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"THE YOUNG SHALL GROW IF . . ."

By

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Professor of Food Science and Technology

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INTRODUCTION

Right from childhood, I have been exposed to elements of agriculture. Having been born to a farmer, I learnt at an early age, how to tender crops, harvest corn, yams, tomatoes, vegetables and more importantly to weed the farm on regular basis. When the idea of going to school was finally brought to me, my heart was filled with joy not because education had any meaning to me but because, I saw this as a victory over farm labour.

My University career started at the University of Ibadan in 1960 when I registered as a prelim student. Incidentally, that coincided with the year of Nigerian independence and all qualified applicants from the University were awarded the Federal Government (of Nigeria) Scholarship as part of the bonanza to celebrate the independence. My scholarship and the course that I applied for in Chemical Agriculture were not tenable at Ibadan. Moreover, little did I know about what Chemical Agriculture really meant. As such, I was unable to explain fully the differences between ordinary Agriculture and Chemical Agriculture. My sponsors were as confused as I was and to resolve the problem I was renominated for a Commonwealth Fellowship in Canada. This led me to a basic degree in Agricultural Biochemistry at MacDonald College of McGill University, Montreal, Canada.

After the basic degree, I proceeded to Michigan State University where I obtained a Masters Degree in Biochemistry. As a result of one review project on "AFLATOXIN", I was invited by Prof. G. N. Wogan to apply to the Graduate School at Massachusetts Institute of Technology (M.I.T.). On reaching M.I.T., I was made to enter another Masters Programme in Nutrition and Food Science. Finally, this culminated into a Doctoral programme at the Harvard School of Public Health where I obtained the Degree of Doctor of Science in 1971.

Meanwhile, on the completion of my Masters Programme in 1968, Prof. H. A. Oluwasanmi, the first effective Vice-Chancellor of Obafemi Awolowo University (OAU), invited me to his hotel in Boston, Massachusetts to discuss possible appointment to the proposed Department of Food Science and Technology. I applied for the post of Lecturer II and the application was approved pending the completion of my studies.

THE ESTABLISHMENT OF THE DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

I arrived in Nigeria on July 16, 1971 and came straight to OAU, Ile-Ife. That evening, a tall, soft-spoken, English man walked into my room in the V.I.P. Guest Houses and said: Hello, I am Prof. G. R. Howat, Head, Department of Food Science and Technology". After the usual courtesy and social discussions he invited me to visit the Department the following morning. The Department was hitherto part of the Department of Animal Science with Prof. A. A. Adegbola as Head of Department. On the advent of Prof. Howat and aided by a young Nigerian (i.e. this speaker) the Department of Food Science and Technology was truly born. The Department was located on the ground floor, Faculty of Agriculture, near Agricultural Extension and Rural Sociology with just two rooms, and one of the rooms was no bigger than a cubicle.

Several months later, the Staff was reinforced by the arrival of another Nigerian, Dr. P. O. Ngoddy (Prof. Ngoddy is currently the Academic Deputy Vice-Chancellor, University of Nigeria, Nsukka). Moreover, Esther Balogh was co-opted from the Department of Animal Science to the new Department of Food Science and Technology. In addition, A. O. Ogunsua was already on study leave from OAU at the University of Reading (U.K.) as one of the potential staff for the Department of Food Science and Technology. Till date Professors Balogh and Ogunsua have remained steadfast and loyal staff in the Department.

The aims and objectives of the new Department were clearly spelt out in the first inaugural lecture delivered in this University by Prof. Howat titled: "Not By Bread Alone". That first in the Inaugural Lecture Series was held on 30th November, 1971. In the historic lecture, the learned Professor dwelt on issues involved in the study of Food Science and Technology. The study of milk and dairy products, meat and meat products, cereals, tubers, legumes, oils, beverages - alcoholic and non-alcoholic, etc.

Thus, it was conceived that a new Department of Food Science and Technology would enhance an all-purpose training of a manager to man all these food commodities; someone who is not a specialized manager but who is adaptable to all conditions of change and who is also flexible to learn in the process. Twenty seven years after that lecture and on this occasion of the second of such lectures from the Department, I am proud to stand before you to confirm that all these objectives, aims, and aspirations have been met.

NUTRIENT REQUIREMENTS OF INFANTS AND CHILDREN

The nutrient requirements during infancy, childhood and adolescence are greater than those of adults owing to the necessity of maintaining healthy growth rates. The weight of an infant doubles during the first six months of life and trebles during the first twenty months, after which the growth rate declines considerably until adolescence. The weight gain per kg body weight is about 5-6 grams per day, in the first six months of life, falling to about 2-3 grams in the second six months of life, 0.5-0.6 grams in the second year and 0.3 grams in the sixth year, thereafter remaining at about this figure until adolescence.

