FORMULATION AND EVALUATION OF HOME-MADE WEANING DIETS BASED ON TRADITIONAL WEANING PRACTICES IN ONDO STATE.

BY:

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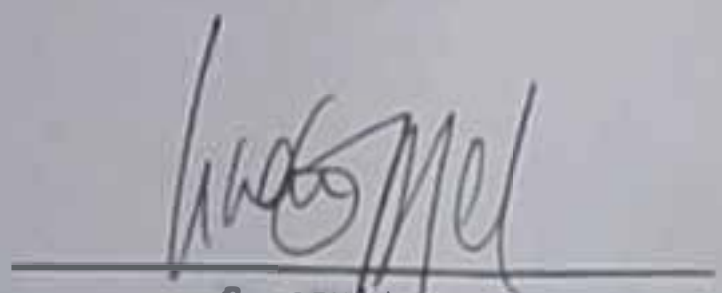
CERTIFICATION

This is to certify that this study was carried out by Bamidele Davis OMOTOLA in the Department of Human Nutrition, College of Medicine, University of Ibadan, Ibadan, Nigeria.



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DEDICATION

This thesis is dedicated to my Late father, Late Mr. L. OMOTOLA; my children, Mayowa and Desola OMOTOLA and to the greatest glory of God.

ABSTRACT

One thousand four hundred and eight (1408) mothers whose children ranged between 4 and 36 months were recruited from well baby clinics, immunization centres and the local communities from five local government areas of Ondo State to participate in the study.

In addition, fifty (50) resource persons were interviewed in the five local government areas on traditional weaning practices and pattern. Socio-economic data that included principal occupation of mothers and fathers, age of mothers, educational attainment and sanitary data were collected and analysed. Survey of available traditional weaning foods as well as existing weaning trend were also collected and analysed. Samples of commonly consumed traditional weaning foods in the study area were collected and analysed for moisture, combustible energy, fat and protein.

Based on the survey findings, twelve weaning diets were formulated and prepared from maize meal, rice, cassava, mature unripe plantain, cowpeas (common beans), groundnuts, soybeans, amaranthus leaves and palm oil. Each of the formulated weaning mixture contained a staple of either maize meal, rice, cassava flour or plantain and protein supplement of amaranthus leaves and either of cowpea, soyabeans or groundnuts. Palm oil was added to all the mixtures as additional source of concentrated energy as well as to influence the viscosity of the mixtures while enhancing the palatability as well as providing β - carotene to the diets.

The weaning mixtures were formulated to provide adequate level of energy and other selected nutrients based on the principles of multi-mixes using least cost statistical approach to determine the quantities and proportion of the component ingredients in the mixtures that would meet the requirements of young children. The compounded weaning diets were subjected to proximate analysis and eight of them to bioassay using weanling rats as well as to sensory evaluation and consistency/viscosity measurements.

The result obtained from this study revealed that the mean ages of the mothers were similar, twenty-six years, for all the five local government areas (LGA). The two principal occupations of the mothers were petty trading and farming both accounting for the job description of 56% of the mothers by local government area except in Ikere local government where food vending was highly important next to trading. 71% of all the mothers in all the five local governments had at least primary school education. 80% of all mothers depended on other sources of water for domestic use apart from pipe borne water in all the five local government areas. The socio-economic parameter of the mothers were similar and all belonged to low income rural households. All the 1408 children were breastfed for varying lengths of time from birth to thirty-six months and 81% of them were still on breast at 9 months of age. It was observed that breastfeeding was the preferred and normal way of child feeding in the areas studied. The mean age of completion of weaning differed along local government areas but 85% of all the children had been weaned completely at the age of 19 months.

Maize gruel was the traditional semi-solid food first introduced to children in all the 5 local government areas while gruels of cassava and plantain were subsequently introduced to children in three of the 5 local government areas. Seventy-three (73%) percent of the mothers had introduced semi-solid foods to their children by 6 months. Hospital personnel and parents/in-laws were the most important group of people that influenced mothers on child feeding in all the 5 local government areas.

Fruits were the first foods generally offered to infants at the mean age of 4.93 months followed by gruels at the mean age of 6.5 months. Sugar and artificial sweetners were observed used for infant feeding as early as the mean age of 4.5 months. The use of oils for infant feeding was delayed till about the mean age of 7.71 months.

Proximate composition of selected samples of weaning gruels commonly consumed by the children showed that the moisture content ranged from 83% in maize pap to 90.2% in cassava gruel, protein content ranged between 0.15% in cassava gruel and 1.39% in maize pap, fat content ranged from 0.05% in cassava gruel to 0.63% in maize gruel and the combustible energy ranged from 36 kcal/100 gm in cassava gruel to 64 kcal/100 gm in maize pap all on wet ready to consume basis.

The proximate composition of the formulated and propored weaning mixtures showed that the moisture content ranged between 75% in RGAO (rice, groundnut, amoronthus and oil) and 81.1% in RSAO (rice, soybeans, amoranthus and oil), the combustible energy ranged from 99 kcal/100 gm in MSAO (maize meal, soyabeans, amaronthus and oil) to 101 kcal/100 gm in MCAO (maize meal, cowpea, amaranthus and oil) while the protein content ranged from 2.51% in

RSAO to 3.54% IN CCAO (cassava, cowpea, amaranthus and oil) and the fat content ranged between 3.1% in RCAO (rice, cowpea, amaranthus and oil) to 6.86% in PGAO (plantain, groundnut, amaranthus and oil). All the above were on 100gm edible portion. The protein quality of the selected weaning mixtures formulated showed that the corrected protein efficiency ratio (C - PER) values ranged between 2.11 in CGAO (cassava, groundnut, amaranthus and oil mixture) and 2.40 in RGAO (rice, groundnut, amaranthus and palm oil mixture). Their net protein ratio (NPR) values ranged from 3.32 in CGAO to 3.65 in RGAO while the net protein utilization (NPU) values ranged from 71.96 in PGAO (plantain, groundnut, amaranthus and palm oil mixture) to 86.24 in RGAO. The true digestibility values ranged from 81.37 in PGAO to 90.18 in RGAO while biological values of the proteins in the mixtures ranged from 81.66 in CCAO to 90.56 in RGAO. All the protein quality parameters measured were statistically significantly different for the various weaning mixtures assessed except for the NPR ($P<0.05$). The protein quality of all the mixtures formulated, prepared and bioassayed fall within acceptable range recommended by the protein advisory group (PAG) of the United Nations, on weaning mixtures.

Sensory evaluation results of the eight selected weaning mixtures showed that there were significant differences in the appearance/colour, taste and consistency of the mixtures ($P<0.05$).

Based on the results of protein quality attributes the best diet was MGAO followed by MGAO (maize, groundnut, amaranthus and palm oil mixtures) and PGAO. Thus, depending on available local foods, any of the three diets could be recommended as suitable for proper growth and development of the weaning child in Nigeria.

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Finally, my gratitude goes to Miss 'Bisi Osunwole for typing the scripts of this thesis.

GOD BLESS YOU ALL ABUNDANTLY.

B.D. OMOTOLA

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CHAPTER ONE

INTRODUCTION

The greatest single factor that probably contributes to the survival of most Afican children has been the wide spread acceptance of breastfeeding as a normal way of life by African women (Omololu 1972 a, b; Orwell and Murroy 1974; World Health Organisation, WHO, 1981 and Omotola and Akinyele 1985). However, over the past four decades, incidence and duration of breastfeeding has declined in many developing countries particularly in the urban areas; and among the lower socio-economic class (M^{c}Cann et al 1981; WHO, 1981, Omotola, 1984 and Ogbeide, 1975).

Growth studies in Nigeria and other parts of Africa showed that the growth velocity of exclusively breastfed infants were satisfactory when compared to international growth reference standards for ages 4 - 6 months beyond which it fails below satisfactory levels; except those whose dietary intakes were supplemented with other foods [Delavady J. 1980; Waterlow and Thomson 1979; Juez et al 1983; Whitehead and Paul 1981 and Waterlow et al 1980].

The age at which breastmilk alone becomes inadequate as the sole source of nutrients for the infant are reportedly influenced by maternal nutritional status which is subject to individual variations and to the child's environmental condition. However, at some point in the infant's life, complementary foods are introduced while breastfeeding continues through the second year of the child's life in many traditional African societies. [Prema 1987 and Ashfaq 1987, M^{c}Cann et al 1981].

Complementary food, also termed weaning food, is defined to be any food liquid, semi-solid or solid given to an infant or child in addition to breastmilk. However, the term weaning is used by different people in different ways to mean different things. For example, it is used to indicate the introduction of foods other than breast milk or or formula milk and breastmilk is stopped i.e. it signifies the end of a stage or feeding phase. The term weaning is derived from the ancient Anglosaxon word 'wenian' which means to become accustomed to something different. The Oxford English Dictionary definition of weaning has two meanings; one is to get accustomed to food other than milk while the other is to disengage or care from habit by enforced abstinence of counter attraction. This dictionary definition covered both sides of the controversy surrounding the meaning of weaning. In the strict English sense, weaning means stopping breastfeeding, thus consumption of any kind of artificial milk as a replacement of breastmilk indicates a weaned child i.e. the child had been weaned off the breast. However, the univereally agreed practice is not to stop breastfeeding, at least in our circumstances as a developing country, but to continue breastfeeding as long as our cultural, social and personal habits will allow.

The weaning period is thus a period during which infants are gradually introduced to a variety of non-milk foods while the relative importance of breastmilk in the diet declines.

Breastmilk, unlike other foods, improves nutritional status of infants not only because of its excellent energy and other nutrients blend but

also because it lessens the effect of infections due to its content of active anti-infective agents. (Goldman et al 1982 and Blau et al 1983). Traditional complementary foods in most developing countries including Nigeria are described as often being low in caloric density (Whitehead 1979; Kazimi and Kazimi, 1979; Osuhor 1980; Akinrele 1966 and Eka 1978), low in protein content, (Ogbeide et al 1985); contains little or no fat (Naismith, 1973) and limited in micronutrients (minerals and vitamins).

It is noteworthy to realise that during the weaning period, the child goes through the phase of drinking to eating of semi-solid to solid foods. Most weaning studies reviewed were directed towards the balancing of the nutrients of the weaning foods often to the detriment of consistency of the diet (Akinrele and Edwards 1971; Ketiku and Smith 1984). Studies had shown that children's intakes were of low energy even when fed ad libitum (Akinyele and Omotola 1986; Zeithlin et al 1978 and Kanawati et al 1973). Bulkiness has been suggested to be the inherent problem with our traditional weaning diets making it very difficult for our children to consume enough. Bulk as term implies weight, volume and viscosity of the food. Weight is an easy measurable quality while viscosity, a measure of liquidity through solidity, is a rather more difficult quality to measure when compared to weight. Viscosity of cooked foods is most affected by dilution with water but varies with different ingredients, amounts and temperature of the foods (Church 1977). As foods become more dilute, larger quantities of the food will be required to provide a specified amount of energy.

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The introduction of any food other than breastmilk to the infant carries the risk of decline in suckling particularly if the foods are introduced very early. It is also a potential vehicle for the simultaneous introduction of infectious agents. The resulting situation of decline in suckling and infection is very well recognised and variously described as weanling diarrhoea, weanling dilemma or suckling dilemma. (Taba 1970; James 1972; and Rowland et al 1978).

Several factors play roles in the determination of time and type of weaning. Such factors include socio-cultural factors that play important roles in determining the dietary habit and nutritional status of any population group. It is thus critical to study the culturally related foods used for weaning so as to identify the basis for the choice of some foods for weaning purposes. Traditional weaning foods are determined by local customs, food fads, available foods, religious factors, economic consideration and the social influences of friends, relatives and institutional organisations: [Treuherz et al 1982; Brown 1978].

Thorough understanding of local weaning practices and traditional weaning foods will provide vital informations that will lead to the development of local home based weaning foods of wider acceptance locally. However, there exists gaps in available information on local weaning practices and traditional weaning foods available in this part of the country.

Omololu (1973) conservatively estimated that 7,300 children die annually of malnutrition in Nigeria before the age of four years, while

between 73,000 to 84,000 Nigerian children suffer from malnutrition at any one time. Dietary evaluation of Nigerian households showed that about three-quarters of rural households appear to suffer dietary energy deficit, which indicates lack of enough food to meet individual energy requirement [Collis, Dema and Omololu 1962]. recent studies in Ibadan among the urban poor show that height for age deficit was prevalent among 29% - 50% of the children surveyed, [Omotola et al 1985]. The few published studies in the area of child nutrition in Nigeria reviewed above only highlighted the magnitude and dimension of malnutrition among this segment of the population nutritionally most vulnerable to malnutrition. In improving weaning diets, nutrition education would have major role to play but the actual practices existing must be fully understood before attempts are made to modify feeding practices, as well as the underlying economic and socio-cultural reasons for them.

OBJECTIVES:

1. To explore and determine the weaning pattern, type of traditional weaning foods and factors considered in the choice of weaning foods in some select local government areas of Ondo State.

2. To collect and collate recipes of local traditional weaning foods in use in the study areas.

3. Determine the nutrient composition of samples of traditional weaning foods with respect to energy, moisture and macronutrients content.

4. Formulate some weaning diets based on locally available foods with the intent of improving the nutrient quality of selected recipes of weaning foods.

5. Chemical and biological evaluation of the weaning diets so compounded to ascertain their adequacy for infant/child feeding.

CHAPTER TWO

LITERATURE REVIEW

FOOD HABITS:

A thorough understanding of the social aspects of food and food consumption patterns is useful to understand the nutritional situation of any group of people. Food habits are the ways in which individuals or groups or persons in response to social and cultural pressures choose, consume and make use of available foods [Guthe and Mead 1945]. The main functions of food in a society is for survival, however from the social point of view, the human body's need for food has done much to shape the society through all activities concerned with food production, distribution and utilization [Richards, 1939 and Malinowsky, 1944]. Man does not think of his foods in terms of energy and nutrients but each society decreed what was or is food and what is not food and what kinds of food should be eaten and on what occassions [Leach, 1970]. People in many traditional societies have traditional ways of classifying their foods different from the scientific classification of foods based on chemical composition or functional attributes. [Landman et al 1983; Church et al 1976 and Githagui 1980].

SOCIAL FUNCTIONS OF FOODS:

Foods may serve some or all of the following inter-related functions in any society:

1. Gastronomic functions:- Man, most often times, eats foods for his pleasures. The pleasurable qualities of foods depend on the

organoleptic properties of taste, odour, appearance, texture structure and temperature as perceived by man's senses. The pleasure derived from food is partly determined by culture and psychological factors [Konwenhoven 1970]. Taste and appreciation of foods differ from one region to another [Gibson 1981]. For example Europeans are reportedly well known for their preference for soft foods while Africans prefer to chew or have granular taste of rice eaters as against the glutenous taste of some other societies [Den Hartog et al 1983].

2. Foods function as a measure of Cultural Identity:- Foods may establish the cultural identity of a group of people for example, through a mesh of taboos, obligations and food avoidances [De Garine 1962]. Food avoidances or taboos in a society serve to show differences between various groups and as a means of cultural identity e.g. the Ondoa avoidance of a particular bush rat, Okete. The diets of strict vegetarians, rastafarians and other sects serve to distinguish such groupings from the rest of society and give a feeling of identity.

3. Foods Possessing Religious or Magical Functions:- Different societies have foods reserved for their magical or religious functions. In folk medicines, food is considered to have special properties, for example, the avoidance of certain foods during pregnancy, early

lactation and even weaning because of their harmful properties [Sokr. 1971, Ogbeide 1974: Gupta and Sharma 1980]. Most traditional religious ceremonies have dietary regulations and foods of particular type (s), prepared in particular ways, are used in the service of god.

4. Foods as Means of Communication:- The universal perception of Africans as being very hospitable is not unconnected with their ways of entertaining visitors or strangers. Foods offered to a visitor may put him at ease and thus facilitate communication. Exchange of foods during social or cultural functions sometimes have elements of strong competition when the type and size of meals exchanged are considered. In situations when most members of the family go out to work outside the home and only come together at meal times such meal times allow them opportunity to discuss mutual issues, as it is often the case in highly industrialised communities [Cibson, 1981].

5. Food As An Expression of Economic Status:- Food has long been recognised as a measure of wealth or status. Most cultures have recognised prestige foods mainly reserved for special occassions. The increasing contact among countries, urban and rural societies has led to the stigmatization of foreign European foods as prestige foods in less industrialized countries [Church et al 1976 and Eide 1980]. Such foods are highly refined and industrially processed. [Painter 1972].

6. Means to Exercise Influence and Power:- Food can be used to exercise influence and often people in control of food supply also control such societies. In the pattern of household food distribution, the head of the family, often the father, gets the best part and lion share of any available food. In recent history food aid to poor countries are often based on political consideration rather than need. Sometimes food supply as a measure of trade are often not done on economic consideration alone but with a colour of political or ideological influence for example, economic sanctions, the wheat crisis of U.S.S.R due to Americas withholding of wheat supply thus causing serious shortages in the U.S.S.R. in 1986 during the cold war era [Amartya Son 1984].

ENVIRONMENT AS A FACTOR IN CHILD NUTRITION

The choice and use of available foods have an ecological component termed the environment. The diet of any community is closely related to its ecological zone among other considerations. [Annegers 1973]. Domestication of plant is often in response to the natural ecosystem i.e. either seed culture of the drier regions and the root-tubers culture of the more humid regions [Harris 1969; Food and Agriculture Organisation of the United Nation, FAO, 1970]. Plant domesticetion often lead to dependence on a single staple such as rice, maize, cassava, yams or plantain. However, if the staple of the community is poor, in certain nutrients, nutritional deficiency may result. For example, in

the forest zones of Nigeria with root and tuber culture, the diet is characterised by deficiency of protein and riboflavin [I.C.N.N.D. 1967]. Differences may be found between various communities of the same ecological zone (e.g. in food distribution, food avoidance, infant feeding) which may result in different nutritional problems.

The age long balance between the community and its environment is being disturbed by external factors. Population growth, urbanisations and changes in crop system are other factors known to influence food habits.

Fig. 1.

Fig. 1: Main determinants of a community's food habit [Source: Den Hartog and Van Staveren, 1983].

Farming System:

Farming in most parts of Nigeria is characterised by production of food crops for household consumption and sole i.e. subsistence farming. FAO (1970) estimated that 64% of the food consumed in Africa south of the Sahara was derived from subsistence farming. However, cash cropping is now practiced in most parts of Ondo State and money has now become a necessity in most rural areas. The cash income in most cases is often used for non-food purchases e.g. payment of taxes, levies, school fees, dowries, weddings, burials, purchase of radio sets, bicycles, motor cycles, television sets, cigarretes etc [Kraut and Cremer, 1969]. The economic development in rural areas that leads to cash cropping and marketing may and it often has harmful side effects on nutrition e.g. the replacement of labour intensive food crops by food crops requiring less labour but nutritionally inferior and replacement of food crops by non-food cash crops (Lipton 1977). Such side effects include the dependence of rural households food supply on irregular wages or monetary returns and on food market forces of demand and supply.

Cash cropping weakens the socio-economic status of women where agricultural extension is directed to cash crops and most often to men [FAO, 1979].

COOKING FUEL SCARCITY:

The effect of the alteration of balance of community and environment might not be limited to marginal food supplies alone particularly to the

poorer households but might also lead to low income, rising cost of food and diminishing source of cooking fuel [FAO 1981]. Most rural dwellers depend on firewood as the chief fuel for cooking [Eckholm 1976].

Population growth which is far outpacing the growth of new trees portends nutritional consequences for the poorer households. Fuel scarcity may result which will in turn may result in longer search for firewood in rural areas, a task once done with little difficulty [Eckholm 1976]. Firewood scarcity will be a burden to those that are to search for firewood i.e. women and the young children. On the other hand, scarcity will increase the unit cost of available firewood which will increase the cost of cooked foods or reduction in frequency of consumption of cooked meals [FAO 1983 and Lunven 1983] or it will increase deforestation with consequent erosion due to lack of vegetation cover [United Nations Environmental Programme, UNEP. 1989]. Lack of vegetation cover will endanger food production due to loss of top soil and arable land resulting from erosion (UNEP 1989). Alternative fuel sources such as kerosine or bute gas are increasingly expensive for families in rural areas used to collecting firewood for no cost.

INFLUENCE OF URBANIZATION ON FOOD HABITS:

Urbanization is the most dramatic and fundamental social force leading to changes in developing countries with major impact on nutrition. The definitions of what constitutes an urban area are many. The United Nations

defined it in terms of population size of at least 20,000 people and occupation, non-agricultural (U.N. 1969). Rapid population growth due to high fertility rates and migration is greatly altering the demographic structure of the population (Arriagn 1968). Urban environment affects food habits and dietary patterns (Freedman 1973) because all foods have to be bought and time for lengthy traditional food preparation is not always available. De Garine (1969) stated that urban food habits depend initially on traditional food habits and later on new influences. Urbanization is a two-way process, not only do people migrate from the rural areas to the cities but also outward spread of urban influence into rural areas (Anderson 1964; Gutkind 1974; Omotola and Aina 1991). Migration of young able bodied people from the rural areas also lead to reduction in farm labour that translates to substantial reduction in food production in rural areas. Urban influence could also lead to shift in food crops production solely meant for urban markets at the expense of food crops for the farmers family. The close ties that exist between urban migrants and rural dwellers (Adepoju 1974 and M^{c}Gee 1975) serves as influencing channel on the ways of life of the rural dwellers which includes food habits, tastes and attitude.

SOCIO ECONOMIC STATUS AND FOOD HABITS:

In urban areas, one could easily distinguish three socio-economic classes with each class having characteristic food and nutrition habits.

Socio Economic Class	Food Habits
1. High:- recognised among traditional aristorcrat, high-ranking civil servant and top manngers in industries.	High intake of energy, protein fat and sugar. Large intake of highly refined foods, imported industrially prepared foods and convenient foods in tins, cons and bottles.
2. Middle:- recognised among professionals, lower civil servants	Combines elements of high and low socio-economic group food habits with a stronger tendency to emulate the high group.
3. Low:- recognised among labourers, other ranks and unskilled workers	Lower intake of energy, protein fat ond sugar. Monotonous food consumption. Low intake of imported foods or industrially produced and processed foods.

Table 1: Typical food habits among urban socio-economic classes in developing countries.

The proportion and absolute number of people in the high and middle socio-economic classes are small but they exert a strong influence on food economics of the communities particularly their demand for imported foreign foods, [Briscoe 1963]. Many of the differences in food habits found among the three socio-economic classes of the urban areas are also found in rural areas with distinct social classes. However, this does not generally apply to rural traditional areas [Den Hertog and Staveren 1983].

Income:

Income is a major factor that influence food habits and nutrition. Several community based studies confirm that malnutrition is concentrated among the low income groups [Simmons 1976 a and b and Medayet 1971]. Significant increase in income often result in purchase of more expensive foods that might be of less nutritional value. It may also result in change in dietary habits such as change from starchy staples to meat, fats, sugars, fruits and vegetables. In a Sri Lanka studies, improvement in income only had a modest effect on food habits [Coleman et al 1973], this observation made the authors to conclude that long term improvements in nutritional status will depend on a faster rate of economic growth.

Household Size:-

Household size influence food habits and nutrition particularly in poor households that depends on cash for food purchases. Quioguo (1969) showed that with increase in family size, consumption of food of animal origin decreases and staple foods are replaced by cheaper ones or decreased in quantity as well. Protein and dietary energy intake per head may also decrease.

