measurements are useful criteria for assessing nutritional status. Puri et al. (1976) studied feeding pattern and growth. Breast feeding was found to be ideal for weight gain up to the age of 4 months. Prolonged breast feeding without supplementation after 7 months resulted in a marasmic child. Devdas et al. (1984) concluded that supplementation of weaning foods to the infants showed better growth pattern than that of those who are not fed on any supplementary food.

Chandrasekhar et al. (1980) fed MWF to the infants for 6 months and anthropometry measurements were taken. It was found that children who received supplements were taller and heavier than their counterparts. Increase in crown heel and chest circumference was significant. Arm circumference did not find to influence significantly.

According to Briend and Bari (1989) the arm circumference was the most sensitive and specific anthropometric measurements for detecting children with high mortality rate.

Gain in weight was found to be more in infants who were fed with malted weaning foods than those who fed on proprietary weaning food. (Malleshi and Amla, 1987).

Devdas et al. (1984) also found that body mass index (BMI) could well be correlated with weight, and weight for height (per cent). A children with height of 90% or above 2.5 kg. showed better maintenance of weight for height and BMI to 6 months than did the others. Different studies have quoted different combinations, but so far combination of 2-3 cereals with legume have not been studied.