When breastfed by a healthy, well nourished mother, with normal lactation, the new born child consumes adequate amounts of dietary-macro and micro-nutrients to meet his daily requirements. Moreover, the efficiency of utilization of mother's milk by the infant is assumed to be 100% (WHO, 1974). Breast feeding is "a natural safety net" against the worst effects of poverty.

If the child survives the first month of life (the most dangerous period of childhood) then for the next 4 months or so, exclusive breast-feeding goes a long way towards canceling out the health difference between being born into poverty and being born into affluence. Unless the mother is in extremely poor nutritional health, the breast milk of a mother in a Nigerian village is as good as the breast milk of a mother in a Manhattan, New York apartment. So, even under the poorest roof, a child who is breast-fed in this period is likely to be as healthy and to grow as well as a baby born into a European or an American home. It is almost as if breast-feeding takes the infant out of poverty for those first few vital months in order to give the child a fairer start in life and compensate for the injustice of the world into which it has been born. In recent years, there have been signs that this strand of child protection is beginning to fray. In many Nigerian cities, the incidence and duration of breast-feeding has begun to fall precipitously.

Breast feeding after the first year of life needs additional supplementation in order for the child to maintain a steady growth. The nutritional demands and requirements of the growing child also entail additional considerations for nutrients and unless these additional nutrients are provided, the child's growth rate will be jeopardised. Some of these additional considerations include an increased need for proteins, energy, vitamins and minerals.

The human body is an engine which can set free the chemical energy bound in fuels present in foods. These are carbohydrates, fats, proteins and alcohol (macro-nutrients). The reactions and mechanisms at the cellular levels require the assistance of biological catalysts in the form of vitamins and minerals (micro-nutrients). The body continually converts and replaces its component parts. Energy is needed for the synthesis of new organic substances both in growth and maintenance. The body also has to have energy for internal work such as the action of the heart in circulating the blood and the movements of the diaphragm in breathing and respiration. Less obvious is the work done in maintaining the concentrations of salts and ions in the cells and body fluids. Sodium and chloride are the main ions in the blood (extracellular) and potassium and phosphate are the main ions in the cells (intra-cellular). The difference in the ionic composition of the fluids intra- and extra-cellular is essential to their normal functioning and can only be maintained by chemical reactions utilizing energy. All these processes constitute the resting energy expenditure when the body is completely at rest and it is generally referred to as "Basal metabolisms".

Nutrient requirements by the growing child increase sharply after the age of one year. For example, the energy requirement for the less than one year old is about 820 K Calories or 3.4 mega joules, but at the age of 1-3 years this has increased to nearly double, about 1360 K Calories or 5.7 mega joules. Also the protein requirements based on high quality protein intake of eggs or milk, have increased to 16 grams per day from 14 grams per day (WHO, 1974). Similarly, the vitamin requirements have increased. Thiamine (vitamin B1) has increased to 0.5 mg per day from 0.3 mg, Riboflavin (B2) 0.8 mg from 0.5 mg and Niacin 9.0 mg from 5.4 mg. These factors are complicated by the fact that in the developing countries, poor mothers are unable to meet their own nutritional requirements let alone the demands of their growing infants. Since the period of 1-3 years of age coincides with the period of rapid growth rate and a period of high nutritional demands, feeding supplementation in form of weaning foods become mandatory.

RESEARCH INTO THE FORMULATION AND PREPARATION OF INFANT WEANING FOODS

Definition

Weaning may be defined as the introduction to the infant, any food, solid, semi-solid or liquid other than breast milk. Any item besides breast milk that is given to the infant in any manner represents a weaning food. If milk is provided directly from a human female other than the biological mother, weaning has not occurred; however, if milk from another mammal (particularly cow's milk which is often used) is provided this is considered weaning. Traditionally in China and many parts of West Africa, mixtures of barks and roots are given as the initial feed to infants, this would qualify as a weaning diet. However, these herbal decoctions are noted for their laxative actions and can sometimes induce severe diarrhea (Jelliffe, 1968).

Formulation of Weaning Foods

If we consider the events in the life of the average infant in the industrialized countries, we find that there is early discontinuation of breast-feeding, or no attempt at breast feeding at all for the vast majority. However, the early introduction of a formula by means of either disposable bottles and nipples or with the use of sterilization in the home, even in poor circumstances present no major obstacle for the mother. There is refrigeration and the entire process can be accomplished without hazard or difficulty. Also in the industrialized countries, preparation of strained baby foods is conveniently taken care of by the baby food manufacturer.