FOOD TABOOS (FOOD AVOIDANCES):

Taboos or food avoidances influence dietary patterns and nutrition within the household. Food avoidances could be permanent or temporary [de Garine 1967]. It is considered permanent when such foods may never be consumed while temporary avoidance applies to individuals during certain

periods within the persons life cycle either birth, pregnancy lactation, childhood or various diseases or illnesses. Most temporary food avoidances concern the vulnerable groups, pregnant and lactating women, infants and children during periods of weaning and rapid growth. Temporary food avoidances may have significant consequences on the individuals particularly if avoidances takes place during critical periods of their life cycle. Temporary food avoidances are often the kinds that will deprive the individuals of nutritionally valuable foods such as meat, fish, eggs, vegetables, sugar or oil [Ogbeide, 1974 and Simoons, 1962]. Permanent food avoidances in contrast have little effects on the nutrition of the individual since most avoidances generally involve whole population or group of individuals e.g. pork and the Muslims; Okete (bush rat) and the Ondos.

DYNAMICS OF FOOD HABITS:-

The food habits and dietary pattern of a society are never static but ever changing with changes in socio-economic system. One major aspect of the dynamics is the diffusion and acceptance of food crops and animal throughout the world [Miehoff 1967]. Maize, sweet potatoes, cocoa, cassava groundnuts were reported to have originated from America and introduced to Africa through Asia. These food crops are among the estimated 50% of total food crops found in Africa that have their origin in the Americas [Schnell 1957]. Some of these new foods have had considerable influence on the societies in which they have been accepted. Maize was until recently the food of the poorer sections of the Mediterranean society [Chick 1960],

Acceptance of bread in Africa and other non wheat producing areas further a-test to the dynamics of food habits (Young 1973). Bread and other wheat products enjoy wide acceptance because of urbanization and the need for time-saving foods and the high presence of people with bread-eating habits. Food habits change could either be for better nutritionally or worec by external influences or by modification from within the society. Change in food habits is generally induced by major agencies, government or events each with its own objectives and methods (Lathom 1972). High demand for certain foods in a community is not likely to be reduced by nutrition educotion alone but by other strategies in combination with nutrition education (Colby 1964). In most nutrition programmes, face-to-face communi-cation is the method of choice with mass education methods being of relative insignificance (Manoff 1974 and Parlato 1974). Messages given may sometimes conflict with those of different agencies given to the some target audience e.g. health, education, agriculture, community development etc. (Davey et al 1969).

PHYSIOLOGICAL FACTORS IN INFANT NUTRITION:

The age at which various functions and organs of the newborn reach sufficient maturity to allow for the introduction of semi-solid foods with out producing metabolic, mechanical and immunological adverse effects are other important aspects of weaning. Acceptability of a diversified diet is only an aspect. The age of introduction of weaning foods should depend partly on the development of the functional ability of the gastro-intestinal

tract (g.i.t.) as well as on the maturation of mechanical factors necessary such as chewing and swallowing. Other considerations are behavioural, psycho-social, cultural and the types of weaning foods available.

The types of weaning foods to be given will depend on the presence of appropriate biochemical pathways for digestion, absorption and utilization of each nutrient contained in such diet. The quantity of the food will depend on the digestive and absorptive capacity of the g.i.t. for different substrates which in practical sense depends on appetite. However, the primary determinant of when to wean will be nutritional as well as behavioural.

GASTRO-INTESTINAL TRACT DEVELOPMENT

Morphological evidences show that the apparatus for taste is fully developed by the 16th week of fetal life [Bradley 1972; Murray and Murray 1970] and the ability of neonates to taste is active at birth [Crook 1981].

Swallowing behaviour was documented in human foetus at 12 week while the three phases of swallowing were reported possible at birth [Crybouki 1965]. Swallowing is usually divided into three phases namely the oral, pharyngeal and esophageol phases. In the neonates, the latter two phases were not well co-ordinated until after the 1st 48 hours after birth [Crybouki 1965]. The functional length of the esophageal sphincter develops progressively from birth to 6 months but it is functionally effective at birth [Sarkar 1983].

The stomach receives food, stores it, reduces solids to fine particles

and regulates delivery to the duodenum. Gastric emptying depends on the size of the opening of the pyloric and the differences between intra-gastric and intraduodenal pressures, [Hunt et al 1968]. The rate of emptying of the stomach also depends on the distension of the stomach, osmolality, consistency of the meal in the stomach, presence of fat and acid in the duodemum, [Cook 1975]. Gastric motor are active at birth [Cavell 1981] and their activity depends on the nature of the meal i.e. liquid, semi-solid or solid.

Basal gastric acid secretions occur within few minutes after birth and gradually increase over several hours to reach levels near those of older children as shown by studies of Euler et al (1977). Gastric acid secretion increase from few hours after birth till about 10 days [Agunod et al 1969], decreases thereafter up to 30 days [Christie 198] and increases several folds progressively thereafter up to 24 weeks when the stomach secretory capacity approaches the lower limit for adults [Grand et al 1976].

Peptic activity is shown to exist by 16 weeks of fetal life [Werner 1948 and Keens et al 1927]. Pepsin secretion parallels gastric acid secretion reaching adult levels by 18 months [Agunod et al 1969]. The secretion of intrinsic factor in the gastric juice at birth reaches 50% of adult levels which progressively increase to reach adult levels at 3 months of the infants life [Agunod et al 1969 and Radho et al 1967].

Lingual lipase activity is reported to exist at 25 weeks of fetal life and the level reaches adult levels at birth [Hamosh et al 1981]. It is

believed that the occurence of lipolytic activity in gastric aspirate resistant to low p^H compensates for low pancreatic lipase andbile salts secretion during the neonatal phase.

The small intestine mode up of the duodenum jejunum and ileum are completely formed with all neccessary anotomic structures to about 75% adult length at birth [Siebert 1980]. All intestinal enzymes are active at birth with some of them exhibiting activity as early as 4 - 5 weeks of fetal life [Auricchio et al 1965]. Active transport mechanism of nutrients across the gut lumen are demonstrably present at both the fetal stage and at birth reaching about 2/3 of adult published values at birth [M^{c}Neish et al 1979] for glucose and neutral amino acids. Absorption of fructose, dibasic and dicarboxylic amino acids and oligopeptides are unknown both at fetal stage and at birth but absorptive mechanisms for them have been reported to be fully developed at 8 months post partum [De Belle 1979].

The pancreas is fully developed and functional at 20 weeks of gestation as shown by the studies of Laito et al (1974) while pancreatic enzymes excepting amylase are detectable in measurable quantities at birth [Tract et al 1975]. However, few weeks after birth amylase becomes barely detectable increasing rapidly with other pancreatic enzymes progressively with age till 2 - 3 years of the child's age [Zoppi et al 1972].

There are evidences of early synthesis and presence of bile acids in the gall bladder of the fetus from 22 weeks gestation [Bongiovanni 1965]. However, there appears to be a period of secretory failure during the las

2 - 3 weeks post partum as evidenced by intraluminal bile salt concentrations [Poley et al 1964 and Watkin et al 1975]. This observed secretory failure is postulated to be physiologic cholestasis existing at birth, [Watkin et al 1975].

In summary, the increasing digestive and absorptive capacities noted in the first year of childhood are mainly due to organ growth and development rather than any other reasons.

Gastro-Intestinal Tract Functional Capacity:

Carbohydrate Digestion and Absorption:-

There are evidence in literature to show that there is functional lactose insufficiency in infancy up to 2 months post partum which decreases thereafter [Lifschitz et al 1983 and Barr et al 1984]. This insufficiency is postulated to be due to the feeding patterns and rate of gastric emptying [Barr et al 1984]. However, in contrast to lactose, sizeable amounts of cooked starch is reportedly well tolerated at birth even though α-amylase activity is low at birth [De Vizia et al 1975]. Results of balance studies show that 1 month old normal infants were able to perfectly absorp 10g/day of cooked wheat, corn, tapioca or potato starch and up to 40g/day of cooked rice starch [Auricchio et al 1968 and De Vizia et al 1975], with high co-efficient of absorption (>97%). The high absorption co-efficient is due to great efficiency of the duodenal α-amylase and colonic bacterial fermentation with latter path way assuming great importance when the carbohydrate becomes more complex [Shulman et al 1983].

Protein Digestion and Absorption:-

Functional capacity of the newborn gut to digest and absorb proteins cannot be evaluated from balance studies unlike carbohydrates and lipids because of endogenous protein secretions. However, a few conclusions were drawn from available studies that during the first week of life, the upper limit to protein ingestion is unrelated to gut functional capacity but to the immaturity of renal excretion of nitrogen and though pancreatic trypsin secretion is not fully developed till about 2 - 3 years of age, it is almost sufficient from birth [Lindberg 1974 and Schmitz et al 1987]. Protein supplement can be introduced at any time and level subject to renal capacity. However, there is the risk of mild digestive symptoms manifesting as loose, foul-smelling putrefactive stool if gut absorptive capacity is exceeded.

Lipid Digestion and Absorption in Infancy:

Balance studies had been used extensively to assess the functional capacity of the infant gut to absorb fat. Some of the results show that there is obligatory fat excretion in faeces that amounts to 1g/day [Cotton 1972] and there exist physiological fat malabsorption even when fed with human milk in both full term and preterm infants [Roy et al, 1982].

However, this observable malabsorption disappears at 2 months of age when lipid absorption co-efficient reaches 95% and over for breastmilk while cow's milk fat is poorly absorbed with a co-efficient of less than 90% even at three months of age in full term babies [Fomon et al 1970].

Evidences from literature show that the malabsorption is probably a function of type and amount of fat ingested [Williamson et al 1978 and Signer et al 1974]. After 3 months post partum, physiological steatorrhea (absorption co-efficient < 70%) is only observed when fat intake is as high as 5 - 7g/kg body weight/day and composed of butterfat [Fomon et al 1970]. In conclusion, gradual increase of ingested fat at weaning should have no adverse affect nor their origin have such effects.

Renal Function in Infancy:

The functional capacity of the kidneys in infants and newborns is much lower than in children and adults [H^{c}Cance, 1962; Rodriguez - Soriano 1987]. In most of the studies, neonatal and infantile renal functions were compared with adult standard values with correction for weight or surface areas. Understanding the quantitative limitation of the developign kidney is important so as to keep the nutritional load within tolerable limits of the infants kidney.

Anatomic and Functional Development:

The human kidney development begins by the 5th week of gestation and is completed by the 34th week. At the end of full gestation, the kidney possesses a full compliment of about 850,000 - 1,000,000 nephrons per kidney [Rodrigues-Soriano 1987]. Anatomic maturation of the kidney has been reported to be dependent on the size and histological appearance of the glomeruli and the size and disposition of the tubules [Patterman et al 1965]. During infancy, there exist preponderance of glomeruli over tubules however, the composite glomeruli/tubules ratio decreases during growth approaching

adult values [Fettermnn et al 1965]. Functionnl copncity studies show that the infant's kidney matures both morphologically and functionally during the 1st year of infancy [Guignard 1982 and Spitzer et al 1974]. The glomeruli filtrntion rate (GFR) is dependent on the hydrostatic pressure, osmotic pressure which is the opposing pressure, the permeability of the glomeruli membrane and the total filtrntion area. The GFR is low in the first few days of life but increases steadily as the baby grows older reaching about 2/3 of adult levels at about 3 months of infancy [Guignard 1982]. Thus infants at 3 months and above could tolernte wider amounts of water and solute in response to the morphological and functional maturation of the kidney.

Tubular reabsorptive capacity of Infants kidney studies revealed that the reabsorptive capacity are low when compared with adult values and [Rodriguez-Soriano 1987] much lower than glomerular functionnl capacity.

Inspite of the renal immaturity of the young infant's kidneys, they are still capable of maintaining normal internal environment given appropriate dietary intake and still maintain normal growth. However, when dietary intake is inappropriate or when growth anabolism is missing then the developing kidneys easily experience over-load of solute and water resulting in retention of excretory products. Most of the renal limitations are completely overcome from after six months of infancy excepting the ability to handle salt load [Rodriguez-Soriano 1987].

BEHAVIOURIAL ADAPTATION IN WEANING

Suckling or chewing and swallowing are all necessary prelude to digestion and absorption of food by the gut of the infant. Suckling involves a learned process initiated through non-nutritive suckling to nutritive suckling while chewing, an essential skill which infants must acquire to allow for progressive introduction of solid foods preceeds swallowing [Gryboski 1969 and Wolf 1972]. Observational studies show that neonates exhibit extrusion reflex when spoon is introduced into the anterior part of the mouth. This behaviour changes by 4 - 6 months when spoon is introduced with the tongue depressed to accept the food into the posterior part of the mouth and is swallowed. At 7 - 9 months post partum, rhythmic biting movement is observed even in the absence of teeth [Herbst 1981]. Illingworth and Lister (1964) showed that the child's ability to chew is part of a developmental learning process suggestive of a critical period of development during which infants can and must learn to chew. The stimulus to chew is influenced by the texture, taste, smell and appearance of the food which in turn affects the pharhyngaecophageal function of swallowing [Gryboski 1965].

NUTRITIONAL FACTORS IN WEANING

Nutrients recommendation for healthy infants must take into consideration several factors such as the differential growth rates of infants which is partly influenced by nutrition and partly by environment. While usual recommendations are safe, sufficient and practical for almost

all healthy normal infants, they may be excessive or deficient for a few.

Energy Requirements:-

Energy needs vary according to age and weight for full term infants in the first year of life. Neonatal energy requirements are comparatively lower on unit weight basis because the body contains more metabolically inactive water than in later life as the infant begins to change in body composition [Barness 1985]. The United States of America's National Academy of Science - National Research Council, NAS - NRC, (1980) recommended an average of 115kcal/kg/day for the first 6 months and 105kcal/kg/day for the next 6 months of infancy. Wide differences have been found in energy intakes of infants fed either breastmilk [Dewey et al 1982] or formula fed [Stewart 1981]. Dewey et al (1982) found an average energy intake of 107kcal/kg/day at one month in breastfed infants which declined to 85kcal/kg/day at 5 - 6 months while Stewart (1981) found a range of energy intakes of 56 - 152kcal/kg/day in his group of formula fed infants studied at 3 months interval with total average energy intake declining slowly with increasing age.

Whitehead et al (1982) in their Cambridge studies, estimated infant's energy need from periodically measured breastmilk intakes to be 104kcal/kg/day on the average for boys at two months, 97kcal/kg/day at 3 months, 91kcal/kg/day at 4 months, 89 at 5 months, 87 at 6 months and 89 at 8 months. This study thus concluded that breastmilk as the sole food is adequate for the infant up to 6 months. The requirement for growth is a substantial part of the total energy requirement in young infants [FAO/WHO/UNU 1985].

Caloric utilization are influenced by such other factors such as temperature, specific dynamic action of food (digestion and absorption) and infants activity such as crying [Payne et al 1971].

Normal growth is usually assessed in relation to reference growth standards of which the National Centre for Health Statistics, NCHS, reference figures are widely used though most countries have developed their own reference figures [Hamill 1977, Tanner et al 1966 and Jonas 1974]. Growth reference figures only indicate average growth for the group from which the figrues were derived. However, deviation from the mean of one set of figures does not necessarily indicate abnormality particularly if the children reviewed have different environments and nutritional customs. This is particularly true in early infancy when growth is so rapid and infants follow very different growth curves different from the reference standards and yet appear well and adequately nourished (Whitehead et al 1984]. In a review of sixteen studies of infants energy intakes, Whitehead et al (1981) concluded that total energy intakes from milk and solids were lower than those recommended by the joint FAO/WHO Ad hoc expert committee in 1973.

Infants are able to adapt to lower energy intakes particularly during weaning by reducing spontaneous activity. The importance of activity and the need of infants to keep warm are relevant to the ability of infants to adapt to their nutritional environment. Child rearing practices could modify metabolic needs so as to spare nutrients for growth. Omololu (1982) in a comparative analysis of energy intakes of infants at home and those in

orphonage observed that home based breastfed infants thrived on very low energy intakes of between 57 to 51kcal/kg/day from fourteen days to ninty days while those raised in orhanages could not be supported on such low energy intakes. His explanation was that those studied at home were wrapped and strapped to their mothers backs from morning till night and kept worm by the close proximity to their mothers bodies while effectively preventing them from moving by tight wrapping. Thus energy need to keep warm and activity were very low at home unlike in the orphonage where infants were nursed in cots that were cooler and the infants were free to move freely in their cots thus more energy were required for heat production to keep worm and activity.

Energy requirements were met primarily by carbohydrates and fat though protein ingested may be used for energy particularly if the other two dietary energy sources are limited. Energy requirements for maintenance takes precedence over protein needs for growth if carbohydrates or fats are limited.

Infant studies from most developing countries show that breastfeeding is a universal practise and when other foods are introduced, mothers do not stop their babies suckling from the breast [Omololu 1972 a and b; WHO 1981 and Omotola *et al* 1985] and can thus sustain milk production of about 600ml/day for the first year [Whitehead *et al* 1980].

This level of breastmilk production provides nearly all the protein needs of the baby in the first year. However, such production level will

not be adequate to meet energy requirement thus energy will be the most limiting and energy dense complimentory food will be required from obout six monthe of infancy.

Protein Requirement

Mature human milk protein content has widely been reported to be adequate to meet the protein requirements of hoolthy infants for the first year of life provided breastmilk intake continue un-interrupted and with slight reduction in volume over the year [M^{C}Laren, 1974; Whitehead et al 1980]. Pooled mature human milk contains an average of 0.9gm protein, peptides and amino acids and 0.2gm non-amino acid nitrogeneous compound per 100ml [Svanberg et al 1977]. This protein quantity may be lowered in breastmilk produced by mainourished mothers but normally breastmilk protein content falls slowly during the first four months of lactation in well nourished mothers and falls slightly further after six months of lactation [Lemons et al 1982].

Protein requirements are based on needs for growth, obligatory nitrogen loss in urine, feaces, skin and its appendages as well as for synthesis of hormones, enzymes, sole for the maintenence of osmotic pressure gradient and the synthesis of other proteins in the body. Protein quality depends on digestibility, utilization and the distribution or pattern of its amino acids. Limitation of essential amino acids in infants and children will affect tissue and organ growth, height, weight and head circumference

[Barness, 1985]. However, excess of one or more essential amino acid (s) will result in amino acid inbalance which will cause defects in body protein production or utilization [Barness et al 1957]. Estimates of infants protein requirements based on human milk intake involve other considerations such as role of non-protein nitrogen constituents of milk apart from digestibility of human milk [Alois et al 1975]. Non-protein nitrogen constituents of human milk is estimated to be about 25% of the total nitrogen content [Alois et al 1975].

Widdowson (1981) calculated infant protein requirement to be 1.6gm/kg/day but based on nitrogen balance studies, the calculated value was 30% lower than even when high quality protein were fed [FAO Nutrition Rept; 1973]. About 2/3 of the protein requirement of infants is used for growth in the first month which gradually decreases to about 10% by the twelveth month of the baby's life [FAO Nut Rept. 1973]. Protein requirements are related to quality measured in terms of biological value (BV), protein efficiency ratio (PER), and net protein utilization (NPU). FAO expert group fixed requirement to range from 2.40gm/kg/day for infants below three months to 1.44gm/kg/day for infants 9 - 11 months based on egg or milk proteins [FAO 1973]. However, when protein of lower quality is consumed as it is the practice in most developing countries, the requirement are proportionately increased.

Studies from the Gambia and some other developing countries show that majority of the mothers are able to sustain milk production of about 600ml/day for the first year which provides nearly all the protein need of the infant in the first year [Whitehead et al, 1980 and Vis et al 1987].

Table 2.1: Daily Average Energy Requirements and safe level of Protein intake for infants and children: Three months to two year sexes combined [FAO/WHO/UNU 1985]

Age	3 - 6 months	6 - 9 months	9 - 12 months	1 - 2 years
Approx. weight (kg)[1]	7	8.5	9.5	11
Energy requirements[2] kcal/kg/day	100	95	100	105
Kcal/day	700	810	950	1150
Safe level of protein[3] g/kg/day	2.43	2.22	2.07	1.72
g/day	17	19	19	18.5

1. Approximate NCHS median weights at mid of age group
2. Based on the FAO/WHO/UNU Expert group report (1985)
3. Safe level of protein intake have been adjusted to assume protein quality of the diet in poor communities (about 70% FAO/WHO/UNU standard).

Source: Adapted from Improving the Nutritional status of children During the weaning period by Mitener et al (1984).

LIPIDS

Mature human milk provides about 40 - 50% of energy as fat (3 - 4g/100ml) though it may be slightly lower in malnourished mothers. A minimum of 30% of the dietary energy as fat appears desirable not only to satisfy energy needs but also to facilitate absorption of essential fatty acids, fat soluble vitamins, calcium and other minerals as well as to balance the diet to conserve other nutrients which might otherwise be used for energy (Alfin-Slater et al 1980). Linolenic acid, a polyunsaturated fatty acid is essential and found in most vegetable oils except safflower oil though the precise requirement is not known (Holman et al 1982). Essential fatty acids are necessary not only for growth but also for function and maintenance of cell membrane, lipotropic activity, synthesis of prostaglandins, reproduction and cholesterol metabolism (Fomon 1974). Fat also confers enhanced palatability to diets as shown in studies of palatability tolerance zone in which dry foods were only described palatable with the addition of sufficient fat (Church 1977).

WATER

Water requirement are related to calorie consumption, environmental temperature, activity, growth rate and specific gravity of urine. Water is required for maintenance, excretion of excess protein, electrolytes intake and changes in body composition. Allowance for activity increase basal water need by about 50% i.e. from basal skin loss of 30ml, 15ml respiratory

tract loss, 50 - 70 ml/100Kcal for excretion of non-concentrated urine to 150 - 200ml/100 Kcal [Ziegler et al, 1971]. Infants fed 150ml/kg/day breast milk require no supplemental water feed from birth to the end of first year if no other osmotically active foods or fluids are given. The practice of offering breastfed infants water supplements and other supplemental foods and fluids before 4 - 6 months has been described as unnecessary and physiologically undesirable excepting when breast milk alone cannot provide sufficient energy need for growth and to further safeguard introduction of contaminants through water [Goldberg et al 1983].

Table 2.2: Average water requirements in infancy

Age	3 days	3 months	6 months	9 months	12 mont
Weights (kg)	3.0	5.4	7.3	8.6	9.5
Water Reqt (ml/kg/day)	80-100	140-160	130-155	125-145	120-135

Source: Adopted from Nutrition for Healthy Neonates by Lewis A. Barness (1985).

Infant Feeding Trends:

Infant feeding pattern has and is witnessing changing trend in almost all cultures including affluent Europe, America and other developing economies. These changes take place over time. In Europe, for example,

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between 1940s and 1970s, it was reported that it was fashionable to introduce solid early to the infants coinciding with a time when breastfeeding rate declined [Shukla et al 1972 and Stolley et al 1981]. Similar trend was observed in America [Stewart 1943, Sackett 1956]. Oates (1973) pointed out that it was usual to introduce solids to infants at 3 - 4 months after birth in United Kingdom, Shukla et al (1972) observed that 93% of infants studied were taking solids as early as thirteen weeks post partum in Britain. Similar trend was observed in the studies of Stolley et al (1981) in West Germany.

The time of introduction and type of solid food first introduced to the child varied depending on tradition and socio-economic factors. The food industries in Europe and United States of America also played significant roles in the observed trends by their aggressive advertisements, mother crafting and the utilisation of the services of medical and health personnels who aided them in their sales of industrially produced infant formulated foods including baikost. Baikost is defined as any food given to infants other than milk or formula and are commercially/industrially produced (Andersoo et al 1987).

From the 1970s and coinciding with a period of increasing rate and frequency of breastfeeding, introduction of solids became increasingly delayed [Gerber 1984 and Maslansky et al 1974]. The duration of exclusive breastfeeding within the European community was reported to be closely related to the recommendation of the relevant governmental authorities and European Society of Pediatric Gastroenterology and Nutrition sub-committee

on nutrition (1981 and 1982), excepting in the Nordic countries of Finland, Norway and Turkey [Ballabriga et al 1987]. There exists wide variations in the kinds of solids first introduced which is influenced by local traditions and available foods e.g. fruits were first introduced in Southern Europe, vegetables, meats and cereals in Northern Europe [Ballabriga et al 1987]. The sequence of introduction of solids is also variable (Table 2:3). The changes in feeding pattern witnessed in the 1970s also witnessed the reduction of mothers patronage of industrially and commercially prepared weaning foods with mothers preferring specially ptepered home made weaning diets for their infants [Ballabriga et al 1987].

Weaning foods marketed in the United States of America have been formulated to meet consumer demand in that society and are characteristically of low caloric density, low in fat and protein content and thus inappropriate for infant feeding in developing countries [Anderson et al 1987]. More highly diversified diets are now formulated known as follow up formulae specially and specifically formulated for infants of over six months of age and now available in Europe and America.

The prevalence of breastfeeding in Europe in 1984 ranged from about 45% to 100% at birth for France and Finland; at three months it ranged from 10% to 90% for France and Finland, at six months it ranged from 0 to 70% and at twelve months it ranged from 0 to about 25%. The explanation of the authors for the wide European variation in breastfeeding prevalence was linked to hospital practice and government policy particularly in Finland with the longest maternity leave (of 35 weeks) in Europe [Ballabriga et al 1987].

Infant feeding trends in developing countries cannot be easily grouped as it was done for Europe and America. However, literature shows different trends based on community differences e.g. India, Central Africa, East Africa, West Africa, Latin America nod Asia [Vis et al 1987; Ramachandra 1987; Ahmed 1987; Ajenifuja 1987 & Ogbeide 1975b] hnvo different infant feeding patterns. Most women in middle and upper socio-economic groups in India introduce supplements to breastfed infants by three months and the supplement usually consist of fruit juices, processed cereal based weaning foods and breast milk substitute [World Health Orgnnisation, WHO, 1980]. Ramachandra (1987) found no difference in growth rates of exclusively breastfed Indian infants up to six months and those breastfed with supplements from 3 - 6 months thus he concluded that there was no nutritional advantage of early supplementation. Howevor, the supplemented infants recorded higher mobidity despite that they come from upper and middle socio-economic classes. The traditional poor urban in India introduces supplements to breastfed babies by about six months and the supplements consist of well cooked, mashed adult food of cereals and pulses. Ramachandra (1987) also reported that differences exist along socio-economic and urban-rural groupings in India. Weaning foods mostly used were combinations of rice, pulses, vegetables, cereals, mammalian milk and sugar. These are mostly made into porridges or puddings. Fruits were not commonly used, but banana was most popular [Ramachandra 1987].

Ahmed (1987) reported that 34.1% of 1,250 infants surveyed in Pakistan had commenced supplementation before six months while 7.04% had not given any supplement at eighteen months. The types of supplements given showed that 29.7% used a portion of the family diet, 6.6% used specially prepared diets while 4.8% used commercially prepared feeds. Buffalo's and cow's milk were mostly used as well as porridge of rice, pulse and oil or pudding of rice and milk or semolina pudding.

Ajenifuja (1987) in a review reported that 90 - 100% of Nigerian infants had commenced supplementation with milk or milk products by three months in both urban and rural areas. He reported that cereals were introduced to 22% of the urban infants by three months and 10% of poor rural infants; 10% of urban infants were receiving animal products by three months and more than 2/3 of urban infants were receiving animal products by six months. Among the poor in both urban and rural areas, only 35 - 55% of supplemented infants were receiving foods of animal origin by 9 - 11 months and about 25% were receiving vegetables between 3 - 6 months while 50% of them were receiving legumes by twelve months. There exist differences in weaning practices along socio-economic and rural - urban grouping in Nigeria.

The studies of Omotola and Akinyele (1985) showed that supplementation among Ibadan urban poor commenced fairly early and about 50% of the infants studied had been receiving supplements by six months. Among the Hausas of Kaduna, supplementation commenced by five months of infancy (Oduhor 1980).

Porridges of corn, guinea corn and modified adult foods were the most preferred modified adult foods given to the infants [Omotola et al 1985]. The studies of Kazimi et al (1979) in Owerri, Cherian (1981) in Zaria and Osubor (1980) in Kaduna showed that porridges of maize and guinea corn were the most popular weaning food followed by modified adult diets.

Similarly, supplementation commenced by five months of infancy in Zaria and Owerri. Studies of Nnanyelugo (1985) in Anambra State showed that supplementary feeding commenced as early as 2 - 3 months of infancy consisting of infants preparation, corn starch pap, beverages and fruits. In the same study, over 80% of rural mothers commenced complementation with modified adult foods of yams and rice by 4 - 5 months. The weaning period was reported to be influenced by rural-urban grouping and was shorter among the urban group when compared to the rural group [Nnanyelugo 1985].

The conclusion drawn from the Nigerian studies is that religion, culture, economics and available foods influenced the time, type and pattern of weaning apart from education, occupation and rural or urban residence.

Infant feeding patterns in Tunisia are reportedly influenced by cultural, psychosocial and traditional factors [Hamza 1987] as in most developing countries where socio-economic status is usually associated with the time of introduction of supplements. Several attempts have been

Table 2.3: Recommended Pattern and Trend of Infant Feeding by types of Foods and Country.

COUNTRY	Breastfeeding Rec	Breastfeeding Trend	Industr. Rec	Formula Trend	Home Made Rec	Home Made Trend	Fresh Cow's Milk	First Solid Rec	First Solid Trend	Food Type	Cereals Rec	Cereals Trend	Meats Rec	Meats Trend
Austria	4-6	1-2	4	3	-	-	6	4	3	Fruits, Veg	5	4	5	4-5
Belgium	3-6	3	3	3-4	2-3	2-3	9	2-3	3	Cereals, Fruits	2	3	4-5	4
U.S.S.R	3	3	2	3	-	-	5	5	4	Cereals	5	4	5	4
Finland	6	6	-	-	N.R	-	8	5	3	Vegetables	5	6	5	5-6
France	3	1-2	-	2-3	N.R	-	10-12	3	2-3	cereals, Fruits	3	2-3	-	4
G.D.R.	4	variable	4	3	N.R	-	9	4	4	Meats, Veg	7	7	6	4
F.R.G.	4	4	5	3	1.5	1.5	6	4	3	Meats, Veg	5	4	4	5
Greece	4-6	4-6	NOT IN USE		4-6	2-4	12	-	2-3	Fruits	4	4	6-7	5
Hungary	4	4	8	variable	8	?	8-9	4	2-3	Fruits	6	2-3	5	5
Ireland	3-4	3	3-4	-	N.R	-	6-9	3-4	3-4	Cereals, Fruits	3	3	5	5
Italy	-	3	-	3	3+	3+	5-6	-	3	cereals, fruits	-	4	-	6
Netherlands	3-4	-	3-4	-	N.R	-	7	4	4-5	Fruits	6	6	7	7
Norway	4-5	3-4	3-4	3-4	N.R	-	10	6	5	Vegetables	6	5	6	6
Poland	3	-	-	-	-	-	-	3	3	Fruits	4	5	7	6
Rumania	4	?	-	-	-	-	4	4	-	Cereals, Fruits	4	-	5	4
Spain	4	-	4-6	-	N.R	-	12-18	-	3-4	Cereals, Fruits	4	3	-	6
Sweeden	6	6	4-6	4-6	N.R	-	5-6	4	3	Vegetables	6	6	5	5
Switzerland	4	?	4	?	N.R	-	8	4	3-4	Fruits, Vegetables	5	5	5	4
Turkey	6-8	24	4-6	6	4-6	24	6	4	6	Cereals, Fruits	4	6	5-6	4
United Kingdom	4-6	-	4-6	-	-	-	6	3	4	Cereals	3	3	6	-
Nigeria	6	1-2	-	1	N.R	1-3	-	-	4	Cereals	4-6	1	-	10

Source: Adapted from Ballabriga et al (1987) 986.

N.R: No specific recommendation

made in most developing countries both in the past and currently to manufacture weaning foods based on locally available foods that will be most culturally acceptable, affordable and highly nutritious.

WEANING FOODS IN NIGERIA.

The success of weaning involves some basic issues intricately intertwined with food i.e. the type(s) of food(s) given, how the foods are given and when and why the foods are given. The most widely reported weaning foods in Nigeria are gruels of maize, millet and guinea corn but other less widely reported foods are gruels and porridges of other staples such as cassava and plantain. Fermented milled maize is the most popular first traditional weaning food commonly used in Nigeria, called koko or kamu among the Hausas [Osuhor 1980 and Cherian 1981], Akamu or Agidi among the Igbos of Owerri, [Kazimi et al 1979] and Ogi among the Yorubas [Oke 1967]. Maize meal is prepared by soaking stone free and cleaned maize in adequate amount of water for three days to allow it to ferment till the dry maize is soft enough to be milled. This process apart from being fermentative, allows the maize to steep [Akinrele 1966 and Oke 1967]. The soft maize is then milled in a corn mill, the starch of the milled maize is later washed free from the chaff (integumenta) in a large pool of cold water using appropriate sized sieve or mesh (locally, muslin cloth is used). The washed starch is allowed to settle and the extra water on top decanted. The resulting precipitate, Ogi, is then cooked in water to a thick porridge or gruel. The processing

loss of Ogi preparation from the stage of maize to pap had been studied by many scholars [Akinrele 1966 and Oke 1967]. It was reported that 4% of the maize crude protein, 50% of calcium about 20% globuline, 75% phosphorus and 10% of iron were lost as a result of processing maize to Ogi [Oke 1967]. Bulk has been the major limiting factor of cooked Ogi to good nutrition because it contains about 90% moisture to maintain a semi-solid consistency [Akinyele et al 1987].

Gruel of guinea corn (Dawa) sorghum spp and millet (Gero) Pennisetum spp are also sometimes used. Traditionally, the cereals are prepared in the same way as maize. However, the Yorubas sometimes mix maize and guinea corn or millet together, milled and the starch washed out (Precipitated) to be used for infant feeding. Some of the studies reviewed reported the addition of milk, egg or sugar or combination of any two to the gruel for infant feeding [Osuhor 1980, Cherian 1981, Kazimi, et al and Akinyele et al 1987]. Spiced millet gruel called "fura" and sour milk called "nono" were reportedly used as refreshing drink/beverage particularly during the dry season for infants [Osuhor 1980 and Cherian 1981].

The Hausas of Northern Nigeria have porridge of guinea corn or millet or rice with different vegetable soups as the first solid next to gruels of maize to the infants. Several types of vegetables were reported to be popularly used including Baobab (Kuka), Benniseed leaves (Karkashi) spinach (Alayaho), Roselle (Yakwa), Okro and Pumpkin (Kubewa) cooked

with spices and flavoured with locust beans (Dadawa). Beans and bean dishes were rarely used for infants because they were believed to cause flatulence. Mashed yam and rice were the next important infant foods. It is thus evident from the foregone that the solid foods for infant weaning are modified adult foods.

Among the Igbos of Eastern Nigeria, next supplement to gruels of maize or guinea corn are mashed yams, rice, beans, bread, plantain and cassava, foofoo or gari [Knrimi et al 1979 and Nnanyelugo 1985]. Like the Hausas, the Igbos also consume vegetable soups along with the modified adult foods. Beans and bean dishes were similarly not given prominence as important foods for infant weaning. Milk preparation were reportedly included in some of the gruels and porridges given to infants but they were however, much diluted to points of no or low nutritional benefits to the infants [Nnanyelugo 1985].

Weaning foods among the Yorubas are somewhat different from the other two major ethnic groups in Nigeria. Beans and bean dishes were the first solid foods given to infants next to gruels of maize pap by the urban poor of Ibadan [Akinyele et al 1987]. Foods such as moinmoin, akara, beans pottage were commonly consumed, [Omotola 1984]. Other foods of importance were rice, rice and beans, yams, eba, amala and snacks such as biscuits, puff-puff and pies of meat and fish.

Nutrient compositional studies of common traditional weaning foods showed that most of them were low in energy and protein, [Akinyele et al 1987, Akinrele 1966, Oke 1967, Eka 1978 Ogbeide, 1985 and Naismith 1973].

The conclusion of most studies on traditional weaning foods and the view widely held by most nutritionists is that protein is the most limiting nutrient of traditional infant diets. Many efforts had been made to develop protein-rich foods for infants and children.

DEVELOPMENT OF PROTEIN-RICH FOODS

The nutritional problem usually most noticeable during weaning was previously conceived to be mainly due to protein deficiency [Protein Advisory Group (PAG) Statement 3, 1971]. However, in the light of our experience and the relationship between proteins and the other nutrients, it is now realised that the problem is essentially a calorie plus protein deficiency since the body's first requirement is for supply of energy [Joint FAO/WHO 8th Report on Nutrition 1970].

Several protein rich food schemes had been embarked upon in several developing countries in the past in a bid to correct the protein inbalance [Orr 1972]. However, the main objectives for setting up the schemes have not been fully realised though some of them are no longer in operation. About seventy protein rich food schemes were established in thirty-six developing countries between 1956 and 1970, of these, thirty were found in thirteen latin American countries, Nineteen in eight Asian countries, seventeen in thirteen African countries and three in two Middle East countries [Orr. 1972].

Most of the food schemes were initiated by United Nations agencies in conjunction with the governments of the respective countries in response to results of nutrition surveys conducted by the agencies between the late 1940s and early 1950s [Brock et al 1952 and Waterlow et al 1956]. Some other food schemes were initiated by Research Institute, Universities and very rarely by governments. All the food schemes reviewed were designed as commercial and industrial projects with about 71% of them owned by private companies. The remaining 29% had either government private enterpreneur joint ownership, regional government, Research Institute or co-operative bodies as the project owners. Most of the privately owned schemes had local owners rather than international ownership though a few were subsidiaries of multinational international companies [Orr 1972].

The characteristic of most of the protein rich foods underscored the prime objective of making them low priced thus the United Nations Agencies placed emphasis on use of oil seeds residues as the source of concentrated protein. Soyobeans is the most dominant oil seed widely used either alone or in combination with groundnute. Groundnuts, cottonseed, sunflower, coconut and rapeseed were the other oil seeds used in protein rich food schemes. Alternative source of concentrated protein was dried skimmed milk (DSM) which was obtained from European Economic Community (EEC) food aid stocks. In addition to protein source, protein

rich foods also contained flours mostly of cereals such as rice, maize and wheat and rarely of tubers or starchy fruits.

Most of the earliest manufactured food products under these schemes were intended to be combined with other foods except in few cases such as Incaparinas. The more recent food schemes have addressed some of the problems and the foods are now prepared in such manners that there are reduced need for preparation nt home, i.e. they are now more convenient and are complete foods in their own rights. They are expected to be consumed alone rather than adding them to porridges or gruele. Some of the food products were in the form of biscuits, soft drinks and beverages.

Most of the protein rich food schemes are no longer in operation due to several reasons ranging from lack of community acceptability through technical problems to pricing problems. Other reason for their failures include lack of inatitutionni patronage, promotional difficulties competition with donated foods, lack of governmental support, lack of adequate knowledge of local food habits and attitudes.

Most of the protein rich food schemes in Africa were popular in the 1950s and 1960s. Algerian Superamine made of 10% dry skimmed milk (DSM), 56% chickpea and 28% wheat was popular up to 1967. Similarly, Faffa produced in Ethiopia composed of 18% soyabeans, 5% DSM, 10% legumes and 57% wheat was popular up to 1967. In Kenya two weaning products were

popular between 1959 and 1967, Simba composed of 15% DSM and 85% maize was popular up to 1959 while Supro, composed of 15% DSM, 25% Yeast and 50% cereal was popular up to 1967 [Orr 1972]. The weaning food produced in Madagascar consisting of 38% soyabeans, 5% DSM and 40% rice was popular up to 1965 while super maeu and soya porridge produced in Mozambique and Uganda respectively were popular up to 1968. Both products were made of soya beans, DSM and maize in varying proportions.

The earliest efforts in the production of protein rich weaning foods in Nigeria were translated into the production of Amama and Arlac. Later efforts have resulted into production of soy-Ogi, Cerelac, Nutrend and lately Soyamuso. Amama was produced in Nigeria by Gloxo Pharmaceuticals in 1959 as a food additive made up of 75% groundnut cake and 25% DSM. It had no cereal in its composition and its production was stopped in 1961 due to the discovery of aflatoxin in some of the products. However, apart from the technical problem of aflatoxin in the groundnut cakes used, it also had the problem of being a food additive and was also promoted as medicine rather than food. The attitude of health authority then was that malnutrition was n sickness that can be cured by measured doses of dietary additives rather than by complete food [Orr 1972].

Arlac was another protein rich food product produced by Unigate, a British firm in partnership with the then Northern Nigeria government in 1963.

Production depended on the groundnut flour from Zarin oil mill. The production of Arlac stopped in 1968 partly due to lack of profit, financial support from UNICEF, United Nations children Emergency Fund, the closure of Zaria oil mills and the unstable political climate in the country then.

In the early 1970s, the Federal Institute for Industrial Research, FIIRO, explored the possiblity of piloting production of cheap weaning food based on soyabeans and maize called SOY-OGI. Industrial patronage of FIIRO's pilot plant is slow although the product, soy-ogi is reported to be well accepted. The most probable reasons for the lack of patronage of the plant by industry is the huge cost involved based on an absolute technology of industrial fermentor of the plant design.

Two of the few food industries in Nigeria made some recent significant contributions in the local production of weaning foods. Nestle Foods Nigeria PLC produce and market two brands of weaning foods called CERELAC and NUTREND while Glaxo Nigeria PLC produce and market BABENA. The market share and contribution of these foods to infant nutrition in Nigeria is low. In the estimates of Fetuga (1991) the two firms can at best meet the demands of about 1% of infants born in Nigeria even at full capacity. Thus there is still need for more concerted efforts to provide nutritious, balanced and acceptable weaning foods to most Nigerian infants.

The Nutrition Division of the Federal Ministry of Health and Human Services, Lagos produced a booklet containing some forty-three recipes meant for use by mothers for the weanlings and based on local foods available in the different parts of the country [Nutrition Division 1986].

The Department of Human Nutrition, University of Ibadan and many departments of Biochemistry in Nigeria had conducted elaborate studies into Nigerian weaning foods and many more studies had evaluated compounded weaning diets. Dutra De Oliveira and Carneiro (1970) evaluated a diet composed of banana flour, whole milk and corn oil mixture, called LUB and found that LUB had a PER value of 2.76 and it promoted growth in infants. Ekpeyong et al (1977) evaluated fortified maize flour diets fortified with blends of cashew nut meal, locust beans meal and sesame meal. The best mixture had a PER value of 3.6, NPR value of 4.4, NPU of 72.4% and a BV of 75.9%. Ketiku and Smith (1984) evaluated a blend of corn ogi, boiled fish, red palm oil and awedu, called "Apapa mix". They obtained PER value of 2.2 and NPR value of 4.1. Olubenya (1988) compounded thirty different diets based on the principles of multimixes but evaluated the protein quality of seven of them. He obtained PER values ranging form 1.7 to 2.7 for banana, beans and amaranthus mixuture to maize, fish and tomatoes mixture. The NPR values of the mixtures ranged from 1.6 to 4.4 and a TD value range of 81.1% to 87.7%. The

enrliest protein rich food schemes in Africa that existed between the 1950s ond 1960s produced diets that hod protein contents of between 20 - 51.0% with Amama containing 5i% protein and energy of between 350 and 460 kcal per 100 gm portion.

Nutritional Evoluotion of Protein Foods:

The basic concept of the protein quality of a diet depends largely on the pattern and concentration of the essential amino acids that the diet is ablo to provide to the body for the aynthesis of nitrogen containing compounds. Protain quality may thus vory with tho amount and pattern of amino acids required for tho functions measured.

Classically, evaluation of protein quality begins with the determination of nitrogen content, identification of the nitrogenous constituents and assessments of the nutritional voluo which includes digestibility and finally the capacity of the protein to meet the nutritional requirement of humsn of various ages.

Protein quality evaluation techniques are divided into four broad groups nasely chemical, microbiological, biological and clinical assay techniques.

CHEMICAL ASSAY TECHNIQUES

Nitrogen in foods do not only come from amino acids in proteins but also from other food components that may or may not be used as part of the total nitrogen economy in the body [Erickson et al 1963]. In

view of the non-specific nutritional significance of the non-amino ocid and non-peptide nitrogen, nitrogen analysis of diet is more precise than the nutritional significance that con be attached to it. For most practical purposes, protein quality evaluation are evaluation of nitrogen content of the test diet which is usually expressed as crude protein after multiplication by appropriate conversion factor [FAO/WHO 1973; Tkachuk 1969].

Conventionally, the nitrogen content of protein is estimated by the Kjeldahl techniques of which there are several modifications of the original technique [Munro et al 1969 and Association of Official Analytical Chemists (AOAC) 1975]. There are other alternative methods used to determine the nitrogen content of diets such as those using Biuret and the Folin-Ciocalteu reagents, fluorimetric techniques [Cole 1969], dye-binding procedures [Ashworth et al 1962] and those based on use of autoanalyser dependent on colorimetric method based on reaction with alkaline phenolate-hypo-chlorite reagent [Pellet et al 1980].

The other analytical procedures involves analysis of individual amino acids in the test diet. Most of this procedures require preliminary treatment of the test diet to hydrolyze the protein to its free amino acids constituents. A review of available amino acids analytical procedures show that there does not exist any ideal procedure because of the wide variation in composition of protein and protein foods

[Pellet et al 1980]. However, the major problem is the destruction of amino acids during acid hydrolysis of the diet notably the essential amino acids [Spitz 1973, Robel 1973 and Savoy et al 1975]. Amino acids are released and destroyed at different rates depending on the amino acid composition and characteristics of the test sample. Tkachuk et al (1969) recommended a multi level five separate hydrolysis consisting of three acid hydrolysis of different time durations another two special acid hydrolysis to provide accurate assessment of amino acid composition. Most of amino acids assay depends on the use of chromatographic techniques. Developed techniques for amino acid analysis includes high performance liquid chromatography (HPLC) [Molnar et al 1977], Ion-Exchange chromatography (IEC) [Spackman et al 1958], gas-liquid chromatography [Moss et al 1971] and thin-layer chromatography (TLC) [Bujard et al 1966].

Results of amino acids content of foods obtained from alkali or acid digestion might be different from what might be available to the body i.e. absorbable and utilizable by the body. In view of this, in-vitro enzymatic hydrolysis methods were developed to assay available amino acids [Mauron 1970]. Mauron (1970) showed that there is a significant correlation between results of in-vitro enzymatic methods of available amino acids and animal feeding tests (bioassay) though the in-vitro values were consistently much lower. Amino acids content of foods can only be useful indicator of potential nutritional value only

if expressed in relation to a reference protein. Block and Mitchell (1946) used egg protein as reference protein in their original amino acid score model. Other proteins such as casein, milk proteins or human amino acid requirements are now used so as to get better agreement between biological and chemical predictions of protein quality. Amino acid score is defined as milligram of essential amino acid per gram of the test protein divided by milligram of essential amino acid per gram of the reference protein multiplied by 100 (Joint FAO/WHO 1973). It is very common to base score on the amount of lysine, total sulphur amino acids or tryptophan since they are often the most limiting essential amino acids in most foods and diets.

Chemically determined amino acid content of foods can be corrected for biological availability if digestibility factors are used to obtain protein utilization (Akeson et al 1964 and Saunders et al 1973). Proteolytic enzymes have been used to predict digestibility of foods or diets in vitro enzyme systems such as pepsin-pancreatin, papain-trypsin, chymotrypsin and amino-peptidase (Mega et al 1973).