However, in the developing countries there are many problems associated with every phase of the process needed to prepare an acceptable infant formula. For example, there is no safe water supply and both water and fuel have to be carried into the home; food may be contaminated as may be the utensils for measuring and preparation. Even if the initial weaning food could be sterilized there is rarely any refrigeration available in rural areas, so that everything requires preparation immediately before serving. Because of their high costs, infant formula is usually over-diluted with water, thus reducing its nutrient values and often adding microbial pathogens.

A child that is partially weaned between 6 to 18 months is at a vulnerable period in his development. While still growing extremely rapidly, he has just been depleted of most maternal protective antibodies. As he is exposed to foods other than milk, infection by bacteria, viruses, parasites and insects will set in. Each infection, whether of the gastro-intestinal or respiratory tracts or of the skin is accompanied by anorexia (Frood *et al.* 1971). There is associated fever, weakness and dehydration as well as loss in weight and growth rate. All these factors will increase the possibility of undernutrition and with the attendant synergism, susceptibility to infections will be repeating itself.

Thus, in the formulation and preparation of infant weaning foods special considerations must be given to not only the nutrient compositions but the safety of the raw materials and the hygiene and culture of the populace for which it is intended. Most industrialized countries use infant formulae that are based on animal milk and milk products, especially cow's milk which can be produced in large quantities. Sometimes the surplus from the "have countries" are given to the "have-not countries" in form of gifts-in-aid. This happens often during the periods of war, national disasters or famines, rarely do they happen in normal times. Moreover, such gifts are also associated with political strings and conditions. The use of sanctions and naval blockades affect the flow of foods and other products to the developing countries. It is therefore very essential that the developing countries must develop the capacity to produce their own weaning foods from local raw materials, since cow's milk is not a cheap commodity in these countries.

Historically, Incaparina was the first product of its kind to be developed under an International programme. The product was developed in 1963 by the Institute of Nutrition of Central America and Panama (INCAP). The product was intended to supplement the traditional diet and not specifically the weaning period. Incaparina was designed for the preparation of a warm drink, called "atole", traditionally consumed in Guatemala. This was followed in 1967 by a programme in Algeria that led to the development of a product called "Super-amine". A similar product was also made available in Egypt. In 1969, Ethiopia developed a product called "Faffa" by the Ethiopian Nutrition Institute. Since then, other countries have followed this pattern e.g. "Colombinarina" from "Colombia" "Shadomin" from Iran; "Sek-mama" from Turkey and "Pro-Nutro" from South Africa.

Traditionally in Nigeria, infants and children are weaned on a food preparation from fermented corn, known as "OGI". This gruel has been reported (Akinrele, 1966; and Collis *et al.* 1962) to be deficient in protein and thus being an etiological factor in the causation of protein energy malnutrition (PEM). In proposing an adequate weaning formular the Federal Institute for Industrial Research, Oshodi (FIIRO) developed in 1971, a process for incorporating a full fat soya flour into "Ogi" and gave it the name "Soy-Ogi". This product contained 30% soya flour with 70% fermented corn. Also, the product was shown (Akinrele *et al.*

1970) to be nutritionally adequate both in nutrient composition and amino acid patterns when compared with other commercial imported weaning foods. The authors further showed that the formula was effective in ameliorating the common symptoms associated with PEM (Akinrele and Edwards, 1971). I must confess that I was highly inspired by this classical piece of evidence which came out as I was beginning to set up my laboratory at Obafemi Awolowo University, Ile-Ife.

Recent Advances in the Preparation of Weaning Foods

The common weaning foods prepared in the home from cereal flours come in form of porridges. Such porridges are characterized by high viscosity and low energy contents per unit volume of food, necessitating frequent feedings to meet the daily energy requirements of the child. This is not practical in rural or urban areas where mothers have to work the whole day away from home. This is generally referred to as dietary bulk in infant feeding and it has received prominent attention in food research in the last ten years.

In 1988, it was reported (Desikachar and Malleshi, 1982) that 5% of malted barley could, because of its high amylase content, substantially reduce the viscosity of a 15% hot paste slurry of commercially available weaning foods such as Nestum produced by Nestle, Cerelac (Nestle) and Farex (Glaxo). On the basis of this observation and hypothesis, Gopaldas *et al.* (1986) developed an amylase rich food (ARF) from beans (*Pennisetum typhoideum*) which when added at a level of 4 g % (weight per weight of total solids) a 10% gruel lowered the viscosity considerably.