MICROBIOLOGICAL ASSAY TECHNIQUES

Microbiological assay methods are particularly useful when equipment required by other methods are not available or for the convenience of the analyst. Originally, microbiological assays were used to determine the amino acid content after initial acid hydrolysis

of the protein. However, they are now used in addition to determine available amino acid and protein quality. Ford's (1962) original assay method used Streptococcus zymogenes to measure available amino acids but unfortunately the organism does not require lysine thus making it impossible to measure lysine.

A protozoan, Tetrahymena pyriformis that require same types of essential amino acids as the growing rat was later introduced to replace Streptococcus zymogenes [Fornell et al 1956]. The Tetrahymena bioassay was further improved upon with the use of T. thermophila which is a more rapidly growing specie [Baker et al 1978]. The major drawback to the use of Tetrahymena in bioassay is their sensitivity to most food additives and spices which inhibits the growth of the protozoan thus hindering its ability to measure protein quality [Satterlee et al 1979].

BIOLOGICAL ASSAY TECHNIQUES

Biological assay methods make use of experimental animals and are regarded as providing all necessary information about protein quality thus it is held in high esteem [Pellet et al 1980]. There are several techniques that are discussed under this group. All assays require the use of laboratory animals and are divided into three sub groups:

(i) Single level assays with or without reference to protein-free control

(ii) Multi level assays in which response may be measured by growth or water content of carcass

(iii) Other assay methods

Single level bioassays are further divided into two, one group depends on nitrogen balance data and the other on change in body weight of the experimental animal.

The earliest and simplest bioassay was dependent on measurement of change in body weight of young rats fed the test diets [Osborne et al 1919]. The quantitative estimate derived was referred to as protein efficiency ratio, PER.

The purpose of using animals for protein assay is to quantify nutritional quality as a characteristic of the test protein. Conventional methods of assessing protein quality assumes implicity that there exists a linear relationship between the product of amount and quality of protein to utilizable protein [Committee on Amino Acids, Food and Nutrition Board 1974]. Osborne et al (1919) showed that the PER varied with the level of protein in the diet thus they recommend that test protein should be assayed at optimum level. However, conventionally, test diet are fed at 10% level or 9.09% [AOAC, 1975]. PER estimate were discovered to be influenced by factors that influence total food intake [Pellet and Young, 1980].

Net protein ratio (NPR) is an improvement over PER due to inclusion of a zero protein intake control group. NPR determination is another protein quality index derived from change in body weight and was introduced by Bender and Doell (1957). Other indices were introduced

all based on changes in body weight of the experimental animals as a result of the test diet. They include relative net protein ratio (RNPR), relative nutritive value (RNV) and relative protein value (RPV).

Several bioassay procedures had been developed that relied on nitrogen retention as the dependent variable in the determination of protein quality. The simplest of such assay is measurement of net protein utilization (NPU) [Bender and Miller 1953] which measures differences in nitrogen content of carcass fed the test diet and the control fed protein free diet. Alternatively body water content is sometimes measured to derive nitrogen content based on predetermined ration of nitrogen/water of the animal [Miller et al 1955. Nitrogen balance studies are also used in which nitrogen intake and nitrogen excretion are determined for the animals fed the test diet and those fed protein free diet thus estimating nitrogen retained by the animals [Eggum 1973]. This procedure allows for the estimation of apparent digestibility (AD), true digestibility (TD), net protein utilization (NPU) and biological value (BV) of the protein which is usually fed at 10% level.

CLINICAL ASSAY TECHNIQUES

Clinical methods for evaluation of protein quality are based on the same principle as the corresponding animal assay but with specific modifications for human applications. The principal procedures measure either change in growth or nitrogen balance either

alone or in combination with estimation of serum proteins and amino acids, haemoglobin, blood urea, nitrogen and urinary creatinine excretion. More refined growth criteria of change in cell mass of the body is theoretically recommended than overall increase in weight or height in children [M^{c}Neil et al 1979]. Similarly change in body protein content is considered imprecise relatively and also costly. Some of the parameters and indicators of protein quality measurement in human are also influenced by other variables different from quality attributes of the test diet e.g. blood volume, lean body mass, environment among others [Graham et al 1966, Viteri et al 1968]. The traditionnl measures of protein quality such as NPU and PER are conducted in children fed at sub-optimal levels of intake for maximum growth with all studies based on nitrogen balance. Studies of Scrimshaw et al (1974) and Inoue et al (1974) show that protein quality assessment in human subjects give equally comparable results to using rats. Nitrogen balance data are obtained by direct measurement of dietary nitrogen intake, urinary and fecal nitrogen output in clinical trials without taking integumental, obligatory urinary and fecal nitrogen losses into account. Nitrogen losses from these sources are relatively constant and difficult to measure [Pellet et al 1980]. Human nitrogen balance have further limitation ranging from error in fecal nitrogen estimations due to test protein to difficulty of getting all of the material out of the container used [Calloway et al 1971].

LIMITATIONS AND STRENGTHS OF PROTEIN QUALITY EVALUATION TECHNIQUES:

All the assay techniques have their short comings and strength and their choice depends on the type of information required, the available equipment, time, money and the level of accuracy desired. The relative proportion in which the essential amino acids are needed depends upon the species, its physiological status, the inter-relationship and interactions among the amino acids themselves. The concept of a single pattern of amino acids being used as a comparative yardstick is also bedevilled with the concept of protein quality.

The major advantages of chemical and microbiological assay techniques include speed, simplicity and low cost particularly when the required equipment are available. They also offer ease of identification of limiting amino acids, data generated could be subjected to computer analysis to predict or complement protein of desired quality. Their major drawbacks include possible erroneous impression of the bio-availability of amino acids in chemical assay techniques, the non recognition of the role of non specific nitrogen and role of toxic materials in the test diet present as food component. Amino acid scoring ignores differential utilization of amino acids and proteins, amino acid released during digestion in the body as a result of sloughing off the mucosal cells of the digestive tract and other proteinaous secretion into the intestinal lumen.

A major drawback of bioassay methods based on protein efficiency ratio (PER) determination is that it makes no allowance for protein used for maintenance and the index value obtained are not proportional i.e. PER value of two is not twice as good as PER value of one. Variability of PER values are influenced by factors that influence total food intake. PER assays are not always reproducible. Different types of bioassays may give different absolute values. Laboratory assay environment are usually different from real life non experimental situation.

Drawbacks of the clinical assay techniques include stringent procedures, environmental factors and factors related to the diet such as adequacy of calorie intake, appropriate and constant protein intake for ease of comparison, controlled water intake, standardized meal times among others.

CHAPTER THREE

MATERIALS AND METHODS

MATERIALS

Place of Study:-

The study was carried out in Ondo State which is one of the thirty states of Nigeria. The state is divided into twenty-six local government areas by the 1991 local government edict.

The local government edict No 6 of 1976 formed the basis for the selection of the five sampled local government areas used for this study. The 1976 edict created seventeen (17) local government areas while a 1983 edict created more local government areas leading to re-organisation and adjustment of local government boundaries. In 1985, another edict was promulgated re-creating the original seventeen local government areas and abolishing the 1983 local government amendment edict. However, in 1991, the Federal government created more local governments from the original seventeen to twenty-six local government areas consisting of:

1. Ado-Ekiti local government area
2. Akoko North East local government area
3. Akoko North West local government area
4. Akoko South local government area
5. Akure local government area
6. Ekiti East local government area
7. Ekiti south West local government area

8. Ekiti West local government area
9. Emure-Ise-Orun local government area
10. Idanre local government area
11. Ido-Osi local government area
12. Ifedore local government area
13. Ijero local government area
14. Ikala local government area
15. Ikole local government area
16. Ikere local government area
17. Ilaje-Ese-Odo local government area
18. Ile-Oluji-Oke-Igbo local government area
19. Irepodun-Ifelodun local government area
20. Irele local government area
21. Odigbo local government area
22. Ondo local government area
23. Ose local government area
24. Oye local government area
25. Owo local government area
26. Moba local government area

The five local government areas selected for this study were former Ekiti South (now Ikere and Emure-Ise-Orun local government areas).

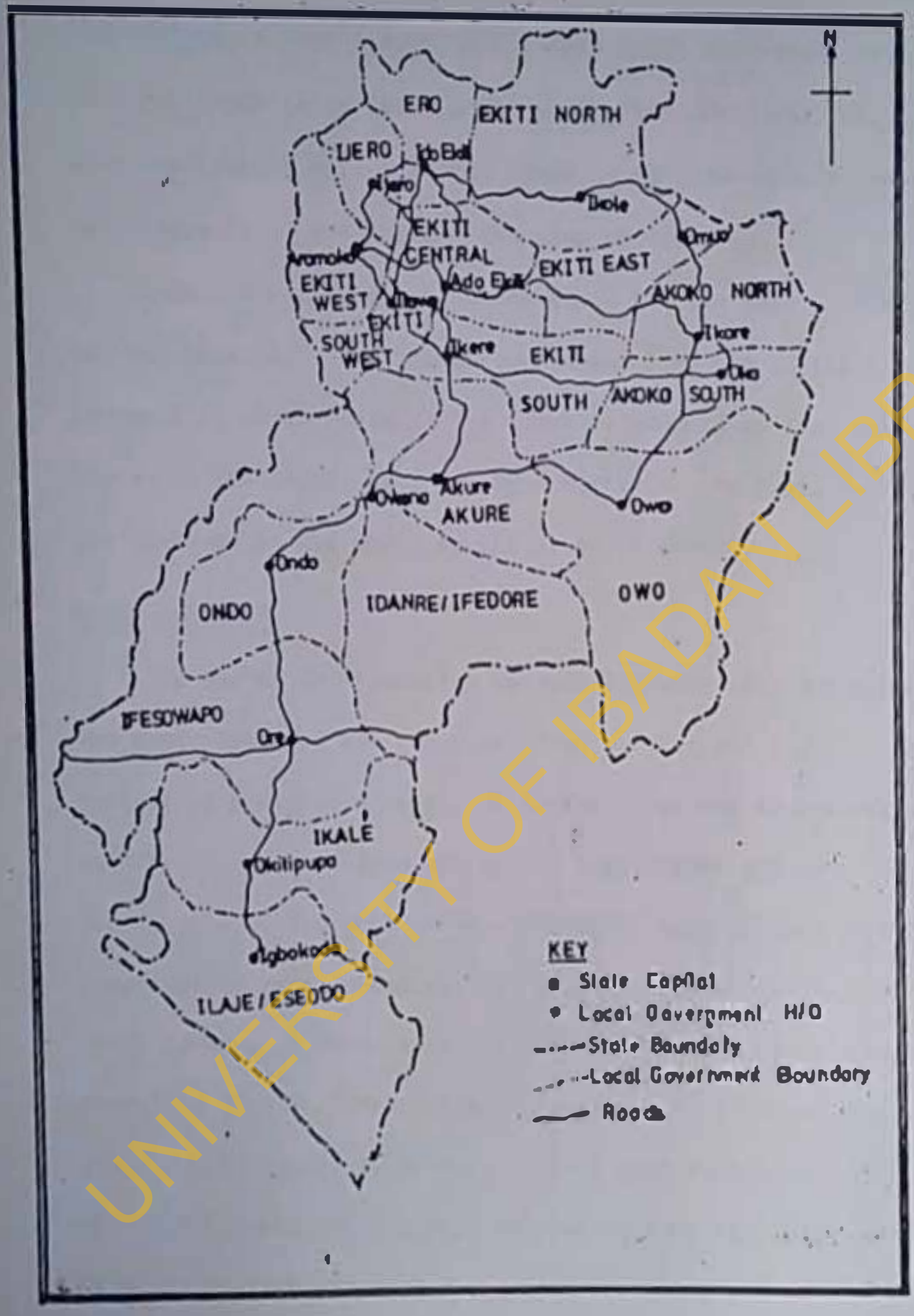

Fig. 2: Map of Ondo State showing the local government structure

Ifedore/Idanre (now Ifedore and Idanre local government areas), Ikole (now Ikole and Irele local government area) Ondo and Owo. The local government areas were selected based on the convenience, accessibility and diversity (a compromised sampling procedure).

Ondo state is located in the humid tropics with distinct dry and wet seasons. The vegetation ranged from the forest to the derived savannah of Akoko North. The state is bounded by Kogi and Kwara states to the North, Osun and Ogun states to the West, Edo state to the East and to the South by the Atlantic Ocean.

STUDY SUBJECTS:

The survey was conducted between February 1987 and August, 1988. The study involved one thousand, four hundred and eight (1408) mothers of children aged 4 - 36 months. The sex distribution of the children was six hundred and ninety eight males and seven hundred and ten females. The mothers were recruited from welfare baby clinics, immunization centres and primary health care centres located in the local government areas selected for this study. Some mothers were recruited from the communities. Recruitment of mothers were based on mothers willingness to participate and give information freely and voluntarily thus mothers were crecruited into the study as available from the centres and areas.

Health professionals that included the native traditional birth attendants and the Iya-Abiyes/Alagbo -omo were randomly selected as resource persons for discussions with the study team.

METHODS

Data were collected through structured pretested questionnaire (interview), community observation techniques and conversational approaches on the feeding practices of children aged 4 - 36 months living in the study areas.

Questionnaires were standardized, prepared in both English and Yoruba languages and administered to the mothers. The questionnaire was fashioned to collect background information of the families, district, sanitary conditions, housing, socio-economic indicators, available foods, attitudes and beliefs as well as availability of cooking fuel by type. [See Appendix II and III].

The questionnaire information was supplemented with home visits, community observation and conversation with randomly selected resource persons. Diet history sheets were attached to each of the questionnaires.

FOOD SAMPLES:

Sample portion of weaning foods used by the mothers were collected and kept for laboratory analysis.

CHEMICAL ANALYSIS OF WEANING FOOD SAMPLE AND FORMULATED COMPOUNDED WEANING MIXTURES:-

Moisture Determination: (A.O.A.C., 1985) Materials:-

1. Moisture oven
2. Moisture cans
3. Analytical balance
4. Desiccator
5. Domestic kitchen blender
6. Plastic plates

METHOD:

The individual food sample was homogenized with the aid of a small kitchen blender. 2.0g of the homogenate sample was transferred into the pre-weighed aluminium moisture cans and transferred into a moisture oven preheated at 60°C. After 24 hours, the cans were transferred into air-tight desiccator to cool. The cooled moisture cans containing foods were then weighed on the analytical mettler balance. The cans were later returned into the oven for six hours at 70°C. The temperature of the oven was later raised to 100°C till the food samples were dried to a constant weight.

Percentage moisture was calculated for each food sample from the difference in weight of the wet and fully dried samples. Each food sample determination was done in triplicate and the mean of the results were used for further analysis.

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The remaining food homogenate was transferred into plastic plates and dried in the moisture oven. The dired food samples were then ground into powder using small kitchen grinder. The resultant ground powder were transferred into labelled cellophane bags and kept away for further analysis.

COMBUSTIBLE ENERGY DETERMINATIONA: A.O.A.C., 1980

MATERIALS:

Ballistic Bomb Colorimeter

Thread

Galvanometer

Bombing Crucibles

Oxygen Gas

Desiccator

Benzoic acid (Analar)

METHOD

The powdered dry food samples were made into pellets with the aid of a pelleting machine. Two small pellets were made for each food sample and were separately oven dried in envelopes at 60°C for 24 hours to remove any moisture that the samples might have absorbed during the pelleting process. The oven dried pellets were then transferred into air-tight desiccator to cool. A known weight of the cooled dried pellet not more than 1gm was then bombed in the Ballistic bomb calorimeter at 25 atmosphere of oxygen.

Analytical grade benzoic acid was used as standard for the callibration of the galvanometer. A blank determination was also carried out using the length (5cm) of cotton thread and empty crucible. Based on the number of deflection relntive to that of bonzoic acid and blank, the combustible total energy of tho food aamploa were calculated using mathematical formulae. Six readinga were taken for the standnrdization of tho galvanometer using the analytical grode benzoic acid. The mean valuo of the six readings was used for the standard calculations. The food aamples wore analysed for total combustible energy in duplicates and the mean valuo for each food sample was used for calculation. The calorific values of the food samples were calculated and recorded in kilocalorica (Kcal).

DETERMINATION OF CRUDE FAT (ETHER EXTRACT) A.O.A.C., 1980

MATERIALS:-

Soxhlet extraction apparatus

Fat extraction thimblea

Analytical balance

Reagents: Petroleum ether

Water Bath

Beakers

METHOD:

5 gm of the dried powdered sample was weighed into a porous fat extraction thimble and put inside the soxhlet extraction apparatus.

Extraction was done continously with petroleum ether for 8 hours. The solvent was evaporated on water bath to about 20 ml which was transferred into a weighed 100 ml beaker. The flask was rinsed twice with 10 ml portion of petroleum ether and transferred each time into the beaker. This was evaporated on the water bath and the extract dried for thirty minutes at 100°C in the moisture oven for two hours. The cooled beaker was later weighed and the difference in weight of the beaker gave the weight of the crude fat content of the sample. A blank was also run to correct for the weight of the reagents before the calculation of the percentage fat content in the food samples.

DETERMINATION OF CRUDE PROTEIN: A.O.A.C. 1980

MATERIALS:-

electric heating block

microkjeldahl digestion flask

nitrogen autoanalyser (Technicon AA - 2 model)

REAGENTS:-

Potassium sulphate and selenium oxide

concentrated sulphuric acid (analytical reagent grade)

alkaline phenate (mixture of sodium hydroxide and phenol) - 100g of NaOH dissolved in some distilled water in a standard 1 litre volumetric flask. 140ml of phenol was added to the solution and the flask was made up to the 1 litre mark with distilled water.

Sodium hypochlorite (commercial bleach).

METHOD

The A.O.A.C. (1980) microkjeldahl method was used, 0.2gm of the dried food sample was digested with 2 ml of th conc. sulphuric acid (H_2SO_4). After digestion, the digest was transferred into 25 ml volumetric flask. The digestion flask was rinsed out with distilled water and the rinse water woe added to the volumetric flask and made up to mark with distilled water.

5 ml of the solution in the volumetric flask was pipetted out and put into the cuvet of the auto-analyser. The nitrogen content was then read on a chart against a standard. The protein content of the sample was then estimated by calculation by multiplying the crude nitrogen value with 6.25 based on the belief that 16% of proteins in food is nitrogen.

EVALUATION OF PROTEIN QUALITY OF SELECTED WEANING MIXTURES BY BIOASSAY TECHNIQUES:-

The quality of the protein in the compounded weaning diets were evaluated using the bioassay procedures described by Eggun (1973) for the determination of NPU (net protein utilization), biological value (BV) and digestibility while the method of Campbell (1960) as described by the National Academy of Science - National Research Council (NAS-NRC) 1963 was used for the determination of (PER), protein

efficiency ratio and NPR (net protein ratio).

Eighty (80) white albino rats of the wister strains aged 20 - 23 days of both sexes were used as experimental animals for the protein quality evaluation. Eight (8) weanling rats were used per compounded experimental diet while another group of eight (8) were fed referenced Casein diet with casein being the only source of protein while yet another group of eight were fed protein-free basal diet.

The rats were randomly allocated into the different groups on the basis of their weight and were individually housed in metabolic plastic cages. The cages constructed in a way that urine and feaces of the animals could be easily collected separately. The diets were weighed into individual labelled feed-can attached to each cage. Each cage also had a glass feeding bottle facility for water feed. The animals were fed ad libitum for four days with the experimental diets so as to allow them acclimatize to the diets and metabolic cages. During this four days, no weighings were done and no records were kept. Thereafter, daily records for food consumed, and body weights of the animals were kept so also were the records of fecal and urine output of the animals were all kept for further analysis.

After ten days of feeding and record keeping of feed consumption, fecal and urine output, the NPR value for each rat due to test diet was determined using the formula below:

$$NPR = \frac{\text{wt gain of test animal + mean wt. loss of control}}{\text{protein consumed by the test animal.}}$$

the average NPR for the group was then determined from the individual NPR values.

The feaces and urine for the last five days of the ten days were pooled together separately for each test diet; the pooled feaces were then oven dried at 85°C for 24 hours. The dried feaces was then milled into powder using small kitchen blender and kept away for nitrogen determination. The daily urine output of the animals were collected separately into small plastic containers containing 1 ml of H_2SO_4 each as preservative.

The NPU, (net protein utilization), digestibility (D), and biological value (BV) were then estimated using the following formula.

$$NPU = \frac{N_2 \text{ retained}}{N_2 \text{ intake}} = \frac{I - (F - F_k) - (U - U_k)}{I}$$

$$D = \frac{N_2 \text{ absorbed}}{N_2 \text{ intake}} = \frac{I - (F - F_k)}{I}$$

$$BV = \frac{N_2 \text{ retained}}{N_2 \text{ absorbed}} = \frac{I - (F_k) - (U - U_k)}{I - (F - F_k)}$$

Where I = amount of nitrogen ingested

" F = fecal nitrogen

" F_k = endogeneous fecal nitrogen

Where U = urinary nitrogen

and U_k = endogeneous urinary nitrogen

After the initial ten days, records of weights and food were kept while still feeding the rats for eighteen more days but records of urine and fecal output were discontinued. After feeding the rats for twenty-eight days, the PER value was determined as follows:

$$\text{PER} = \frac{\text{weight gain of test animal}}{\text{protein consumed}}$$

Corrected PER = PER x 2.5

determined PER for reference casein diet

Diets:-

The basal protein-free diet was composed of

corn-starch	80%
vegetable oil	10%
Non-nutritive cellulose	5%
Vitamin mixture	.1%
Mineral salt mixture	4%

The experimental diets were prepared in such a way that the 10% protein were incorporated at the expense of the corn starch i.e. casein and the compounded weaning diets were added to the basal diet at the expense of the corn starch to provide a diet of about 10% protein.

The amounts of the experimentol diets added were estimated from the chemical analysis results of the protein content of the diets. The final resulting test diet were analysed to determine their protein contents.

FORMULATION AND PREPARATION OF THE WEANING DIETS: ESTABLISHMENT OF NUTRIENT TARGET VALUE FOR THE PROPOSED WEANING DIETS:-

In formulating weaning foods, estimates of the average food energy intake of a group is established rather for an individual due to normal biological variation in energy needs between individuals and as explained in the literature, it is dictated by satiety mechanisms Beaton et al (1974). Thus in the group of children, there will be some that will require little energy and may not consume enough nutrients if our diets are formulated based on recommended daily allowances (RDA) of energy and nutrients and average energy requirements. RDA values were expected to cover requirements of 97% of the population thus intakes based on RDA will consequently be deficient for about 3% of the population.

Our target for this project are children aged six months based on findings of studies reviewed in the literature. About the mean in

a normal population will be found smallest and biggest consumer defined for this purpose to be ±2 standard deviation around the mean. Based on the observation of Beaton and Swiss (1974), the estimated variation of infants energy requirements per kilogram body weight is ±23% around the mean. Thus the lowest and highest requirement will be ±23% about the mean. The smallest consumer who need less food energy do not necessarily need less nutrients (Tables 3.1 and 3.2).

From table 3.2. energy requirement increases with increasing age while the recommended daily intakes (RDI) for protein remains essentially the same between seven and twelve (7 - 12) months of age and the RDI for B-Carotene, Vitamin C and Iron are the same throughout the age group 6 - 12 months.

Table 3.1: Daily energy requirements and nutrients recommended for six months old children.

	Least Consumer	Average Consumer	Most Consumer
Energy (Kcal)	645	838	1031
Protein (g) (reference)	12.6	12.6	12.6
B - Carotene (mcg)	1800	1800	1800
Vit C (mg)	20	20	20
Iron (mg)	10	10	10

Table 3.2: Recommended daily intakes of Energy and Nutrients for infants 6 - 12 months.

Age (months)	Av. wt. Sexes Combined	Av. Energy (Kcal)	Prot. (g)	B-Carotene (mcg)	Vit. C. (mg)	Iron (mg)
6	7.5	838	12.6	1800	20	5 - 10
7	8.0	880	13.0	1800	20	5 - 10
8	8.5	920	13.3	1800	20	5 - 10
9	8.9	950	13.4	1800	20	5 - 10
10	9.2	966	13.2	1800	20	5 - 10
11	9.6	987	13.2	1800	20	5 - 10
12	9.9	1005	13.0	1800	20	5 - 10

Source: Energy requirements based on FAO/WHO (1973) reports and body weights based on NCHS reference figures (1976).

If our diet is formulated with reference to infants with least requirements, then all the children will receive adequate amounts of nutrients and if the stomach capacity of six months old children are similar, (least and most requirement) 270 ml [Secretin 1975], then children with most requirement will have difficulty eating enough.

However, most of the 6 - 12 months old children will still be on the breast while being complemented with weaning foods thus as shown [Table 3.3], children with the least requirement will obtain 12.6gm reference protein per day from a combination of breast milk and weaning foods which meet the RDA for protein for that age. Children with most requirement will consume a 204 ml portion of the weaning food thus their needs will be met within the 270 ml maximum stomach capacity.

The target values for the nutrient composition of the formulated diets are based on the recommended daily allowance for the least consumer of six months of age i.e. energy requirements of 645 Kcal per day. Protein 12.6gm per day and the diet must have a net protein energy value of 7.8%, B-carotene intake of 1800 mcg per day, vitamin C of 20 mg per day and 10 mg per day of iron.

Our chosen reference value of 350 ml of the prepared weaning diet i.e. the diets must provide 1 Kcal per ml is arbitrary.

The principles of food square and multimixes [Cameron and Hofvander, 1983; Mitzner, et al 1984; and Jelliffe 1967], were used in the formulation

Table 3.3: Daily Energy, and Portion sizes for six months old children from a combination of breast milk and compounded weaning foods.

	Least Consumer	Average Consumer	Most Consumer
Energy (Kcal)			
Daily Energy Reqt.	645	838	1031
Energy from breastmilk	420	420	420
(600 x 70 kcal/100ml)			
Energy from weaning food	225	418	611
Portion size (ml)			
3 portion (Kcal/portion)	75	140	204
Volume per portion (Kcal/ml)	75	140	204
Protein			
RDA for protein (g)	12.6	12.6	12.6
Protein from 600 ml breastmilk			
(600 x 1.2g prot/100ml)	7.2	7.2	7.2
Amount of reference protein			
from weaning food (g)	5.4	10.0	14.7
Reference protein per portion	1.8	3.3	4.9
Total Daily protein (reference) intake (g)	12.6	17.2	21.9

of the proposed wenaing diets based on available local weaning foods and ingredients observed in this study.

PREPARATION OF THE PROPOSED WEANING DIETS:

Four (4) different staples were identified as readily available in our study areas namely Cassava (flour), Plantain (flour), Maize and Rice (flour) and were used for infant feeding. These four staple foods were used in combination with four (4) protein supplements and vegetable oil.

Local Staples	Protein supplement	Vitamin supplement	Energy supplement
Cassava	Cowpeas	Amaranthus	Red Palm oil
Maize	Groundnuts	Red palm oil	
Rice	Soya beans		
Plantain	Amaranthus		

A basic double mix table was contructed (Appendix I) obtained from computer annlysis performed on KAYPRO II microcomputer using "Perfect Calc" software to calculate the least cost proportion of ingredients to be used for the basic mix. The constructed basic mix table contained twenty-four (24) mixes wirh 10 gm.or 5 gm of vegetable oil. Further to this, triple mixes or multimixes of the staples, protein supplement and vegetable were constructed using proportion and substitution principles.

Amaranthus leaves were chosen as the preferred vegetable for this study because of its wide usage and popularity in the study area. The composition by weight and proportion of the twelve compounded weaning mixtures are shown below (Table 3.4 and 3.5).

The detailed recipe and method of preparation of the weaning diets are presented in the Appendix while Table 3.6 show the codes, numbers and ingredients contained in each weaning diet mixture.

Table 3.4: Weight (g) of raw ingredients composition of proposed weaning diets on edible portion basis.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Maize meal (g)	46	48	68	0	0	0	0	0	0	0	0	0
Cassava flour (g)	0	0	0	29	37	47	0	0	0	0	0	0
Unripe plantain	0	0	0	0	0	0	92	60	146	0	0	0
Rice flour (g)	0	0	0	0	0	0	0	0	0	39	60	49
Cowpea (g)	22	0	0	38	0	0	57	0	0	0	0	18
Groundnuts (g)	0	9	0	0	13	0	0	30	0	17	0	0
Soyabeans (g)	0	0	6	0	0	12	0	0	14	0	6	0
Amaranthus (g)	60	97	70	72	165	120	55	55	76	61	50	48
Red Palm Oil (g)	10	10	10	10	10	10	10	10	10	10	10	10

Table 3.5: Relative Percentage Composition of Weaning mixtures dry matter basis

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Maize meal	51	56	69	0	0	0	0	0	0	0	0	0
Cassava flour	0	0	0	31	42	52	0	0	0	0	0	0
Plantain flour	0	0	0	0	0	0	30	30	58	0	0	0
Rice flour	0	0	0	0	0	0	0	0	0	49	61	65
Beans flour	25	0	0	43	0	0	51	0	0	24	0	0
Groundnut Powder	0	11	0.	0	16	0	0	43	0	0	18	0
Soyabeans flour	0	0	8	0	0	14	0	0	16	0	0	8
Amaranthus leaves	11	19	12	14	29	22	9	13	14	13	9	12
Red Palm oil	13	13	11	12	13	12	10	15	12	14	12	15

Table 3.6: Codes and Recipes of Weaning mixtures

Diet No	Diet Code	Ingredients
I	MCAO	Maize meal, cowpea, Amaranthus leaves and Red Palm oil.
II	MGAO	Maize meal, Groundnuts, Amaranthus leaves and Red Palm oil.
III	MSAO	Maize meal, soyabeans, Amaranthus leaves and Red Palm oil.
IV	CCAO	Cassava flour, Cowpea, Amaranthus leaves and Red Palm oil.
V	CGAO	Cassava flour, Groundnut, Amaranthus leaves and Red Palm oil.
VI	CSAO	Cassava flour, Soyabeans, Amaranthus leaves Red Palm oil.
VII	PCAO	Plantain (Mature unripe), cowpea, Amaranthus leaves and Red Palm oil
VIII	PGAO	Plantain, Groundnut, Amaranthus leaves and Red Palm oil.
IX	PSAO	Plantain, soyabeans, Amaranthus leaves and Red Palm oil.
X	RCAO	Rice/Rice flour, Cowpea, Amaranthus leaves and Red Palm oil.
XI	RGAO	Rice, Groundnut, Amaranthus leaves and Red Palm oil.
XII	RSAO	Rice, Soyabeans Amaranthus leaves and Red Palm oil.

Eight (8) of the twelve diets prepared were subjected to bioassay protein quality evaluation as well as sensory evaluation. The consistency/viscosity of the prepared ready to consume weaning mixtures/diets were also measured/assessed. All cassava and plantain diets as well as Diets II and XI were further evaluated.

PRACTICAL COOKING PREPARATION:-

All the ingredients used for the weaning mixtures were obtained locally from the local markets in the study area.

Cassava Flour:- This was made from the smoked dried cassava paste balls called "Fupuru" which was scrapped clean, pounded into flour and sifted to obtain fine flour.

Plantain flour:- Mature unripe green plantain were purchased from the local markets for the flour preparation. The mature pulp were sliced, dried, milled and sieved to obtain fine plantain flour.

Maize Meal:- This was made from locally bought maize using the traditional home based method. of steeping, (fermenting), milling and leaching the maize starch.

Rice Flour:- Local Igbimo-Ekiti rice was bought from the local market, picked and winnowed to make clean and stone free. Some of the cleaned rice was washed and sun dried then milled into flour while the rest was kept and used when needed to prepare cooked rice using traditional method.

Groundnut:- They were bought from the local market, picked to free them of stones and make clean. Some were roasted while the others were kept and boiled as needed.

Cowpeas (common beans):- The white variety was the most common and popular in our study area. This was bought from the market. The beans were picked free of stones and pebbles, winnowed and washed. The clean beans were then wet dehulled and then cooked soft or ground into paste.

Some of the initial beans stock were cleaned, picked free of stones and pebbles and dry dehulled. The dry dehulled beans were then roasted and ground into fine powder which was kept in air tight container for future use as needed.

Amoranthus leaves (Amaranthus Caudatus) Tete:-

Among the many leafy vegetables consumed in the study area, Amaranthus caudatus was the most common. The vegetable was also very popularly consumed. The vegetable was bought fresh from the local market each time it was needed.

Soyabeans:- This was obtained from the local market. Some of the soyabeans bought were cleaned free of pebbles, stones and dirts, then were dehulled, blanched (patboiled), drained, dried and milled. Some were later roasted after initial blanching and dehulling while some also were dehulled, blanched and ground into smooth paste.

Vegetable Oil (Red Palm Oil):- Red palm oil was used for all recipes evaluated and prepared because it was readily available in the study area and the most common vegetable oil commonly consumed.

Measurement of Consistency/Viscosity of Selected Weaning Mixtures:

After the preparation of each weaning diet based on its recipe i.e. ready to be consumed for our target six months old child, the diets were placed in a water bath to cool to a temperature of 35°C - 40°C. The consistency of each recipe was then measured at this temperature using a modified Adam's consistometer following the method below:

1. An open ended cylinder was placed in the centre of the measuring plate.
2. The prepared diet was poured into the cylinder up to the level indicated on the cylinder.
3. The cylinder was then quickly removed thus allowing the preparation to spread on the plate.
4. After a three minutes lag, the consistency of the preparation was read by counting the number of concentric circles corresponding to the limit of spread of the preparation.

Sensory Evaluation of Selected Weaning Mixture Prepared.

Prepared formulated diets were subjected to organoleptic assessment of flavour, taste, mouth feel, colour/appearance, consistency and over all acceptance. The assessors consisted of twenty-four mothers who were untrained in sensory evaluation but familiar with taste and feel of the major ingredients contained in the compounded weaning

mixtures. The assessors were mothers who voluntered to be recruited for the study and were all from Ondo state.

The assessment was carried out in Home Economics food laboratory under natural lighting. Assessors were individually seated and supplied with individual trays containing the coded food/diet samples, a glass of tepid water for rinsing mouth in between tasting and a questionnaire to record response.

Each assessor filled a questionnaire expressing her opinion on a five point scale (modified Hedonic scale) about the taste, colour/ appearance mouth feel and consistency of the coded diet onmple (s) presented to her.

Sensory evaluation questionnaire was designed to assess food samples attributes of colour, flavour, taste, mouth feel consistency and overall acceptability for children aged 6 - 12 months. The sensory characteristic data collected were subjected to statistical analysis according to Larmand (1982) method.

CHAPTER FOUR

RESULTS

DEMOGRAPHIC AND SOCIO ECONOMIC CHARACTERISTICS OF THE STUDY GROUP

A total of one thousand, four hundred and eight mothers were interviewed from five local government areas of Ondo state. Four hundred of them were recruited from Ondo local government area, two hundred and eighty-six from Ikere local government area, two hundred and sixty-four from Ikale, two hundred and fifty-two from Owo and two hundred and six from Idanre local government areas. Table 4.1 below shows the distribution of survey sample by local government area.

Table 4.1: Distribution of Survey Sample by Local Government Area.

Local Govt. Area	No of mothers	Sex of Children	
		Male	Female
Idanre	206	107	99
Ikere	286	146	140
Ikale	264	133	131
Ondo	400	192	208
Owo	252	120	132
Total	1408	698	710

The towns and villages studied were Idanre and Atosin in Idanre local Government areas, Ikere and Ise-Ekiti in Ikere local Government

area, Okitipupa and Ode-Aye in Ikale local government, Ondo (Obun Ondo) and Oboto in Ondo local government and Owo and Ipele in Owo local government area.

In addition to the mothers, fifty community workers made up of community nurses, health workers and traditional medicine women known as Iya-Abiyes were similarly interviewed regarding their knowledge, attitudes and practice with respect to weaning.

The composite distribution of the children by age group and by local government area is shown below in Table 4.2. There were at least ten children per age group between four and twenty-five months but the number of children aged thrity months and over were signficantly lower in all local government areas studied.

SOCIO-ECONOMIC

"The summary of the socio-economic characteristics of the respondents (mothers)" and their family background is shown in table 4.3 below. The mean ages of the mothers in all the five local government areas are similar, twenty-six, though mothers from Owo local government area appeared relatively younger. In all the five local government areas, 71% of the mothers had at least primary school education. Ikale and Idanre local government areas had the highest percentage of illiterate mothers (40% and 35% respectively), who had no formal education. Petty trading and food vending were very important occupations of the mothers except in Ikale local government area where farming displaced food vending to the third position. About one third of the mothers except in Ondo local government area claimed to be full housewife who had no paid employment within or outside the households.

Table 4.2: Age and local government area distribution of children studied.

Age Group	Number of Children by local government					
	Idanre	Ikere	Ikale	Owo	Ondo	Totoal
4 < 7	42	70	42	39	98	291
7 < 10	39	59	29	30	82	239
10 < 13	25	44	38	33	77	217
13 < 16	19	37	32	46	23	157
16 < 19	16	23	12	37	39	127
19 < 22	10	12	20	23	26	91
22 < 25	20	15	19	18	20	92
25 < 28	9	14	20	12	15	70
28 < 31	9	8	16	10	17	60
31 < 34	12	2	12	1	3	30
34 < 37	5	2	24	-	-	31
TOTAL	206	286	264	252	400	1408

Household Facilities

Most of the households surveyed depended on other sources of water for domestic use except in Owo local government where 46% depended on pipe-borne water. Well/Spring and rain waters were the other sources of water identified during the survey.

Thirty eight to sixty-eight percent of the household surveyed had no adequate toilet facility as assessed by availability of pit latrine or water closet.

Record of place of birth of the children show that 75.4% of the children were born in hospitals/maternity centres. Ikale local government recorded the highest percentage of home delivered children amounting to 39% while Ondo, Ikere and Idanre had 28%, 24% and 18% home delivered children respectively.

INFANT AND CHILD FEEDING PRACTICES

Breastfeeding:- All the 1408 children were breastfed for varying periods from birth to thirty six months. The duration of breastfeeding however, varied significantly from one local government to the other (Table 4.5) and the percentage of children still breastfed at nine months was at least 70% of the sample studied. The response to "how old was the baby when breastfeeding stopped" gave a different picture from Table 4.5 which indicated that at about three months, 12% of all the 1408 mothers had stopped breastfeeding. It is thus reasonable to assume and conclude

Table 4.3: Age and Principal Occupation of Mothers and Fathers Occupation by Local Government

	Idanre	Ikale	Ondo	Owo	Ikere
Mothers mean age (yrs)	26.0	26.9	26.8	26.0	26.3
Std. deviation	±6.2	±6.2	±6.6	±5.9	±6.2
Age Range (yrs)	16 - 41	18 - 45	17 - 45	15 - 40	18 - 45
Mother's Occupation					
Farmers	5%	36%	3%	7%	5%
Petty traders	56%	28%	63%	45%	30%
Full housewife	33%	30%	18%	28%	38%
Food Vendors	6%	6%	16%	20%	27%
Father's Occupation					
Farmers	56%	56%	30%	54%	40%
Artisans	22%	10%	39%	30%	19%
Traders	11%	19%	26%	8%	9%
Labourers	11%	15%	5%	8%	7%

Table 4.4: Educational Attainment and Household Ammenities of (Parents) Respondent Family

	Idonre	Ikale	Ondo	Owo	Ikere
Mother's Education					
Illiterates	35%	40%	23%	30%	20%
Primary	35%	42%	43%	40%	52%
Secondary	25%	17%	30%	27%	20%
Vocational	5%	1%	4%	3%	8%
Father's Education					
Illitorates	15%	26%	10%	20%	8%
Primary	50%	40%	45%	44%	56%
Secondary	30%	29%	40%	32%	30%
Vocational	5%	4%	5%	4%	6%
Domestic water supply source					
Pipe-borne	10%	8%	15%	46%	20%
Well/Spring	52%	35%	67%	29%	63%
Rain	8%	46%	-	-	-
Stream catchment	30%	11%	18%	25%	17%
Toilet Facilities					
Pit/Water closet	32%	62%	49%	53%	61%
Bush/Stream	68%	38%	51%	47%	39%
Refuse Disposal					
Bush	100%	86%	94%	80%	91%
Refuse Heap	-	14%	6%	20%	9%

Table 4.5: Percentage children fed breastmilk per age group by Local Government Area

Age Group (Months)	Idanre	Ikale	Ondo	Owo	Ikere
4 < 7	93%	98%	89%	90%	91%
7 < 10	90%	93%	72%	70%	86%
10 < 13	80%	90%	47%	40%	75%
13 < 16	42%	47%	22%	15%	27%
16 < 19	19%	33%	8%	22%	17%
19 < 22	20%	20%	4%	13%	8%
22 < 25	10%	21%	-	-	-
25 < 28	-	5%	7%	-	13%
28 < 31	-	13%	6%	-	-
31 < 34	7%	8%	-	-	-
34 < 37	-	17%	-	-	-

that mixed feeding was practised by some mothers from as early as one month.

Most of the mothers breastfed their infants on demand rather than on schedule in all the five local governmert areas.

Ninety-eight percent of respondent from Ikale local governmont area breastfed their infants on demand whilo Ondo local government recorded tho lowest percentage of mothers that fod rhoir babios on demand with a valuo of 70% (Table 4.6)

Table 4.6: Percentage Distribution of Mothers by Method of Breastfeeding by local government area

Feeding Method	Idanre	Ikale	Ikere	Ondo	Owo
Demand	86%	98%	79%	70%	76%
Scheduled	14%	2%	21%	30%	24%

Breastfeeding was stopped completely at various ages of the children which varied from one local government to another. (Table 4.7). Some of the children were still on breast up to their third birthday anniversary in Ikale local government area. Most of the children. 84.4% had completely stopped breastfeeding at the age of nineteen months in all the five local Government areas.

Table 4.7: Percentage children Weaned Completely off the Breast by age group by local government area.

Age Group (Months)	Idanre	Ikale	Ikere	Ondo	Owo
4 < 7	10%	7%	10%	15%	13%
7 < 10	15%	10%	19%	31%	33%
10 < 13	28%	13%	27%	58%	55%
13 < 19	83%	70%	83%	97%	89%
19 < 25	90%	79%	100%	100%	100%
25 < 31	100%	89%	90%	95%	100%
31 < 37	94%	89%	100%	100%	100%

The mothers had different reasons for stoppage of breastfeeding when they stopped as shown in table 4.8 below. Mothers satisfaction that their children are old enough as judged with the child's ability to eat adult foods unmodified is the most important reason for stoppage of breastfeeding in all the five local government areas.

Child's refusal and mothers employment were also other significant reasons mothers gave for stoppage of breastfeeding their babies in Ondo, Owo and Ikale local government areas.

Mothers pattern of cessation of breastfeeding was rapid, done over a few days as shown by 70% of all the 1408 mothers in the five local government areas (Table 4.9).

Table 4.8: Mothers reasons for stoppage of breastfeeding - Percentage distribution of mothers by reason by local government areas.

Mothers reason for stoppage of breast-feeding	Idoore		Ikale		Ikere		Ondo		Owo	
	No	X	No	X	No	X	No	X	No	X
Child's Refusal	19	9	21	8	56	20	71	18	57	23
Milk dried up	23	11	29	11	43	15	60	15	37	15
Cracked nipples	35	17	37	14	28	10	34	8	13	5
Family Tradition	47	23	29	11	14	5	20	5	13	5
Child old enough	70	34	116	44	83	29	104	26	70	28
Mother's employment	6	3	16	6	28	10	83	21	38	15
Inadequate milk supply	6	3	16	6	34	12	31	8	24	11
TOTAL	206	100	264	100	286	101	400	101	252	101

Table 4.9: Mothers Pattern of Cessation of Breastfeeding by local Government Areas.

Weaning Period	Idanre		Ikole		Ikere		Ondo		Owo		Total	
	%	No	%	No	%	No	%	No	%	No	%	No
In days	59	122	57	150	70	200	76	304	82	207	70	983
In weeks	33	68	37	98	25	72	24	96	16	40	27	374
In months	8	16	6	16	5	14	-	-	2	5	4	51
TOTAL	100	206	100	264	100	286	100	400	100	252	101	1408

INTRODUCTION OF SEMI-SOLID (SUPPLEMENTARY FEEDING PRACTICE/PATTERN).

Semi-solids or modified adult foods feeding to children commenced after four months in most of the children in all local governments studied (Table 4.10).

Table 4.10: Age of Introduction of Semi-solid to Children by local government area.

Age Semi-solids first introduced	Idanre %	Ikole %	Ikere %	Ondo %	Owo %
< 4 months	36%	21%	38%	45%	42%
4 – 6 months	34%	24%	32%	32%	39%
> 6 months	30%	55%	30%	23%	19%
TOTAL	100%	100%	100%	100%	100%

Sixty-three percent of all the children (1408) in all the five local government areas commenced feeding on semi-solids after four months of age. The semi-solids most usually first offered consisted of home-made gruel of maize (Ogi) alone in 82% of all children while 9% combined the ogi with milk formula and another 2% combined eggs with the ogi. Seven percent of the children who were offered gruels, consumed gruel of plantain or cassava (plain) as first semi-solid supplement. These semi-solid preparations were fed to babies often from feeding bottles. Custard as a gruel was also introduced to children sometimes as alternative to ogi particularly in Owo and Ondo local goverment areas. However, percentage of children that consumed custard, (a commercial coloured flavoured corn flour) was also included in the figures for ogi.

Some mothers also claimed to have introduced fruits particularly oranges, pawpaw or pineapples to children as first supplement depending on the available fruit in season. In such cases, they were home prepared and often fed from spoon or mixed with some plain gruel and fed from bottle.

Modified adult foods were also introduced to children as first supplement. These included food such as pounded yam, yams, beans and bean dishes as well as cassava (Table 4.12).

Table 4.11: Percentage distribution of children by type of first semi-solid introduced by local government area

Semi-solid Preparation	Idanre %	Ikale %	Ikere %	Ondo %	Owo %	Average total
Ogi	79	76	92	75	94	82
Ogi with formula	14	-	8	14	6	9
Ogi with egge	3	-	-	6	-	2
Cassava/Plantain	4	24	-	5	-	7

MOTHERS SOURCES OF INFORMATION ON CHILD CARE

All the mothers interviewed and observed for this study reported to have received advice from different people ranging from family members through hospital personnels to friends (Table 4.13). Fourty-seven percent of the mothers in all the five local government areas depend on advice from the hospitals or clinics while 30% of all the 1408 mothers got advice from parents and inlaws.

FOODS FROM FAMILY MEAL

All mothers responded to have used some foods from the family pot for feeding their children particularly those that had commenced supplementary feeding. Foods cited by the mothers were all solid adult foods which included mashed beans, moimoin, okara, yams, cocoyam, amala, eba, Pupuru, plantain, pounded yam, rice. Home made beans dishes ranging

Table 4.12: Percentage distribution of Children by type of First Supplement introduced by local government area.

Type of Supplement	Idanre	Ikale	Ikere	Ondo	Owo
Ogi	61%	63%	65%	62%	68%
Ogi with formula	11%	-	6%	12%	4%
Ogi with Eggs	2%	-	-	5%	-
Pounded Yam	5%	3%	8%	2%	5%
Orange/Pineapple, Pawpaw	2%	1%	1%	1%	2%
Beans and bean dishes	8%	3%	8%	9%	11%
Yams/Cocoyam	5%	5%	10%	2%	8%
Pupuru/Cassava gruel	2%	11%	-	4%	-
Plantain gruel	1%	9%	-	-	-
Fish	1%	4%	1%	1%	1%
Eggs	2%	1%	1%	2%	1%

Table 4.13: Percentage distribution of Mothers by Source of Advice on Child Feeding by local government areas.