The ARF was prepared after clean wheat grains were soaked in triple the volume of water for a standardized period of 12 hours. This process is known as steeping. After 12 hours of steeping, the seeds were germinated for an optimum period of 72 hours which gave the highest amylase activity. However, mould growth was observed after 48 hours of germination. Therefore a germination period of 48 hours followed by sundrying (40 ± 2°C) was found suitable for preparing an ARF with optimum amylase activity. Oven drying (50°C) and toasting (80 ± 4°C) on a shallow iron pan were also tried.

The results showed that the sun-dried ARF had the optimum amylase activity, however, it had a poor shelf of about 10 days. Toasted ARF had a good shelf life because of a lower initial moisture content (due to the higher temperature of processing). Low moisture content inhibits the growth and proliferation of microorganisms, thereby extending the keeping quality. In addition, a higher processing temperature (80 ± 4°C) in the case of the toasted ARF may itself lower the initial surface microbial load.

Since the toasted ARF was found to have a longer shelf life, which is a desired characteristic for any processed food and makes the product more readily acceptable, the catalytic activity which was comparable to those of pure enzyme or sun-dried ARF, makes this method unique in the rural settings of the developing countries. It posed a simple approach, inexpensive and easily adaptable in any village locality.

It is also known that there are various ways of reducing the viscosity of gruels and among the low cost methods, germination (malting) seems to be the most effective especially using the ARF described in the preceeding paragraphs. During the germination of grains α-amylase activity is developed. The enzyme degrades the starch granules reducing their water binding capacity and consequently lowering the viscosity of the gruels. When germinated cereals are used, therefore, liquid gruel can be prepared with a higher flour concentration than that of gruels made from ungerminated cereals (Mosha and Svanberg, 1983). As children are able to consume more of a liquid weaning gruel than that of a stiff porridge in one meal (Mosha and Svanberg, 1987) they can obtain much more energy and other nutrients per meal from such a gruel than from one prepared in the traditional way from ungerminated flour.

Thus, following the production of ARF in India, a similar work was conducted in Denmark using barley as the main grains (Hansen *et al.*, 1989). The grains were germinated for 2-3 days. As germination increased so also the α-amylase activity increased. After germination, the kernels were dried at a temperature ranging from 25 to 60°C for about 8 hours and kept at 60°C thereafter for about 4 hours. The shoots were removed and malted grains were sifted to a degree of refining comparable to that of the semi-refined portions. Germination had a remarkable reducing effect on viscosity and the effect increased with germination time.

It was observed that it was quite conceivable to increase the dry matter content of gruels some 2 to 3 times by using flour from grains germinated for about 2-3 days or to double it by including a small amount of germinated flour (ARF) to those of ungerminated. Normally, the food intake of a 1 year old must contain an energy density in weaning foods exceeding 0.7-1 K Calorie per gram (Mosha and

Svanberg, 1987). This caloric density was achieved by germination or by adding a small quantity of ARF.

A similar project was conducted in Luganga village in Tanzania (Mosha and Svanberg, 1990). The traditional weaning diets in Tanzania are very much similar to those in Nigeria. The most common gruel in Tanzania is called "Uji" and it is similar to the Nigerian "Ogi" made from maize, sorghum or millet flours. Ordinarily "Uji" contains about 5% dry matter which resulted in an energy density of 0.2 K Calorie per gram of prepared gruel. The upper limit for dry matter is about 20% because, beyond this concentration the gruel became difficult to stir. At 20% dry matter, the equivalent energy density was about 0.7-0.8 K Calories per gram.

Since the human milk has an energy density of about 0.7 K Calories per gram (Macy and Kelly, 1961) it is reasonable to assume that the energy density of a weaning diet should at least exceed 0.7 K Calorie per gram. Moreover, evaluation of food intake studies in young children (Rutishauser and Frood, 1973) indicates that an energy density of a weaning diet of about 1.0 K Calorie per gram is needed in order to satisfy energy requirements of the children (FAO/WHO/UNU, 1985). To meet with the energy needs of the growing child therefore, he will require about 4-5 litres of the gruel containing 5% dry matter. The thicker gruel containing about 20% dry matter provided adequate energy density, but its consistency made it less easy to consume, especially when the child is between 6-18 months old (Church, 1979). The high volume/viscosity character of a diet is what was referred to as "dietary bulk" and can be a major constraint in providing children with enough food in areas such as Nigeria, where starchy staples are the main foods (Nicol, 1971).

Malting or germination of grains as we have seen earlier, or the addition of small quantities of germination flour ("power flour" or ARF) considerably reduced dietary bulk (Mosha, 1983). In fact when the "power flour" of sorghum was introduced in the Tanzania studies, the children ate greater quantities of the 20% dry matter food, comparable to the quantities of foods containing 5% dry matter. The 20% dry matter became liquefied porridge such that children between 6 and 18 months had food intake that was about the same as the porridge containing thin gruel.