Source of Advice	Idanre		Ikale		Ikare		Ondo		Owo		TOTAL	
	No	%	No	%	No	%	No	%	No	%	No	%
Parents/Inlaws	62	30	108	41	80	28	100	25	76	30	426	30
Hospital Staff	93	45	98	37	163	57	168	42	134	53	656	47
Husbands	23	11	47	18	23	8	32	8	22	9	147	10
Friends	28	14	11	4	20	7	68	17	15	6	142	10
Saw others (Imitate)	-	-	-	-	-	-	32	8	5	2	37	3
TOTAL	206	100	264	100	286	100	400	100	252	100	1408	100

from mashed beans to moimoin was the second most important family meal offered to children followed by dishes of yams and cocoyam. Fish and eggs were the sources of animal proteins favoured by mothers for their children. Foods from family meals fed to children were either fed with hand while semi-solid and liquids were fed by bottle. Spoon and cup feeding was not a common practice. Feeding practices were similar for all the group studied irrespective of local government of domicile.

Mothers concepts of foods which were "good and appropriate" and "not good" and undesirable for sick children are as follows:

"Good Foods"	"Not Good Foods"
Pap and plain gruels	Baby milk
Herbs and Native teas	Beans and bean dishes
Sugar/glucose water	All solid foods in general
Jollof rice	(Pounded yam, oba, amala etc)
Eggs	Rice, Cocoyam, Yam
Breast milk	Meat
Steamed foods	All fried foods
	Seasoned foods (spiced)

Generally, most of the mothers agreed that there were foods meant for sick children and those to be avoided. However, beyond this agreement, mothers perception of foods good for sick children varied not only along local government areas but also among individual mothers in the same local government area. Similarly, mothers reasons for the dichotomy also varied. Notable among reasons given for the not good foods included difficult to digest, causes/gives worms and contain many chemicals while those considered good were believed to help child grow and recover from illness. Table 4.14 show the relative importance of different foods from the family pot in feeding weaning age children in the five local government areas.

Table 4.14: Number and Percentage of Children that were Consuming different family foods by local government area

Family Food	Idanre		Ikale		Ikere		Ondo		Owo		TOTAL	
	No	%	No	%	No	%	No	%	No	%	No	%
Bean & Bean dishes	65	32	20	8	77	27	170	43	95	38	427	30
Yam/Cocoyam	37	18	34	13	100	35	40	10	71	28	282	20
Iyan (pounded yam)	37	18	21	8	77	27	40	10	45	18	220	16
Pupuru/Eba	16	8	77	29	-	-	76	19	-	-	169	12
Plantain dishes	8	4	63	24	-	-	-	-	-	-	71	5
Fish	8	4	29	11	11	4	20	5	10	4	78	6
Eggs	16	8	8	3	11	4	40	10	10	4	85	6

DIET HISTORY

Analysis of the data collected on the diet for children based on the structured diet history sheets showed similarity in all the five local government areas studied. Almost all the foods mentioned were home prepared with the exception of some purchased ready made. Even for some of the ready to consume foods, local food vendors were responsible for their preparation and distribution.

Consumption of cassava based dishes were delayed in four of the five local government areas with their local government area commencing cassava dish consumption as cruel from an average of four months.

Table 4.15: Mean Ages at which different Supplementary Foods were introduced to Children in Ondo State

No	FOOD ITEM	MEAN AGE ± S.D (Months)	No	FOOD ITEM	MEAN AGE ± S.D (Months)
1	Rice	6.54 ± 2.55	18	Pineapples	5.59 ± 4.17
2	Maize	6.57 ± 3.11	19	Pawpaw	7.37 ± 3.39
3	Guinea corn	6.89 ± 7.47	20	Mango	17.17 ± 11.57
4	Bread	9.96 ± 3.39	21	Oranges	6.93 ± 3.20
5	Beans	5.48 ± 2.26	22	Okro	5.91 ± 2.84
6	Groundnuts	8.42 ± 3.53	23	Amaranthus	9.05 ± 6.20
7	Soyabeans	5.27 ± 2.55	24	Tomatoes	7.81 ± 3.93
8	Locust beans	12.60 ± 5.85	25	Onions	7.63 ± 3.63
9	Melon	6.01 ± 2.48	26	Peppers	8.18 ± 3.81
10	Cassava	12.58 ± 5.85	27	Red Palm oil	7.71 ± 4.30
11	Yams	9.29 ± 4.34	28	Vegetable oil	7.71 ± 4.30
12	Cocoyam	9.29 ± 2.75	29	Margarine	9.50 ± 5.74
13	Sweet Potatoes	10.36 ± 3.35	30	Tea	6.00 ± 2.98
14	Plantain	11.63 ± 5.39	31	Cocoa drink	7.42 ± 3.43
15	Banana	8.68 ± 4.51	32	Carbonated beverage	7.70 ± 4.47
16	Meat	11.86 ± 7.54	33	Fruit juice drink	5.03 ± 2.30
17	Fish	6.72 ± 4.47	34	Sugar	4.60 ± 1.14
18	Snail	16.67 ± 7.05	35.	Saccharine	4.33 ± 1.38

Similarly, plantain gruel was important in only Ikale local government area. Table 4.15 show the mean commencement age for feeding various foods. Foods like fruits (orange and pineapples) were introduced to children as early as one month of age. Foods commenced at two months ranged from guinea corn or maize gruels, tea and okro soup. Foods such as rice, beans and bean dishes soyabeans, fish, pawpaw, vegetables vegetable oils, margarine, sugar and spices were introduced to children at three months of age .

INFORMAL INTERVIEW AND COMMUNITY PARTICIPATORY OBSERVATION RESULTS:

Market and Food Stores:-

Table 4.16 below show the distribution of food markets available in the two selected towns per local government area.

Table 4.16: Food Market distribution by local government area (selected centres)

Name of local Government	Number of food markets	
	Local govt. Headquarters	Rural Town
Idanre	1 (Idanre)	1 (Atoain)
Ikale	1 (Okitipupa)	1 (Ode-Aye)
Ikare	2 (Ikere)	1 (Iso)
Ondo	5 (Obun-Ondo)	1 (Oboto)
Owo	3 (Owo)	1 (Ipele)

The markets in the local government headquarters are opened for business in most cases daily. However, in Ondo local government headquarters, two of the five markets are opened for business on every fifth and seventh day respectively. All markets in the other rural locations observed are operated on every five day basis. Markets in the local government headquarters particularly the main markets have many food stalls while those in the rural communities have between twelve to sixty-two food stalls.

The types, class, variety and number of available foods in the rural areas of the five local government areas are less diverse and varied when compared to those available in the local government headquarters. Table 4.17 show the summary of available foods in the five local government areas by food class.

COMMUNITY WORKERS RESPONSES, ATTITUDES AND BELIEFS ON CHILDFEEDING

Fourty-three females and seven males were enlisted as resource persons to provide additional information on child feeding. The fifty randomly selected people were part of the community workers found in the five local government areas. They consisted of hospital/clinics/ dispensary staff, traditional birth attendants and community medicine men/women that sell herbs and roots (Iya alagbo-omo/Baba abiye).

Table 4.17: Summary of Available Food Items in the Five Local Government Areas by class of Food.

FOOD CLASS	FOOD ITEMS
Vegetable Ptotein Sources	Groundnuts, Cowpeas, Melon, Soya beans, Locus beans vegetables.
Leafy vegetables	Tete (Amaranthus candatus), Soko (Celosia argentia), Ewuro (Vernomia amygdalina), Elegede (Curcubita pepo), Ila/Okro (Abelmoachus esculenta), Iroko (Telfairia occidentalis), Ewedu (Cocchorus olitorius), Anunututu, Igbagba and Ebolo.
Animal Protein Sources	Beef, mutton fish, Pork, Eggs Fowl, Rabbit, Snails, Cows
Available milk types	Carnation, Peak, Carnco, Coast, Nido Three Crown.
Energy Rich Foods	Yams, Gari, Pupuru, Cassava flour Yam flour, Rice, Plantain, Cocoyam, Sweet Potato, Maize, Guinea Corn, Bread, Fufu.
Fruits	Oranges, Pineapples, Guava, Cashew, Mangoes, Banana, Tangerine, Pear, Lime, Apples Lemon.
Beverages	Cocoa drinks, Palm wine, Ribena, Fruit Squashes, Lipton Tea, Soft drinks, Agadagidi, Burukutu.
Commercial Baby Foods	Similac with iron, S.M.A., NAN, Similac with Cereal, Babena, Cerelac Nutrend.

The three classes of community workers held similar views on the types of foods for children 0 - 36 months. They all agreed that boiled water and glucose water are the first feed for neonates while the traditional birth attendants and community medicine men/women also believed that special boiled herbs are also good and essential. Hospital staff believed and recommended that baby milk (commercial) should be given to infants along with breastmilk as early as possible and often they start from the hospital.

The perception of the resource persons to giving other foods to babies differ from one local government to the other. Hospital staff interviewed in the five local government areas advice introduction of other foods relatively earlier ranging from 1 - 2 months while the other community workers believed that this could be delayed till beyond nine months.

In response to how babies are fed, force feeding and bottle feeding were methods of choice when not breastfeeding. Hospital staff mentioned cup and spoon feeding, mothers rarely practice cup and spoon feeding which the hospital workers never even teach the mothers at post or ante-natal visits. Infants gruels are often prepared once daily and stored in flasks while mothers who cannot afford flask use covered plastic containers. Food storage containers and store in the rural areas are quite different from those in urban areas or local government head-quarters. Fridges are available in some homes in the urban areas but

iorcly used for storage of babies foods which they belief must be kept warm.

Gruels of maize, guinea corn, cassava or plantain are believed to be special traditional infant foods though 30% of the resource persons believed that there are no traditional foods for infants. Dehulled cooked cowpeas and mashed beans are foods considered to be infant special food in all the five local government areas while in addition to this, mashed plantain is considered important in Ikole local government area.

It is a customary practice that mothers cook at least three times daily for the family however, a significant proportion of mothers observed cook twice or once daily while some still cook four or five times daily. Fuel for cooking in all the five local government areas are fire wood and kerosine with a very small proportion, 5% using bute-gas for cooking. Most mothers, 75% in the local government headquarters rely on kerosine while those in the other areas relied on both firewood and kerosine. In Ondo town and in Ode-Aye saw dust stoves were found particularly with mothers that live around the saw mills.

All the resource persons believed that most of the mothers work outside their homes. In their assessment, over 75% of the mothers are believed to work outside their homes in all the five local government areas. Further to this, grandmothers and nannies are important child

caregivers when these mothers go out to work. In Ondo town in particular, nannies home are organised in such manners similar to daycare centres where mothers take their children to be cared for for by old ladies till their return. However, it is not uncommon to find mothers take their young children along with them strapped to their back to their work places outside the home.

COMMONLY CONSUMED TRADITIONAL WEANING FOODS:

The traditional foods commonly consumed by infants and children in the five local government areas studied are presented in the table below (Table 4.18).

Table 4.18: Summary of commonly consumed traditional weaning foods in the five local government areas of Ondo State

FOOD CLASS	FOOD ITEMS
Main sources of Carbohydrate	Maize pap, plantain gruel, cassava gruel, pounded yam, cooked yam, cooked cocoyam, amala (yam flour), pupuru, (cassava meal ball), cooked rice and bread
Main sources of Protein	Mashed beans, cooked dehulled beans, cooked fish, cooked meat, boiled eggs

The results of the chemical analysis of the samples of commonly consumed trnditionnl weaning foods collected are presented in tablo 4.19. The energy value of the traditionnl weaning foods ranged from 36 kcal/100gm edible portion of cassavn gruel with the least energy density to 257 kcal/100gm edible portion of brcod. The moisture content of modified adult foods used for weaning were high ranging from 66% moisture of mashed dehulled beans to 90% of cassava gruel. The foods were generally low in fat ranging from 0.05gm/100gm edible portion of cassava gruel to 0.53gm/100gm edible portion of mashed beans (Table 4.19).

EVALUATION OF FORMULATED AND PREPARED WEANING DIETS/MIXTURES:

The results of the chemical analysis of samples of the compounded and prepared proposed weaning mixtures are presented in Tables 4.20 and 4.21 below. Table 4.20 show the proximate composition of the compounded weaning mixtures on dry matter basis while Table 4.21 show the proximate composition of the compounded proposed weaning diets analysed on wet edible ready to consume basis. The energy value of the diets ranged from 347 kcal to 354 kcal/100gm dry matter basis while their protein content ranged between 8.80gm and 12.40gm dry matter basis. Similarly, the crude fat content of the diets ranged from 10.86gm to 24.01gm/100gm dry matter basis.

Table 4.19: Proximate Composition of traditional weaning foods commonly consumed in the five local government areas of Ondo State.

FOOD ITEM	100gm Edible Portion			
	% Moisture	Energy (Kcal)	% Protein	% Fat
Maize pap	81.0 ± 0.41	64.88 ± 0.46	1.39 ± 0.17	0.63 ± 0.01
Plantain gruel	89.76 ± 0.10	39.04 ± 0.10	0.23 ± 0.10	0.06 ± 0
Cassava gruel	90.18 ± 0.32	35.68 ± 0.11	0.15 ± 0.11	0.05 ± 0
Cooked yam	64.87 ± 0.22	136.00 ± 0.34	1.23 ± 0.30	0.11 ± 0.01
Pounded yam	70.90 ± 0.24	112.04 ± 0.22	1.00 ± 0.16	0.12 ± 0.01
Mashed beans	70.10 ± 0.18	134.85 ± 0.30	5.81 ± 0.87	0.53 ± 0.010
Mashed dehulled beans	66.28 ± 0.10	131.73 ± 0.21	8.16 ± 0.88	0.71 ± 0.04
Ebe	72.58 ± 0.18	101.76 ± 0.17	0.44 ± 0.16	0.12 ± 0.01
Fupuru	70.38 ± 0.35	109.88 ± 0.40	0.47 ± 0.10	0.13 ± 0.002
Amala	77.57 ± 0.26	89.30 ± 0.22	0.89 ± 0.18	0.10 ± 0.002
Boiled cocoyam	78.21 ± 0.37	94.79 ± 0.19	1.63 ± 0.38	1.63 ± 0.20
Boiled rice	69.12 ± 0.17	121.82 ± 0.20	2.50 ± 0.50	0.23 ± 0.02
Boiled fish	63.85 ± 0.09	1177.50 ± 0.36	19.62 ± 0.83	10.38 ± 0.01
Boiled beef	66.56 ± 0.78	212.32 ± 0.27	22.93 ± 0.45	8.49 ± 0.30
Boiled egg	76.89 ± 0.14	162.04 ± 0.18	11.93 ± 0.32	9.71 ± 0.62
Bread	36.20 ± 0.22	256.88 ± 0.37	7.53 ± 0.18	2.22 ± 0.11

Table 4.20: Proximate Composition of Compounded Weaning Diets 100gm Dry Matter Basis.

Sn	Mixture Code	Composition of the diet Mixture	% Moisture	Energy (Kcal)	Crude Protein (g)	Crude Fat (g)
I	MCAO	Maize, Cowpea, Tete, oil	77.29	354	12.24	12.59
II	MGAO	Maize, Groundnut, Tete, oil	78.43	349	11.88	16.65
III	MSAO	Maize, Soya, Tete, oil	75.43	347	11.11	13.89
IV	CCAO	Cassava, Cowpea, Tete, oil	76.86	352	12.40	11.07
V	CGAO	Cassava, Groundnut, Tete, oil	78.00	348	11.32	16.87
VI	CSAO	Cassava, Soya, Tete, oil	77.00	350	10.91	13.04
VII	PCAO	Plantain, cowpea, Tete, oil	76.50	350	11.81	11.13
VIII	PGAO	Plantain, Groundnut, Tete, oil	81.00	348	11.45	24.01
IX	PSAO	Plantain, Soya, Tete, oil	76.43	348	10.16	13.34
X	RCAO	Rice, Cowpea, Tete oil	80.00	349	9.83	10.86
XI	RGAO	Rice, Groundnut, Tete, oil	75.29	349	10.42	18.29
XII	RSAO	Rice, Soya, Tete, oil	81.10	351	8.80	11.73

Tete (Amaranthus Caudatus)

Oil (red palm oil)

Maize (maize meal)

Cassava (cassava flour from pupuru (cassava meal)

Plantain (plantain flour from mature unripe plantain

Soya (Soya beans)

Table 4.21: Proximate composition of Compounded Weaning Mixtures on Wet (ready to consume) portion. (100gm portion)

DIET NO	DIET CODE	% MOISTURE	ENERGY (KCAL)	(g) PROTEIN	FAT (g)
I	MCAO	77.29	101.14	3.50	3.60
II	MGAO	78.43	99.71	3.39	4.76
III	MSAO	75.43	99.14	3.17	3.97
IV	CCAO	76.86	100.57	3.54	3.16
V	CGAO	78.00	99.43	3.23	4.82
VI	CSAO	77.00	100.00	3.12	3.73
VII	PCAO	76.50	100.00	3.37	3.18
VIII	PGAO	81.00	99.43	3.27	6.86
IX	PSAO	76.43	99.43	2.90	3.81
X	RCAO	80.00	99.71	2.81	3.10
XI	RGAO	75.29	99.71	2.98	5.23
XII	RSAO	81.10	100.29	2.51	3.35

Protein Quality Evaluation of the Selected Diets:

Five quality attributes of the protein content of the eight selected weaning diets were assessed and presented in Table 4.22. The corrected protein efficiency ratio (C - PER) of the diets varied from 2.11 for CGAO (cassava, groundnuts, amaranthus (tete) and palm oil mixture) to 2.40 for RCAO (rice, groundnuts, amaranthus and palm oil mixtures).

Table 4.22: Protein quality parameters of the selected eight experimental weaning diets.

S/No	Diet No	Mixture Code	PER	C - PER	NPR	NPU	TD	BV
1	II	MGAO	2.56 ± 0.28	*2.38 ± 0.13	3.63 ± 0.38	*78.08 ± 3.55	88.92 ± 3.71	87.89 ± 2.26
2	IV	CCAO	2.43 ± 0.27	2.26 ± 0.12	3.44 ± 0.60	73.10 ± 2.28	89.08 ± 2.56	81.66 ± 2.11
3	V	CGAO	2.27 ± 0.44	2.11 ± 0.18	3.32 ±00.77	72.81 ± 3.19	88.41 ± 1.82	81.98 ± 2.35
4	VI	CSAO	2.38 ± 0.40	2.21 ± 0.11	3.39 ± 0.32	74.14 ± 3.26	89.85 ± 2.28	82.51 ± 3.51
5	VII	PCAO	2.45 ± 0.33	2.28 ± 0.20	3.40 ± 0.37	73.58 ± 2.47	82.58 ± 2.85	88.91 ± 2.15
6	VIII	PGAO	2.33 ± 0.19	2.17 ± 0.12	3.35 ± 0.51	71.96 ± 3.31	81.37 ± 1.44	87.43 ± 2.56
7	IX	PSAO	2.54 ± 0.25	*2.36 ± 0.08	3.60 ± 0.34	74.43 ± 2.15	83.62 ± 2.42	89.00 ± 2.89
8	XI	RGAO	2.58 ± 0.39	*2.40 ± 0.14	3.65 ± 0.23	*86.24 ± 3.18	90.18 ± 3.72	90.56 ± 3.10
9	Casein		2.69 ± 0.32	2.50	3.89 ± 0.45	91.68 ± 3.69	95.61 ± 3.15	96.88 ± 1.98

PER (Protein efficiency ratio) C - PER (corrected protein efficiency ratio) NPR (net protein ratio) NPU (net protein utilization) TD (true digestibility) BV (biological value).

*statiscally significant ($P < 0.05$)

Table 4.23: Summary of Sensory Evaluation Scores of the Selected Formulated and Prepared Weaning Diets (Mixtures)

Diet Code	Appearance/ Colour	Taste	Flavour	Consistometre Reading	Mouthfeel	Consistency
MGAO	2.3 ± 0.64*	3.2 ± 0.72*	Good	8	3.6 ± 0.65	3.9 ± 0.28*
CCAO	2.8 ± 0.48	2.8 ± 0.44	Beany	7	3.7 ± 0.48	3.3 ± 0.74
CGAO	2.8 ± 0.74	3.2 ± 0.82*	Bland	7	3.6 ± 0.65	3.3 ± 0.68
CSAO	2.7 ± 0.48	2.8 ± 0.38	Bland	7	3.7 ± 0.48	3.3 ± 0.48
PCAO	2.7 ± 0.48	2.7 ± 0.46	Beany	8	3.5 ± 0.51	3.8 ± 0.44
PGAO	2.9 ± 0.78	3.4 ± 0.71*	Peanut	10	3.4 ± 0.50	3.8 ± 0.38
PSAO	3.0 ± 0.72	3.2 ± 0.70*	Plantain	8	3.6 ± 0.49	4.2 ± 0.70
RGAO	3.5 ± 0.51*	3.5 ± 0.72*	Good	10	3.8 ± 0.44	4.3 ± 0.64

* statiatically significant $P \leq 0.05$

Scoring: Adapted Lammond's sensory evaluation method (1982)

5 - Excellent, 4 - very good, 3 - good

2 - Poor and 1 - very poor.

The net protein ration (NPR) values varied from 3.32 in CGAO to 3.65 of RGAO. While the net protein utilization (NPU) values ranged from 71.96 in PGAO (plantain, groundnuts, amaranthus and palm oil mixture) to 86.24 of RGAO. Similarly the true digestibility (TD) values varied from 81.37 of PGAO to 90.18 of RGAO.

Statistical analysis of protein quality attributes of the mixtures showed that the PER, NPU, TD and BV values were statistically significantly different ($P < 0.05$) and vary as the diets/mixture under test.

SENSORY EVALUATION OF SELECTED FORMULATED AND PREPARED WEANING DIETS/MIXTURES:

The mean score responses of the taste panelist were calculated for appearance/colour, taste, flavour, mouthfeel and consistency of the selected eight weaning mixtures compounded and prepared (Table 4.23). All the diets evaluated were coloured ranging from the cream colour of CCAO and PCAO to dark green colour of CCAO. Similarly, the mean score value for colour ranged from 2.3 in MCAO to 3.5 in RCAO. The mean responses for the taste of the diets were statistically significant from each other ranging from 2.7 for PCAO to 3.5 of RCAO ($P < 0.05$) Table 4.23. The consistency and the mouthfeel of the different diets evaluated were judged acceptable, good and very good with score ranging from 3.4 in PCAO to 3.8 of RCAO.

Statistical analysis of the sensory evaluation responses showed that there were statistical significant differences ($P < 0.05$) in the colour of the prepared compounded diets particularly between the maize based and the rice based diets and between the plantain based and the rice based diets. The panelists responses to assessment of the prepared diets consistency showed that the observed differences in the mean assessment scores were statistically significantly different from one another ($P < 0.05$).

Readings of the Adam's consistometer for the different diets correlate highly with the responses of the judges (panelists). In

conclusion the judges agreed that the consistency of the diets were suitable for the age group for which the diets were intended.

CHAPTER FIVE

DISCUSSIONS

SOCIO-ECONOMIC CHARACTERISTICS OF THE STUDY GROUP

This survey reports on the weaning pattern and the constraints or conditioning factors that influence the choice of weaning foods in the selected local government areas of Ondo State. This investigation is unique in the spread of the study area and the number of people studied when compared to similar studies aimed at documenting weaning practices in different parts of Nigeria [Nnanyelugo, 1985; Kazimi et al 1979; Cherian 1981; Akinyele et al 1987]. The study was set out with the belief that the local government headquarters were sufficiantly urbanized to qualify as urban areas. The result however revealed that all the studied areas are rural in conformity with the standard United Nations declaration and definition (United Nations, 1969). Urban Centres are defined in terms of population size, at least 20,000 people and occupation, non-agricultural [U.N. 1969].