The implications of these findings are that in order for the growing child to meet his daily energy requirements more than 3,500 ml of the 5% gruel is needed per day. An amount obviously impossible for a one year old child to ingest even if forced-fed. Of the thick 20% porridge, about 870 ml (25%) per day is needed. This could be eaten in three meals according to an average intake of about 277 ml per meal. this is considered quite sufficient to meet with over 60% of the total energy requirements of a growing child, when the mother's milk supplies the remaining 40%. As the child grows older the proportion of the weaning diet increases, until mother's milk is totally withdrawn.

CONTRIBUTIONS TO WEANING FOODS RESEARCH AT THE DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY, OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE.

The first considerations we had was that among legumes, soya bean might not be the most suitable for preparation of weaning foods in Nigeria. The reasons behind our thinking included: (1) Soya bean was not then widely grown in Nigeria and (2) there were numerous alternatives that have not been exhaustively investigated. Our first approach was to mix protein concentrates from groundnuts with Ogi. These were fed to experimental weanling animals. Twenty four albino rats were placed in separate metabolic cages and fed on the basal diet for a period of 7 days. The animals were then weighed and separated into six equal groups when the experimental diets were introduced. The animals were maintained on these diets for a period of 21 days. A commercially available diet (Cerelac) was used as control (Fashakin and Ogunsola, 1982).

The results showed that in terms of animal growth as demonstrated by animal gains in weight, the combination of groundnut protein and corn flour, "Nut Ogi", was not quite as good as that of the commercial product. However, it was observed that the "Nut-Ogi" and "Soy-Ogi" ranked very closely. The relative performances of these products reflected on the amino acid patterns in the proteins and the different ratios of the essential to the non-essential amino acids. While soybean lacks Methionine, it is rich in lysine. As was reported (Rose and Waxon, 1955) 89% of the total sulphur amino acid requirements by animals could be met by cystine, Furthermore, other reports (Scrimshaw *et al.*, 1958) showed that in diets with poor amino acid balance, the amount of Methionine suggested by the FAO/WHO (1973) reference protein might be too high for infants and might have undesirable effects. This would seem to indicate that the deficiency of lysine in the groundnut protein was more crucial than that of Methionine in the soya protein. The situation might have been further aggravated by the low level of lysine and tryptophan in the corn flour. Cerelac product on the other hand contained whole milk, rich in all the essential amino acids, minerals and vitamins. Thus as would be expected, cerelac gave much higher growth rate compared with the other dietary regimens.

Following our hypothesis that the different performances of animals in these experimental diets could be explained in terms of amino acid contents, seemed to indicate that no singular legume could be combined with cereals to constitute a complete diet comparable to milk-based diets since each legume or any vegetable protein for that matter, is fraught with deficiencies of limiting amino acids. Our solutions to the problem rested on the notion that a combination of a mixture of legume proteins would lend compensatory effects on one another to produce a product close to milk or perfect protein. The new hypothesis was tested.

THE APPLICATION OF MIXTURES OF PROTEIN CONCENTRATES FROM LEGUMES IN THE PREPARATION OF WEANING FOODS

The materials that were used in the investigation included black-eyed cowpea, melon, and soya beans as protein sources and maize grains as cereal flour source. The materials were obtained from the Agricultural Research Farm of Obafemi Awolowo University, Ile-Ife (Nigeria). Only the soya grains were obtained from the Institute for Agricultural Research and Training (IAR&T), Ibadan (Nigeria).

In all cases, the products were cleaned and dehulled and then minced and defatted. The resultant products were milled and sieved, and subsequently they were spray-dried as flour products. A product or cowpea-melon-soy-ogi mixture was thus prepared. Similarly, a basal diet was prepared using the methods of Bernhart *et al.*, (1966). The basal diet was mixed with individual protein source as recommended to achieve isonitrogenous diet containing 10% protein level. A commercially based product from defatted milk powder (Cerelac) was used as control diet. For this investigation, sixty albino rats weighing between 55 and 65 grams were obtained from the Zoological breeding Centre of Obafemi Awolowo University, Ile-Ife, Nigeria. The animals were weighed and randomly distributed in metabolic cages and were adapted to an initial diet containing 4% casein for over a period of seven days. After this period, the animals were re-weighed and re-grouped. The average weight per group was approximately the same. One group of 5 animals which served as control to the experimental groups was sacrificed and tissue samples from the liver, kidney and the plantaris muscle of the hind leg were weighed and frozen (at -70°C) until full analyses were completed. The remaining animals were placed on the experimental diets over a period of 28 days. Water was supplied *ad libitum*. During the period, dietary intake and growth were recorded. After the accomplishment of the experiments, the animals were anaesthetized and sacrificed. Tissue specimens were obtained and frozen until analyses were completed.

The results of the growth measurements showed that the mixture of vegetable proteins performed favourably compared with Cerelac. On the other hand, the use of the individual proteins was not associated with satisfactory weight gain. Actually the differences in growth rate were statistically significant with Cerelac compared with individual proteins from either soya, melon or cowpea, right from the 10th day of the experiment. Significant differences between growth rates of animals fed the mixed diet and the individual proteins commenced only after the 16th day. No significant differences however, were observed between the animals fed Cerelac and the mixed diets throughout the experiment.

Apart from weight gains and animal growth rates, the efficacy over the use of individual proteins was further investigated by the total weight gain of the various body tissues. The increase in tissue nitrogen content in the group of animals receiving the mixed diet and those kept on Cerelac were similar. In contrast, significant differences were observed with groups treated with the individual proteins compared with either Cerelac or the mixed diet. Also, an examination of the protein efficiency ratio (PER) and the net protein retention (NPR) which are parameters measuring growth rates, were recorded in the various dietary groups. The most favourable values were apparent in groups treated with Cerelac and the mixed diets, whereas PER and NPR were inferior in groups receiving individual protein sources.

It might be conceivable to explain these observations on the basis of the amino acid contents in the respective diets as well as the ratio of the essential to non essential amino acids. Melon protein contains high contents of methionine, tryptophan and arginine, in proportions that are much higher than the other vegetable proteins that were tested (FAO, 1970). On the other hand, cowpea protein is known to be rich in lysine, while soya bean protein contains appreciable amounts of cystine. Feeding with a mixture of these proteins may therefore approach a profile equal to that of an ideal protein. The results obtained from the investigation support the hypothesis since dietary treatment with the mixed diet resulted in adequate growth and normal tissue nitrogen contents

During the weaning period, mothers may produce low quantities of breast milk because of inadequate food intake (Collis *et al.*, 1962). For, proper growth of infants and children need adequate protein during the period of weaning and this makes them a highly vulnerable target (Ransome Kuti *et al.*, 1972). Only a mixture of digestible and complementary amino acid profiles produced from locally available vegetable proteins can serve as alternatives to milk proteins.

NATIONAL PROJECT ON THE FORMULATION AND PREPARATION OF INFANT WEANING FOODS FROM LOCALLY AVAILABLE LEGUMES AND CEREALS

In 1986, after a nationwide call for research proposals on projects that were ready for both pilot production and eventual commercialisation, we presented a proposal for the formulation and preparation of an infant weaning food from legumes and cereals. The proposal along with others from the University, was screened through the Faculty Research Committee and the University Research Committee (URC). The National Science and Technology Fund (NSTF) finally approved three proposals in the country and fortunately ours was one of them. However, before the approval, NSTF had incorporated two other research Institutes including Federal Institute for Industrial Research, Oshodi (FIIRO) and National Horticultural Research Institute, Ibadan (NIHORT) into the research project. This was necessary because of the experience of FIIRO in producing "SOY-OGI" and also because of its capacity to make the products at a pilot scale prior to full commercialisation. Moreover, NIHORT too had produced before then a baby food that they named "Soya-Musa" because it contained soya beans and plantains. After all the amendments were accepted and implemented, the project finally took off in May, 1989, with this Speaker as the Coordinator of the project.

The major features of the project involved an initial search for an acceptable formula that would meet the daily nutrients' requirements of growing infants within the ages of 6 months and two years. This period, as we know, constitutes the weaning period in which complementary feeding other than the mothers' milk is required. Our main objective was to use mixtures of legumes rather than singular application of a protein source. This approach was necessary to eliminate the adverse effects of the limiting amino acids which seemed to render single applications deficient and ineffective. Moreover, our formulations were to be adequately fortified with vitamins and minerals.

The nutrient composition of the formulated diet contained soya bean flour (15%); sesame seed flour (5%), vegetable oil (10%); vitamin mix (1%); salt mix (3%) and corn flour (66%). On analysis of the finished product, the protein content was 16.66%; Moisture (5.28%); Fat (8.03%) and Fibre (0.40%). On biological assay after feeding the diet to experimental rats, the animals gained about 67.94 grams in 28 days compared with a similar weight gain of 64.66 grams by animals fed a commercial product (NUTREND) which served as control, since Nutrend also contains soya beans and corn flour.