In three of the local government areas, (Idanre, Ikale and Owo) more than half of the fathers 56%, 56% and 54% respectively were farmers by occupation. Results similar to this had only been reported for studies conducted in rural population where farming has the pride of place as the prime occupation [Nnanyelugo, 1985, Akinmokun, 1988]. The use of educational attainment, occupation and income as determinants of socio-economic status has been fairly criticized as unsatisfactory for socio economic classification in the Nigerian situation [Ogunlade, 1973].

The thrust of the criticism is the absence of socio-economic classification in Nigeria along such lines. It is not uncommon now to find retired senior military personnels and civil servants claiming to be farmers. However, inspite of its apparent short-comings, this criteria are the best available tools to classify people into socio-economic classes.

The study population had a higher level of educational attainment than reported for most rural parts of Nigeria [Omotola et al 1985; Nnanyelugo, 1985 and Akinmokun, 1988]. The high level of the literacy in the study areas (Table 4.4) are mainly due to the high social value placed on education and the large number of schools in the area. Furthermore, majority of the respondents were born during the period of free universal primary education scheme of the old Western regional government and most parents took advantage of the scheme to send their children to school.

Petty trading and food vending were the main occupations of the mothers. Farming was significantly different in Ikale local government area compared to other local government areas where it was the major pre-occupation of the mothers (Table 4.3). Cultural values and the lower level of educational attainment of the women are possible explanations for the high percentage of women farmers in Ikale local government area. The significant proportion of women engaged in trading despite the rural nature of the study setting are indicative of the

economic pressure on the families particularly mothers to look for additional sources of money to supplement the families income.

Infrastructural facilities such as proper housing, water and waste disposal are poor in the studied area. Sixty-one percent of the population sample depended on well and rain for domestic water requirement. The water situation will definitely be worse during the dry seasons when most of the shallow wells will be dry and no rains thus forcing them to resort to other unorthodox sources of water. The Ikales depend on stream and rain water mainly for domestic use. (Table 4.4). The population dependence on bush/stream for disposal of human waste runs along the line of availability of water. In the relatively planned local government headquarters, pit latrines were the rule rather than exception in houses where toilet facilities were available. The general sanitary environment of the study area was poor. Huge heaps of refuse were observed in open sites particularly around the markets in local government headquarters.

RECORD OF BIRTH:

Analysis of where the children were delivered showed that most of the children, 76% were delivered in hospitals or maternity centres. This observation shows a high patronage of hospitals and health centres in the study area. The high literacy rate observed could be responsible for the mothers appreciation of the inherent advantages of giving birth

to children in hospitals or designated maternity centres. Furthermore, all the studied sites have at least a hospital or primary health centre maintained by the local government thus making health facilities more readily available and accessible to the people.

INFANT FEEDING PRACTICES

Infant feeding practice in the areas studied showed that breastfeeding was the accepted normal way of infant feeding as shown in table 4.5. The proportion of infants on breast at about nine months was very high and is much higher than figures reported in similar studies carried out in Anambra state of Nigeria (Nnanyelugo, 1985).

Breastfeeding practice was traditional and based on demand feeding rather than scheduled feeding (Table 4.6). The long duration of breast-feeding which was up to children's second birthday for some babies in the five local government areas were probably due to the nature of mothers occupation that allowed infants to be carried along with their mothers to places of work outside the home. Other explanations are the traditional method of breastfeeding and the traditional rural nature of the study areas. The other possible conditioning influences are the lowered influence of urban centres, marketing system, the five-day marketing system, scarce and expensive breast-milk substitute as well as rural poverty. Inspite of the cross sectional nature of this study, analysis

of infant feeding methods by age revealed that only 11% of all children aged less than seven months had completely been weaned while only 23% of children less than ten months had been weaned completely off the breast (Table 4.7). There appeared to be similarity in the observed trends in three of the five local government areas studied. The three local government areas, Idanre, Ikare and Ikale, have similar social life and are relatively more rural with no single industry apart from cottage agricultural based industries. The other two local government areas, Ondo and Owo local government areas are relatively more cosmopolitan with mothers being more mobile. The relative proportion of full housewives mothers from this two local government areas were lowest when compared to the other three local government areas.

Mothers reasons for stoppage of breastfeeding their children when they eventually stopped were different from one local government area to another (Table 4.8). Thirty-two percent of all mothers believed that the child's age was the prime consideration while other multiple reasons were adduced for stoppage of breastfeeding. Such reasons include; mother's employment, child's refusal to suck at the breast and family traditional practice. Previous studies to document mothers reasons for stoppage of breastfeeding showed that another pregnancy by the mothers was the most important singular and common reason (Omuhor,

1980; Guthrie et al, 1980]. The non signficance of maternal employment as a factor in stoppage of breastfeeding is a further testimony to the type of occupation available to mothers of the study area. Furthermore, the non significance of reasons such as inadequate milk supply and milk drying up also show lactational success in the study areas. Child's ability to eat adult foods un-modified before stoppage of breastfeeding has the additionnl advantage of the child's benefiting from the protein contribution from breastmilk which has been shown to be adequate to meet protein needs of the child up to twelve months [M^{c}Laren 1974; Alois et al 1975] provided the child was free from infection and other debilitating diseases that could increase protein requirement.

SUPPLEMENTARY FEEDING PRACTICS

Supplementary feeding with modified adult foods or semi-solids commenced in most of the children (63% of total) after four months. However, the rest 37% of the children had commenced supplementation before four months (Table 4.10).

There were no significant differences ($P < 0.05$) between the proportion of children that had commenced supplementary feeding before the age of four months in all the five local government areas studied. The first semi-solid supplement offered to children was mainly plain gruel of maize (Ogi) (Table 4.11). The nature of the first supplement,

the age of commencement and the method of feeding such supplement together are nutritionally not desirable particularly when one consider the acute poor sanitary situation of the study areas.

Childhood diarrhoea were common occurences mostly attributable to weaning. Bottle feeding in itself is undesirable because of its impact on breastfeeding and when this is practiced in unsanitary environment with doubtful water source it makes bottle feeding more dangerous for the child. The type of first supplement observed in this study is similar to those observed in other similar studies carried out in other parts of Nigeria [Osuhor, 1980; Kazimi et al, 1979; Cherian, 1981; Oke, 1967 and Omotola et al 1985]. This observation shows that childfeeding has not been influenced by education. There were however, changes in the observed types of modified adult foods given to infants in Ikale local government area and among a small proportion of infants in the adjoining local government areas. Porridges of cassava or plantain are offered to infants in place of maize gruel. This practice was also observed among some mothers from Ondo and Idanre local government areas which shares boundaries with Ikale local government area. This observed practice in Ondo and Idanre local government areas could either be due to migrant Ikales in this local government areas who have not lost their cultural habits [De-Garine, 1962]

or the acceptance of Ikales food habits by their neighbours (Latham, 1972). Ikale local government area has part of its land mass forming part of the coast line of Nigeria which agriculturally supports the propagation of plantain and palm trees. The subsistence nature of agricultural production of the natives makes the production of plantain and cassava the staple crops produced in this area. Furthermore, the ecology of this area also supports production of cassava, plantain ond yams.

Food consumption is strongly influenced in traditional societies by complex socio-cultural factors that affect food behaviour. Some foods are culturally more highly prized than others and when such highly prized foods are roots and tubers as in the case of our study areas where yams, cassava ond plantain are the main staple, the young child is bound to be at a disadvantage due to the small stomach capacity and the bulky nature of roots and tubers with low nutrients density Particularly that of proteins. The change in staple food from yam to cassava as noticed in Ondo local government area ie mainly due to decline in role of yams, increased familiarity with cassava and its Popular products as well as the low labour requirement for cassava propogation. The shift from food crop production to cocoa cash cropping partly further explain the observed shift in food staple in Ondo and Idanre local government areas. These observations were similar to the observations of other workers where changes were observed in types of staples (Lipton 1977 and Fifth World Food Survey, 1985).

The importance of yams, pounded yam, beans and bean dishes for weaning have been similarly reported in other studies in other parts of Nigeria [Kazimi et al 1979; Osuhor 1980; Cherian 1981 and Akinyele et al 1987]. The studies of Nnanyelugo (1985) in Anambra state of Nigeria did not observe beans and bean dishes as important weaning foods. However, the general conclusion drawn from other studies carried out in India, Ramanchandra (1987), Tunisia, Ahmed (1987) and Europe, Ballabriga et al (1987) is that traditional weaning foods are largely tailored along available foods and this was also observed in this study.

MOTHERS SOURCES OF INFORMATION ON CHILDCARE

The observed significant influence of hospital personnel on mothers on childfeeding is not unexpected because of the proximity of hospital services to the population group and the relatively high educational attainment of the mothers studied.

Similar observations have been reported as one of the advantages of women education i.e. ability to utilise health facilities [Founder et al 1982 and Omotola 1990]. The traditional nature of the study areas explains the importance of the influence of parents and in-laws who are readily available to offer support and assistance in child rearing.

The influence of hospital personnel cannot be said to have influenced the mothers positively partly due to the ignorance of hospital personnel of desirable pattern and practice or and mothers inability to follow instructions and advice.

Assessment of the nutritional education knowledge of nurses and midwives sampled in this study showed that most of them were ignorant of desirable childfeeding practice within the context of the environment of the mothers.

Mothers concept of "good" foods and "not good" foods for the sick children did not reveal differences in all the five local government areas. However, the result revealed that rich sources of protein were classified as "not good" for sick children and should therefore be avoided. Taboos or beliefs such as withholding solids at the slightest sign of diarrhoea have the potential effect of precipitating Protein - energy malnutrition in poorly grown children as shown by studies in Punjab [Taylor et al, 1976].

DIET HISTORY

Analysis of the diet history of the areas studied showed similarity in trends thus the data were pooled together to express a single trend for the areas. Fruit juices, oranges and pineapples were the earliest food forms given to children at about 4 - 5 months of the infants ages apart from breastmilk substitute and other preparations such as herbs and native tea. Beans and bean dishes

were foods given next and were introduced at about the mean age of 5.48 months (Table 4.15). Soyabeans also featured in children's diet at the mean age of 5.27 months. The early introduction of soya beans at a relatively early age could be due to the intensive nature of UNICEF promotional programme of soyabeans for children as part of the household food security crops. Cereals like rice, maize and guinea corn dishes were introduced at the mean age of about 6.54 - 6.89 months. Fish was the first food of animal origin given to children introduced at a mean age of 6.72 months. Starchy roots, tubers and fruits were introduced at mean ages ranging between 9.29 and 12.58 months. The trend observed in this study is very different from the trend reported by Ajenifuja (1987) and those observed in Europe as reported by Ballabriga et al (1987). In Europe, cereals and fruits were introduced at mean ages of between 2 and 3 months to babies, which were most often the first foods outside milk or milk based diets. Most of the foods given to the children in this study were home prepared and none of the traditional foods mentioned was industrially produced. However, some of these foods were purchased ready made from local food vendors. Those observations were similar to those reported by other workers in India, Ramanachandra (1987), in Tunisia by Ahmed (1987) and in Egypt, by Hamza (1987).

The consumption of foods of animal origin (flesh) observed in this study commenced at age ranges of 6.72 to 16.67 months which is

comparatively much later than three months reported by Ajenifujo (1987). However, his observation on consumption of legumes and vegetables are similar to what was observed in this study.

FOOD MARKETS AND STORES

The number of recognised food markets and types per area studied showed that there were few food markets and stores excepting in Ondo and Owo local government headquarters. The food markets, particularly those in areas other than the local government headquarters are operated or open for business on either once in every five or seven days and sometimes subjected to closures as part of ritual or cultural ceremonies. The effect of this phenomena is that mothers would only be able to purchase foods on markets days or depend on products from their farms or travel to the next village or local government head-quarter where markets are open for business daily. Sometimes open spaces could be used for evening markets that operate between 7 and 9.30 p.m.. Thus mothers that rely on industrially produced food commodity can only buy enough when money is not limiting on market days. Marketing facilities and malnutrition are reported to be negatively correlated [Schofield, 1979] which is suggestive that people closest to markets will enjoy lower prices, less seasonal fluctuations and better nutrition generally. However, families remote from markets facilities with high degree of self-provision

are more dependent on ecology than economics on nutrition.

Climate, soil and vegetation largely determine the quantity and types of food grown and possibly available food in any particular area. Seasonality is another factor that influences food production and the extent to which subsistence farming influences food availability is dictated by factors of food marketing and distribution. The foods available as observed in the study areas were less varied in nature and the number of commerical infant/child feeding preparations such as commercial weaning foods, baby milks, baby dessert and fruit juices were few in number and variety. This observation further confirms the traditional/rural nature of the studied area.

The influence of the nations economic depressions and nutrition programmes such as UNICEF's household food security programme cannot be over-emphasized as they affect the available foods meant for children in terms of variety. The diversity of available foods reflects more of local production within the community or nearby local government areas. Foods of animal origin are available but expensive except areas that are relatively cheaper. Processed smoked fish from the riverine coastal areas are readily available on market days. Smoked fish are usually not offered to children/infants because of fear of accidental consumption of bones thus frozen imported mackerel are offered boiled for children as alternative to smoked fish.

COMMUNITY WORKERS ATTITUDES & BELIEFS

The quality of guidance that mothers receive from hospital workers was found to be generally poor and probably explain in part the cause of the observed bad trend in this study (Table 4.7, 4.10 and 4.11). Hospital workers admitted some of the constraints to their effectiveness which include the unavailability of appropriate materials/ equipment such as visual aids, projectors and food demonstration utensils. Other constraints are crowded work schedules at the expense of nutrition education talks, lack of adequate knowledge of desirable infant feeding practice, the effect of electronic media advertisement of baby food in General and the strong influence of elders in the communities. The study also observed that there were too many conflicting information available to mothers from all identified sources that included the health workers, mass media, food industries and the community.

COOKING PATTERN AND FUEL

Cooking of food is the exclusive responsibility of women in traditional societies which often include sourcing of water and fuelwood. The increasing difficulty encountered by mothers in carrying out these traditional responsibilities is translating to women now patronizing food vendors and cooking food just once or twice daily particularly for children. Studies of Whitehead et al (1972) in Gambia showed that

women spend between 12% - 27% of total available dietary energy to search for water during the dry season while Lunven (1983) reported that women spend an average of fourteen minutes daily to source for firewood alone. It was observed in this study that the number of times mothers cooked meals daily varied from once to four times with most cooking once or twice daily. Increasing fuel wood shortage and the consequent expensive nature of available fuel wood or alternative might be responsible for the observed reduction of number of times cooking is carried out. Foods cooked once especially for children/babies are often consumed over the whole day. The absence of proper storage facilities can make this practice very hazardous resulting in food borne infections. A report of fuel wood survey by the FAO highlighted the increasing difficulty faced by people in many rural areas who have to walk very long distances to collect and haul fuel wood often leading to reduction in frequency of meals cooking (FAO 1983).

TRADITIONAL WEANING FOODS/FAMILY MEALS

The traditional weaning foods observed in this study were similar to those reported in previous studies carried out in the South-Western part of Nigeria (Akinyele et al 1987). However, the use of plantain and cassava prepared as gruels and offering of pupuru (cassava fufu) and pounded yam as weaning foods are novel. Studies in Anambra (Nnanyelugo 1985) also observed the use of yam and yam dishes for infant feeding.

The proximate composition of the sampled traditional weaning foods which were modified adult foods or food from the family pots were low in energy, protein and fat. The energy density of the gruels were extremely low ranging from 36 to 65 kcal/100gm edible portion. Similarl all the foods except those of animal origin are poor sources of protein and fat. These observations are similar to the finding of other workers that had previously studied Nigerian traditional weaning diets [Oke 1967; Akinrele 1966; Naismith 1973; Akinyele et al 1987 and Ogbeide 1985].

Nutritional Quality of Formulated Weaning Mixtures/Diets:

Tho weaning mixtures formulated in this study were based on the principle of multimixes as put forward by Jelliffe (1967). Most previous attempts were geared towards the production of weaning foods based on cereals which were widely reported as Nigerian traditional weaning foods such as maize meal gruel and sorghum gruel. The cereal were fortified with protein from animal and or vegetable sources particularly soyobeans and fish [Akinrale et al 1970; Olusanya 1988; Smith 1982 and Akomolafe 1988]. However, this present study is different because attempts were made to produce acceptable nutritionally adequate weaning mixtures based on observed community practice and using the principles of least cost methods to determine the quantities and proportion of the ingredients in the mixtures. Few studies in

Nigeria had reported the use of starchy roots, tubers and fruits for infant feeding or weaning diet. The ingredients chosen were readily available and popularly consumed in the area of study apart from being low cost.

Most studies highlighted the relative lower cost of soyabeans to cowpeas but this study observed that soyabeans is relatively more expensive than any other legume in the market. The high cost of Soyabeans may be as a result of the popularity of the bean in nutrition programmes as a super bean. However, soyabeans, cowpea and groundnuts were the main protein sources used for this study's weaning mixtures compounded. Palm-oil was used in the mixture as source of concentrated energy, to enhance the palatibility of the diets as well as influence the viscosity of the overall mixtures. Palm-oil also serve as medium and vehicle for fat soluble nutrients besides contributing B-carotene.

Amaranthus leaves were used in the preparation of all mixtures where they contribute proteins, vitamin C, and B-carotene mainly to all the mixtures.

Proximate composition of the twelve compounded weaning mixtures show great and significant improvement in the energy, protein and fat content of the mixtures when compared to the original traditional gruels and porridges of maize meal, plantain and cassava (Table 4.19 and 4.21). Improvement in energy values from 36kcal/100gm to 99kcal/100gm edible portion were recorded

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while the protein density increased from 0.15 - 1.39 gm/100 gm to 2.51 - 3.54 gm/100 gm. The fat content increased from 0.05 - 0.63 gm/100 gm to 3.1 - 4.76 gm/100 gm edible portion basis. The increases in the nutrient density ranged from about 250% for protein to over 700% in fat content while there was over 155% increase in energy density of the formulated diets over their corresponding traditional gruels and porridges. The fat content of the proposed compounded weaning diets fall within the range found in mature human milk, 3 - 4 gm/100 ml [Department of Health and Social Security, DHSS, 1977]. Similarly the fat content values obtained fall within the palatable tolerance zone as shown by the studies of Church (1977).

Biological Evaluation of Compounded Weaning Mixtures:

Evaluation of eight of the compounded diets using biological techniques showed that the protein quality parameters assessed fall within the acceptable range recommended by the United Nations Protein Advisory Group reported in PAG Guidelines No 8 (1972). The C-PER values of all the diets assessed were above the minimum 2.1 value recommended and the NPU values fall within the "preferred" range of 65 - 80 with the dietary fat contributing more than the minimum 25% of the total energy of the mixture.

There are few studies in which similar ingredients as used in this study were used but there exist many studies in which different weaning mixtures were evaluated. The studies of Karyadi et al (1990)

in Indonesia evaluated mixtures of cassava and soyabeans among other diets and found PER value of 2.17 for the cassava - soya mixture. Attempts by Akinrele to enrich/fortify Gori (1967) (fried fermented cassava) was evaluated by its biological value(BV) which ranged from 68 to 78. The values obtained for the cassava based diets in this study are higher than protein quality parameter values reported in above studies reviewed. The three cassava diets had C-PER values ranging from 2.11 to 2.26.

Recent studies by IITA and NIFORT study team on utilisation of Plantain in weaning mixture using soyabean as protein supplement, only evaluated the "soya-musa" by chemical and clinical trials [Ogazi, 1988].

Comparison of protein quality results obtained in this study with other similar studies such as the Banana, beans and amaranthus vegetable mixture (BBA) of Olusanya (1988) showed that the plantain based diets of this study gave significantly higher values. C-PER values of 2.17 - 2.36 compared to 1.5, NPU values of 71.96 - 74.43 compared to 64 and NPR values of 3.35 - 3.60 compared to 1.6 of BBA (Olusanya, 1988). Comparison of MCAO with cowpea-ogi of Akomolafe (1988) show that both mixtures recorded similar PER values i.e. 2.56 compared to 2.60 of 60:40 cowpea-ogi mixture. However, comparison of MCAO with soy-ogi [Akinrele et al, 1971] and Apapa-mix [Katiku et al, 1984] show that MCAO have higher PER value i.e. 2.56 compared to 2.3 of soy-ogi and Apapa-mix.

The nutritional value of the protein content of the mixtures in terms of C-PER and NPR showed similarity in trend. However, a not

too distinct trend was observed in the variability of the mixtures NPU values which fell more when compared with true digestibility values. Though there were no significant statistical differences in the digestibility value but significant differences existed between the NPU values (at $P < 0.05$). Similarly, there were no significant differences in the biological values of all the eight mixtures evaluated. This observation might be due to the nature of the proteins of the mixtures which were all of vegetable origin and the balance arrived at by the least cost method for their formulation which took the amino acid composition of the component mixture into consideration.

The seemingly apparent better quality of the protein mixtures used in this study could be due to the high digestibility, the high energy content of the diets and the addition of vegetables that supplied minerals and vitamins additional to those in the premix as well as the better balance of amino acids achieved by the approach of least cost statistical method for compounding the diets. The amino acid contribution of amaranthus vegetables cannot be ignored. The amino acid profile of the leafy vegetable shows that it is a good source of methionine and cysteine which is known to be limiting in most legumes. The profile is comparable to the FAO/WHO/UNU (1985) reference amino acid pattern. The leafy vegetables could be used alone to fortify cereals and tubers The relatively large amount of the vegetables added to the cassava based diets more than compensated for the limiting amino acids of cassava and

soyabeans or groundnut or cowpea mixtures. On comparative basis, the amounts of vegetables required to meet the nutritional requirements of the target diets were highest in cassava based diets. Amaranthus concentrates (LPC, leaf protein concentrates) have been successfully used to rehabilitate Indian children suffering from kwashiorkor [Rajalakshimi et al, 1973, Krishnamurthy et al, 1976]. The vegetables are also good sources of carotenoids, vitamins E and K as well as polyunsaturated fatty acids that may collectively contribute to the improved quality of the diets.

Sensory Evaluation of the Compounded and Prepared Weaning Mixtures:

Results of the sensory evaluation of the diets revealed that the colour/appearance of the diets were mostly barely acceptable except the rice, groundnut, amaranthus and palm oil mixture due to the dark colouration largely resulting from the intense green colour of the vegetable. Though the panellist were untrained as sensory evaluators, they were familiar with the culture of the study area and were still able to politely disapprove of the colour as not too suitable/desirable for children's diets. Dark coloured meals and preparations exist in the cuisine books of the study areas but such meals are believed to be medicinal with semi-magical powers. Among the sensory parameters evaluated, the appearance of the mixtures was the only reason mothers might give for not willing to try them on their

children. Acceptable food colour in their view for children/infant diets are off white (cream) to brown. The tastes of the mixtures were generally acceptable though some of the mixtures were claimed to have beany tastes. Mixtures that contained cowpeas were identified by evaluators to have beany taste which could be improved upon by addition of commercial food flavours to mask or improve the taste and or flavour.

Mouthfeel and consistency of the prepared weaning mixtures were assessed as suitable for infants/children aged 6 - 12 months. Consistometer reading values of the diets viscosity were highly positively correlated to mean values returned by the judges, which also indicate agreement with the suitability of the mixtures consistency/viscosity for infants feeding. Domestic kitchen blender might not be available in most homes in the rural areas but mothers could equally use grinding stone to grind the raw ingredients used sestertars for the weaning mixtures (Appendix V). However, if the flours of the ingredients were used then there would be no necessity for a blender.

The mixtures were designed to be fed with cup and spoon and each portion was designed to supply at least half the daily energy and protein requirement.