After the initial chemical and biological assays were completed in our laboratories at Obafemi Awolowo University (OAU) the product was sent to the Institute for Biological Chemistry and Nutrition, University of Hohenheim, Stuttgart (Germany). By the use of High Performance Liquid Chromatography (HPLC) the amino acid profiles were analysed.

Having been fully satisfied with the chemical and biological data together with the amino acid profiles, the product was ready for the crucial clinical studies, that would ensure its acceptability and utilization in the human subjects. The Clinical studies were initially commenced by Dr. J. A. Owa of the Department of Paediatrics, Obafemi Awolowo University, Ile-Ife. He later went on study leave and then the studies were transferred to Dr. Adeodu of the same Department. There were two major setbacks that caused the delay in the completion of the studies: (1) The spate of disruptive, industrial actions involving the nation's Universities and Teaching Hospitals which led to closures of Institutions and limited patient recruitment with follow-up short and long-term laboratory investigations. (2) The economic crisis attendant to the political unrest surrounding the "JUNE 12 SAGA". This led to a high rate of default and discharges, even sometimes against medical advice. However, the clinical studies were completed with the following objectives, to:

(1) Determine the effect of the food (diet as prepared previously) on growth of infants and children with or without protein energy malnutrition (PEM) using the anthropometric measurements of weights and mid-upper arm circumference (MUAC).

(2) Determine the effects of the food (diet) on clinical oedema in patients with oedematous malnutrition (Marasmic-Kwashiorkor).

(3) Use methods of the clinical observations to determine acceptance of the food by the children recruited into the study.

(4) Use the results of the study to determine the suitability of the food as a weaning food for children.

Approval for the study was obtained from the Ethical Committee for research on humans of the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife in 1991. The studies commenced in 1992. Two groups of children were recruited for the study, one with PEM and the other quite normal children. The diagnosis of PEM was based on the Wellcome classification and the work of Jelliffe (1968). All the malnourished children were within the ages of 6 months to 3 years and their illness was not associated with vomiting which would have precluded oral feeding. These patients were recruited from the nutritional rehabilitation unit of the OAUTHC or the Children Emergency Ward.

The group of healthy children were infants whose parents were attending routine follow-up clinic at the Consultants Out-patient Department of OAUTHC. Initially, all mothers were taught the methods for preparing the food at a ratio of 1:4 of clean water and then brought to boiling slowly to form a paste suitable for ingestion. To facilitate good acceptability, a little sugar was added to taste. The PEM children were offered as much of this as possible in 4 to 6 daily servings as tolerated and without limiting their desire for other additional foods, whether supplied by the mothers or the hospital. Similarly, normal children were served the food as the main cereal in the diet.

Each patient was observed for refusal of diets, that may indicate non-acceptance and the rate of disappearance of oedema was recorded. All children were weighed and the MUAC measurements taken at the beginning and at weekly intervals for a total period of about 4 weeks. any adverse conditions or reactions presumed to have been caused by the diet was to be quickly and promptly reported and recorded. However, there were no adverse effects observed throughout the duration of the trials.

The results indicated that out of the 19 PEM patients and 13 normal children, only 11 each concluded the studies. The rest defaulted for reasons enumerated earlier. Out of the 11 patients with PEM, 5 were marasmic, 5 had kwashiorkor and the remaining one had a combination of marasmus and kwashiorkor. Anthropometric measurements, were only completed after the 4th week for 7 PEM patients and 9 normal children. On admission, weights of the PEM patients ranged from 3.4 to 8.5 kg with a mean of 5.55 ± 1.86 kg. At the 4th week the weights ranged from 3.7 to 8.5 kg with a mean of 5.98 ± 1.61 kg. The difference between the two means was not statistically significant. Also in 5 PEM patients, evidence of progressive loss of oedema fluid was noticed within the first week of commencement of the dietary regimen. For the normal patients, weights at recruitment ranged from 3.12 to 9.92 kg with a mean of 6.44 ± 2.28 kg. At the 4th week weights ranged from 3.86 to 10.40 kg with a mean of 7.13 ± 2.21 kg. The difference between the two means was statistically significant.

Similarly, on admission, the MUAC for the PEM patients ranged from 76 to 129 mm with a mean of 96.3 ± 17.4 mm. The MUAC after 4 weeks ranged from 78 to 129 mm with a mean of 101.3 ± 15.5 mm. The difference between the two means was statistically significant. For the normal patients MUAC at recruitment ranged from 84 to 138 mm with a mean of 120.0 ± 17.2 mm. The MUAC after 4 weeks ranged from 94 to 148 mm with a mean of 122.9 ± 14.4 mm. The difference between the two means was not significant. The results are consistent with the following observations, that:

1. The food supports growth of normal children.

2. On long term feeding and after the initial recovery from Kwashiorkor the food may support growth in malnourished patients.