Based on computational analysis, virtually all the diets did not meet the target for iron but the level of iron contained in the compounded diets were significant. It is realised that vegetables were

the main source of iron in the compounded diets. Studies of Taylor (1979) and Oyeloja et al (1976) showed that at least 50% of iron content of most commonly consumed vegetables in Nigeria are physiologically available. Furthermore the level of phytates cootained in most commonly consumed vegetables in Nigeria had been reported to be low thus will not pose problem to iron bio-availability [Taylor 1979; Smith 1982] in our compounded weaning diets. All the weaning mixtures met the target for B-carotene and vitamin C.

CHAPTER SIX

SUMMARY AND CONCLUSION

A cross sectional study of 1408 children aged 4 - 36 months was carried out in five selected local government areas of Ondo state.

The study revealed the following:

(i) That most of the mothers studied had at least primary level education and were mostly engaged in petty trading.

(ii) That the socio economic characteristics of the study areas were similar and conform to the classical definition of traditional rural communities.

(iii) That farming was the principal occupation of the fathers and a significant proportion of the mothers were equally engaged in farming

(iv) That the sanitary condition of the areas studied was generally poor

(v) That most of the children studied were born in hospitals /maternity centres and were all breastfed for varying length of time from birth

(vi) That breastfeeding was a normal method of infant feeding in the areas studied which was culturally accoptable and practiced

(vii) Demand feading was most populor with the mothers and prolonged breastfeeding was common in the areas studied

(viii) Generally, mothers pattern of cessatioo of breastfeeding was rapid and abrupt done for most part over a few days

(ix) Generally mothers commence supplementary feeding on semi-solids after four months with less than 30% of all mothers commencing after six months of the child's age

(x) Plain gruel of home made maize gruel was the first semi-solid food offered to most of the children while some 7% of the mothers offered plain gruels of cassava or and plantain

(xi) semi solid supplements were generally fed from bottles

(xii) First supplementary food offered to children ranged from gruels (plain or mixed) of available staple to modified adult foods from family pots

(xiii) traditional weaning foods offered to children were all home made

(xiv) Beans and bean dishes as well as yam and yam dishes were the most popular foods from family pots offered to children

(xv) Generally, protein rich foods were considered undesirable for sick children by mothers

(xvi) Most mothers relied on advice from hospital workers and parents/in laws on childfeeding and child care

(xvii) Most of the hospital workers interviewed were ignorant of desirable childfeeding practice

(xviii) Firewood and kerosine were the most common fuels used for domestic cooking

(xix) Food vendors were important in providing some of the food needs of most families in the study areas

(xx) Proximate composition of traditional weaning gruels foun in the study areas were low in energy, protein and fat but high in moisture content

(xxi) The type(s) of traditional weaning foods offered to children were influenced by the types of foods available in the areas studied

(xxii) Twelve multi-mix weaning diets were formulated and prepared using least cost methods based on observed weaning practice and available foods in the study area

(xxiii) Proximate analysis of the prepared formulated weaning diets showed that they were nutritionally adequate to meet the needs of growing children and they were less bu

(xxiv) Bioassay results of the selected formulated weaning diets showed that their protein content were of desirable quality

(xxv) Sensory evaluation of the selected formulated and prepared weaning mixtures showed that they were generally acceptable in terms of their taste, mouthfeel and consistency while their appearance/colour were barely tolerable

(xxvi) The viscosity of the prepared formulated weaning mixtures were acceptable and judged suitable for the weaning age group.

RECOMMENDATIONS

Based on the findings of this study, the following suggestions are made to improve the nutritional health of weaning children living in traditional rural areas of Ondo state.

1. There should be concerted efforts by the relevant agencies and governments to improve the sanitary conditions of our rural communities through provision of portable drinking water and improved ventilated pit latrines.

2. Health practitioners should be given adequate nutrition training to update their knowledge on desirable childfeeding practice and general nutrition within the context of our local environments and changing circumstances.

3. Nutrition divisions should be established in all local government areas to provide nutrition education to mothers attending pre and post natal clinics. The division should plan and execute nutrition education outreach programmes to correct some of the widely held beliefs and concepts by traditional health workers, parents and the entire family on desirable nutrition practice, norms and standards.

4. Period of exclusive breastfeeding should be prolonged to at least six months in all traditional areas particularly areas with poor sanitary conditions

5. The use of plain gruels for child feeding should be discouraged and mothers should be taught how to prepare nutritionally adequate home made gruels from locally available foods or the family pot.

6. Mothers should be taught and encouraged to feed their babies supplementary foods with cups and spoons which are easier to clean than bottles.

7. The use of bottles and hand force feeding should be totally and completely discouraged by all health workers.

8. In view of the strategic importance of food vendors to family food security in traditional rural and urban areas, food vendors should be properly trained to provide safe, hygenic and nutritious foods to their customers.

9. Low cost rural technology should be developed to ease the burden of mothers search for fuel wood as well as produce "convenience" community based weaning mixtures that could be easily prepared at home from locally available foods

Contribution to Knowledge:

This study has revealed the existing weaning trend and pattern in selected local government areas of Ondo state. It further revealed the factors associated with the observed weaning pattern in the areas studied. The study observed the use of some staples in weaning gruel preparation as well as the proximate composition of some commonly consumed traditional weaning foods in the areas studied.

The study successfully used least cost statistical methods to determine the composition and proportion of ingredients used in the formulation of nutritionally adequate weaning diets using locally available foods. Furthermore, proper mixture of protein of vegetable source has been shown to provide protein of adequate quality to meet the needs of growing children.

Suggestions for Further Research:

1. Regular studies should be carried out to ascertain the type of information given to mothers at hospitals on childfeeding and child care and to what extent mothers were able to make use of such informations.

2. Routine nutrition surveillance should be conducted to update existing information and establish the various ecological factors that influence and or condition the existing nutritional practice in most parts of Nigeria other than University towns

3. Food technologists should be more involved in nutrition research aimed at the development of nutritionally adequate weaning foods of wide acceptance to the local communities using locally available foods. Such efforts should include attempts to improve the organoleptic properties of the weaning mixtures developed in this study and to make them more convenient for mothers to prepare.

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APPENDIX I

BASIC MIX TABLE

	Rice	Maize meal	Plantain	Cassava flour	Oil
	60/13	57/14	139/23	41/29	10
Soyabeans	72/10	73/13	185/21	55/29	5
	83/8	89/12	234/19	67/28	0
	34/39	33/42	62/54	16/59	10
Cowpea	64/21	60/26	115/49	29/58	5
	86/11	83/15	169/44	43/57	0
	7/43	6/44	15/44	5/45	10
Groundnuts	28/36	24/40	61/42	18/44	5
	50/30	43/36	107/40	32/43	0
	60/102	59/121	159/180	51/207	10
Amaranthus vegetable	74/87	73/110	200/169	64/202	5
	88/72	87/100	242/157	77/198	0

Legend 61/13 means 61g of rice
138 of soya beans

Triple mixture of the staple, protein supplement and vegetables were constructed based on the above basic table using proportion and substitution principles.

APPENDIX II

TRADITIONAL WEANING FOODS QUESTIONNAIRE

Name of Mother.....

Name of Interviewer.....

Date of Interview.....

SECTION A (BACKGROUND INFORMATION)

1.1 Respondent's Address.....

.....

1.2 Tribe of Mother..... Age.....

1.3 Tribe of Husband.....Age.....

1.4 Religion..... Mother's..... Huebands.....

1.5 Husband's Occupation:

Farmer ( ) Artisan (specify) ( )

Labourer ( ) Other (specify) ( )

1.6 Husband's Educational Status:

Illiterate ( ) Primary ( ) Secondary ( )

Vocational ( ) Others (specify) ( )

1.7 Mother's Occupation:

Full time Housewife ( ) Petty trade ( )

Food Vendor ( ) Others (specify) ( )

1.8 Mother's Educational Status:

Illiterate ( ) Primary ( ) Secondary ( )

Vocational ( ) Others (specify) ( )

2.1 Who owns the house you live in?

Self ( ) Family ( ) Rented ( ) Others (specify) ( )

2.2 Please describe the type of the house

Floor ( ) Roof ( ) Walls ( ) Ceiling ( )

2.3 How many rooms are available for sleeping?

2.4 Where do you get domestic water supply

Pipe borne ( ) Well ( ) Stream ( ) Others (specify) ( )

2.5 How long does it take you to get water for domestic use from the source.

less 5 mins ( ) 5-10 mins ( ) 10-20 mins ( )

20 mins and over ( )

2.6 What type of toilet facility is available?

Pit latrine ( ) Water closet ( ) Bush ( ) Others ( )

2.7 How do you dispose of your refuse

Burn ( ) Bury ( ) Bush ( ) Others (specify) ( )

SECTION B (CHILD FOODS & FEEDING)

1.1 Name of youngest child.....

1.2 Age of youngest child..... ( ) months Sex; M/F

1.3 Date .& place of delivery:.....

1.4 Birth weight: ( )kg Length ( )cm

1.5 Present weight ( )kg Length ( )cm

2.1 Do you breastfeed the child now? Yes ( ) No ( )

2.1.1 If yes, How do you breastfeed? Demand ( ) Scheduled ( )

2.1.2 If no, at what age of the child did you stop breastfeeding completely?

( )months

2.2 How did you stop breastfeeding?.....

2.3 Why did you stop breastfeeding when you did?.....

.....

3.1 With what do you feed the child now? Breastmilk alone ( )

Infant food formuln alone (epecify) ( )

Breastmilk and infant food formula ( ) (specify formula)

Others (specify in details).....

3.2 At what age of the child did you commence supplementary feeding?

( )weeks ( )months

3.3 Why did you introduce the supplementary food at that age?

.....

3.4 What was the first supplementary food at that age?

(Please give details).....

.....

3.5 Do you receive advice/information on how to feed your child from anybody?

Yes ( ) No ( )

3.5.1 If yes, who normally gives you advice on supplementary food?

Husband ( ) Your mother ( ) Mother-in-law ( )

Hospital staff (specify) ( ) Friends ( ) Others ( )

4.1 Do you give the child foods from the family pot?

Yes ( ) No ( )

4.2 If yes, what foods?.....

.....

4.3 If no, why not?.....

.....

5.1 Do you prepare food specially for the child?

Yes ( ) No ( )

5.2 If yes, what foods and how is it prepared (give details)?

.....

.....

6.1 What foods do you give the child when sick? (specify detailed recipe and how it is prepared):.....

.....

.....

6.2 What foods do you avoid to give the child when sick?

.....

.....

.....

7.1 What other non-dietary supplementary do you give the baby?

Type	Age of Introduction		Frequency	
	Months	days		weeks
Multivitamins				
Cod liver oil				
Agbo				
Others (specify)				

7.2 Which supplementary foods have you introduced to your baby so far and at which age?

Food		Source		Frequency		Age of Introduction	How prepared Detail, recipe required
		Home Prepared	Purchased Ready Made	Day	Week		
Fruit & Vegetable							
Pawpaw	1						
Oranges	2						
Pineapple	3						
	4						
Cereals	1						
Rice	2						
Bread	3						
Maize	4						
	5						
Grain	1						
Legumes	2						
Beans	3						
	4						
	5						

Food		Source		Frequency		Age of Introduction	How prepared detail, recipe REQUIRED
		Home Prepared	Purchased Ready Made	Day	Week		
Nuts & Seeds	1						
	2						
	3						
	4						
	5						
Roots & Tubers	1						
	2						
	3						
	4						
	5						
Animal Food	1						
	2						
Fish, Meat	3						
Chicken	4						
Snails	5						

Food		Source		Frequency		Age of Introduction	How prepared detail, recipe required
		Home Prepared	Purchased Ready Made	Day	Week		
Others							
Fats & Oil	1						
Vegetable oil	2						
Margarine	3						
Butter	4						
Others	5						
Beverage	1						
Tea	2						
Coffee	3						
Fruit Juices	4						
Cocoa	5						
Others							

to include if locally produced or purchased from the community.

8. Any other information:-

SECTION C

(24 Hours Recall)

FOOD CONSUMPTION DATA

Name of Child:.....

Recorder:.....

Date:.....

Time	FOOD DESCRIPTION/RECEIPE	QTY/VOLUME	COST

SECTION C

(24 Hours Recall)

FOOD CONSUMPTION DATA

Name of Child:.....

Recorder:.....

Date:.....

Time	FOOD DESCRIPTION/RECEIPE	QTY/VOLUME	COST

APPENDIX III

Community Market/Store Check List

1. Name of Community & Type:.....
2. Type (s) of Market (s):.....
3. How often visited/opened to people:.....
4. Total number of food markets/store in the community:.....

.....

5. Use of Oil and Sugar for foods particularly weaning:.....

AVAILABLE FOODS CHECK LIST

1. Available Protein - rich Sources:

   Vegetables:

   Animals:
2. Energy Rich food sources:
3. Available milk types:
4. Available vegetables:
5. Available Fruits:
6. Available Beverages/Fruit juices:
7. Snacks eaten by children:
8. Available commercial weaning preparations:

   General Note: Location of Market/Store relative to people.

APPENDIX IV

INFORMAL INTERVIEW CHECK LIST

(Resource Persons Interviews)

Name of Community:

Position/Status of Respondents

1. What are the foods used for feeding babies from birth to 36 months:

   .....

   .....

   .....

2. At what ages are the foods given introduced? .....

3. Why are babies fed this foods mentioned?

   .....

   .....

4. What are the ingredients used for preparing babies foods?

   .....

   .....

5. How are babies foods prepared and stored?

   .....

   .....

6. How are babies fed their foods?.....

   .....

   .....

APPENDIX IV

INFORMAL INTERVIEW CHECK LIST

(Resource Persons Interviews)

Name of Community:

Position/Status of Respondents

1. What are the foods used for feeding babies from birth to 36 months:

   .....

   .....

   .....

2. At what ages are the foods given introduced? .....

3. Why are babies fed this foods mentioned?

   .....

   .....

4. What are the ingredients used for preparing babies foods?

   .....

   .....

5. How are babies foods prepared and stored?

   .....

   .....

6. How are babies fed their foods? .....

   .....

   .....

7. Who decides the ages at which foods other than breastmilk are given to the babies?

.....

8. At what age do people generally begin to give other foods apart from breastmilk to their children?

.....

.....

9. Which food is usually first given to babies?

.....

.....

10. What foods are given or and avoided when the children are sick?

.....

.....

11. Are there special food traditionally meant for children? What foods? Why?

.....

.....

.....

.....

12. What equipment/utensils is used for food prepared?

.....

.....

13. What types of fuel are used for cooking?.....

14. How readily available are the fuel (expensive/scarce)

.....

14. How often do mothers cook daily?.....

.....

16. What is the common source of water generally used for domestic purpose (drinking, cooking and washing)?

.....

17. How many mothers work outside the home (possibly to earn money).....

18. What works do mothers do outside the home and how often are they away from home?

.....

.....

19. Who looks after babies when mothers go towork or do they take them to work?

.....

20. How do people generally dispose of human waste?

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APPENDIX V

Weaning Mixtures Recipes

Diet I

Maize meal, cowpea, amaranthus and palm oil mixtures

Maize meal 46 gm

Cowpea 22gm

Amaranthus (Tete) 60gm

Palm oil 10gm

Water 340ml

Method :

1. Dehull the stone free and clean beans (cowpea)
2. Grind the dehulled clean beans into a very smooth paste
3. Mix the bean and maize meal paetee thoroughly in a bowl
4. Add about 3/4 volume of the water to the paste mixture, pinch of salt to taste and cook on fire for 20 minutes
5. Destalk the vegetables, pick and wash clean free of dirt, stones/pebbles. Then blanch
6. Cut the blanched vegetables into very small pieces
7. Add the blanched cut vegetable pieces and palm oil to the cooked mixture and cook for another 2 minutes

Diet II

Maize, Groundnut, vegetable and oil mixture

Maize meal 48g

Groundnut 9g

Tete (Amaranthus) 97g

Palm oil 10g

Water 300ml

1. Remove the groundnut skin and grind to smooth paste
2. Mix the groundnut and maize meal paste thoroughly and add some of the water
3. Add the paste mixture into boiling water, stiring well and cook for 30 minutes
4. Destalk the vegetables, clean, pick and wash then blanch
5. Cut the blanched vegetables into fine small pieces
6. Add the vegetables, oil and little salt to taste and cook for 2 minutes.

Alternatively:

Roast the groundnuts and then mill into fine powder. Roasted groundnuts could be kept whole and milled only when needed. If groundnut (roasted) is to be used, it should be added to the cooked maize meal or when the meal is table ready.

Diet III

Maize meal 68g

soya beans 6gm

Tete vegetable 70gm

Palm oil 10gm

Water 350 ml

1. Dehull stone free clean soya beans, then grind into smooth paste.

2. Mix the soya beans paste and maize meal thoroughly to smooth paste

3. Cook the mixture mixed with the water for 20 minutes

4. Destalk the vegetables, pick, wash and clean free of pebbles/sand then blanch

5. Cut the blanched vegetables into fine small pieces

6. Add the vegetables and palm oil to the cooked mixture and cook for another 2 minutes. Add salt to taste.

Diet IV

Cassava flour	29g
Cowpea	38gm
Teto vegetables	72gm
Palm oil	10gm
Water	350ml

1. Grind the dehulled stone free beans into smooth paste
2. Add the caseavo flour to the beans paste plus water to form a very smooth paste
3. Cook the mixture on fire for 20 minutes
4. Deetalk the vegetables, clean and wash free of sand/pebbles Blanch the vegetables.
5. Cut the blanched vegetables into fine small pieces
6. Add the blanched cut vegetables, palm oil and salt to taste and cook for another 2 minutes.

Diet V

Cassava flour	37g
Groundnut	13g
Tete vegetables	145g
Palm oil	10g
Water	320ml

1. Grind skin free ond unmoulded groundnut into a smooth paste.
2. Mix the cassava flour (sifted) with the groundnut paste and water
3. Cook the mixture for 20 minutes
4. Blanch tho cleon, sand free deatalked vegetables
5. Cut the vegetables into very fine small pieces
6. Add the pieces of vegetablo, palm oil and salt to taste to the cooked mixture and cook for another 2 minutes.

Diet VI

Cassava flour	47g
Soyabeans	12g
Tete vegetables	120g
Palm oil	10g
Water	340ml

1. Dehull the stone free soybeans and grind into smooth paste
2. Mix the cassava flour and soyabeans paste plus water
3. Cook the mixture for 30 minutes
4. Deatalk the vegetables, pick and wash clean free of sand then blanch.

5. Cut the blanched vegetables into free small pieces or blend in a kitchen blender

6. Add the vegetables, palm oil add salt to taste to the mixture and cook for another 2 minutes.

Diet V11

Plantain pulp of green unripe finger	= 92g
OR Green mature plantain	= 258gm
OR Plantain flour	37g
Cowpea	57gm
Tete Vegetables	55gm
Palm oil	10gm
Water	340ml

1. Grind dehulled stone free clean beans to a smooth paste
2. Mix the beans paste and plantain flour with sufficient water to form smooth paste
3. Cook the paste on fire for 20 minutes
4. Add palm oil, salt to taste and blanch. Cut vegetables to the cooked mixture and cook for another 2 minutes.

Preparation of Plantain Flour:

Green mature plantain fruits are hand peeled, the pulp are then sliced into thin slices for easy fast drying. The sliced pulp are then spread on a drying tray and either oven dried or sun dried. In oven drying, the pulp is dried at 120°C for two hours and then at 80°C for another 2 - 3 hours. The dried pulp is milled using a Pestle

and mortar or kitchen blender or commercial plate mill. If the pulp is not properly dried the flour mill will form "clot" or stick together. The milled flour is then sieved to remove powder of undesirable sizes. The sieved flour is then stored in a dry air tight container and kept away for further use.

However, if mature unripe pulp is used, then the amount of water to use is reduced. The pulp is pounded to smooth paste, mixed with the ingredients and cooked for required time.

Diet VIII

Plantain pulp	60g or 25g plantain flour
Groundnuts	30g
Tete vegetables	55g
Palm oil	10g
Water	340ml

1. Grind skin free and unmoulded groundnuts into smooth paste
2. Mix the groundnut paste and plantain flour and water
3. Cook the mixture for 20 minutes on fire
4. Add palm oil, salt to taste and blanched. Cut vegetables to the cooked mixture and cook for another 2 minutes

Diet IX

Plantain pulp	146gm
Or Plantain flour	59gm
Soyabean	148m
Tete vegetables	766m
Palm oil	10gm
Water	360ml

1. Dehull the soyabeans and grind into smooth paste.
2. Mix the plantain flour, soyobeans paste and water to very smooth consistency
3. Cook the mixture on fire for 20 minutes
4. Add palm oil, salt to taste and blanched. cut vegetables to the cooked mixtures and cook for another 2 minutes.

Diet X

Rice	49g
Cowpea	18g
Tete vegetable	48g
Palm oil	10g
Water	350ml

1. Wash stone free rice. add some water and cook for 15 minutes
2. Grind dehulled stone free cowpea into smooth paste and add into the rice and cook for 20 minutes
3. Add palm oil, salt to taste and blanched. cut vegetables to the cooked mixtures and cook for another 2 minutes

4. Mash the porridge into smooth consistency.

Alternatively:

Clean the rice free of stones, pebbles and bran, wash and dry. Then mill the dried rice into flour and kept away for further use. The rice flour can be used in place of the rice.

Diet XI

Rice or rice flour	39g
Groundnut	17g
Tote vegetables	61g
Palm oil	10g
Water	360ml

1. Roast and grind groundnut and mix with salt to taste
2. Wash the rice, add water and cook for 25 minutes
3. Wash the vegetables, blanch and cut into fine small pieces
4. Add the vegetable, palm oil and salt to taste and cook for 5 minutes
5. Mash the porridge and sprinkle the roasted groundnuts powder into the porridge.

Diet XII

Rice or Rice flour	60g	1/3 standard cup
Soyabeans	6g	
Tete vegetables	50g	2½ standard cup
Palm oil	10g	1 desert spoon
Water	350ml	

1. Wash stone free and dirt free rice and cook for 15 minutes
2. Add dehulled soyabeans paste and cook for further 15 minutes
3. Add palm oil, salt and blanched cut vegetables to the cooked mixture and cook for another 2 minutes
4. Mash the porridge to smooth consistency

Blanched vegetables could be ground on a grinding stone or milled as it is the practice with preparation of a popular soup in Ondo state (Obanunu).

Soya beans Processing

The soya beans could be bulk processed into flour or paste and stored for further use.

1. clean the soyabeans by removing stones and dirts
2. Boil the beans in water for 20 - 25 minutes (Blanch)
3. Dehull the beans to remove the seed coat/testa
4. Free the beans from the hulls and clean
5. Grind the dehulled beans into smooth paste and store for use
6. Dry the dehulled beans from stage four (4) in oven at low temperature or air dried

7. The dry dehulled beans are then milled into flour

Blanched dehulled soyabeans have the added advantage of reducing cooking time to tenderize the beans, inactivate lipoxygenase and enzymes that causes beany flavour and odour, destroys trypsin inhibitor haemaglutinins and phytic acid.

The dried blanched dehulled beans could be stored and milled as when needed.

Cowpea Flour Preparation

Clean the cowpea, free of pebbles, sand and dirt. soak the clean beans in water and then dehull the beans by hand rubbing. The dehulled beans should be oven dried or sun dried. The dried dehulled beans are then milled into flour, sifted packaged and stored in air tight container for future use.

The beans could be dry dehulled using mortar and pestle or grinding stone.

VILLAGE BASE PROCESSING AND PREPARATIONS

The various components of the home based weaning diets could be made into flour on a small village level within the level of available technology thus making it convenient and reduce mother's cooking time for preparation of meals for their weanlings. However, preparations steps will be modified to incorporate pre cooking such as roasting and heat treatment for the protein supplement and vegetable while anti oxidants will be required to prevent rancidity.