3. The food promotes loss of oedema fluid leading to satisfactory recovery from PEM. It was thus concluded that the diet was suitable as a weaning diet not only for normal children where normal growth is achieved but also in malnourished children where recovery and subsequent growth become possible.

SUMMARY

In summarizing the contents of this lecture, my attention is drawn to the different connotations that the title of the lecture may generate. It is gratifying that different people give the title different meanings depending on the needs, the circumstances and the goals of the interpreter. In this lecture "The young shall grow .... if" has four major parts:

1. We considered the basic nutritional requirements of infants and the growing children in terms of energy, proteins, vitamins and minerals.

2. The research efforts for protein supplements particularly to simulate milk proteins were considered.

3. Our contributions to these research efforts at Obafemi Awolowo University were also emphasized.

4. At the national level, efforts geared to the production of the food supplement at the pilot scale level with the ultimate intention of full commercialisation were discussed.

Therefore, from the nutritional point of view, the young shall grow if the basic nutrient requirements are met. How these nutritional requirements can be met has been the subject matter of this lecture. Moreover, on the lighter note, if we consider the establishment of the Department of Food Science and Technology in 1971 as the birth of a "new baby", indeed this baby has grown. For example, all the pioneers and foundation members are today, professors in their various fields of food specialization. Moreover, one of the early alumni of the Department is today the Managing Director of Cadbury Nigeria Plc, while another alumnus has reached the status of Director of Marketing at the Nigerian Breweries Plc. Further, there are numerous alumni scattered all over the country in different food industries and conglomerates. In this respect, the Department has grown having used and optimized the limited resources at its disposal.

RECOMMENDATIONS

Although continuous calls have been made from many inaugural lectures to Government to do one thing or the other, no significant response has emerged over the years. The time has come for Universities to become more realistic about their goals and aspirations and more importantly the means to achieve them. It is a general phenomenon that some American Universities such as M.I.T. and Harvard normally do not publish their annual budgets. No reasons are usually given but opinion views relate this behaviour to the tremendous contributions coming from alumni bodies. Thus the budget becomes so large and the income so huge that it is almost embarrassing to publish it. My submission therefore is that we can borrow a leaf from this concept of relying more on wealthy and philantropic alumni, both for University funding and development. The task will require a well coordinated linkage between the University and the national associations of Alumni of this Great University. Moreover, there are inherent advantages in relying more on alumni donations for it will guarantee independence and encourage total University autonomy. Decisions on the application of alumni funds can only be settled between the alumni and the University. Both groups share something in common: the interest of the University and its rapid progress.

Whatever it may be worth, one cannot conclude this lecture without bringing to the attention of the Federal Government of Nigeria the need to support and subsidize every Nigerian child from birth to the age of two years. The subsidy could come in form of cheaper distribution of baby foods made from available raw materials. It is the inalienable right of each Nigerian child to survive the toothing problems forced on him by poverty and predominantly environmental factors. It is common knowledge that the industrialized countries support their citizens at birth by offering milk subsidy and hot day meals at school. The Nigerian child deserves to live with free access to medicare and good education.

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All of you listening to me in this lecture are very important people. Permit me therefore to mention a few "fathers" who have travelled all the way from Akure to attend this lecture. These include His Royal Highness, Oba Adebobajo Adesida IV, the Deji of Akure, His Lordship, Rt. Rev. Dr. F. F. Alonge, the Catholic Bishop of Ondo Diocese, His Lordship, Justice Ogunleye, the Chief Judge of Ondo and Professor, Chief Mason Falaiye former Pro-Chancellor of Obafemi Awolowo University. I am grateful to you all.

It now behoves me to thank my Almighty God for the excellent opportunities He afforded me in my educational pursuits and the academic career at Obafemi Awolowo University ("Great Ife"). I have had the experience of working with all the past Vice-Chancellors but one; two of these Vice-Chancellors had made significant impacts on my career in this great University. I refer first to Prof. H. A. Oluwasanmi

who made the initial contact with me during my study days at M.I.T. (Cambridge Massachusetts, U.S.A.), he was a very pleasant and kind person. This direct approach contributed to my loyalty to the University for this total period of 27 years. I am highly indebted and indeed very grateful to him, and may his soul rest in perfect peace.

Secondly, permit me sir, Mr. Vice-Chancellor to say that we have been friends ever since we met in the early 70s. Coincidentally it was during your tenure that I was appointed a Reader in 1992 and a Professor in 1995. When Professor Wale Omole appointed me the Acting Head of Department in 1994 and the substantive Head in 1995, I knew clearly that he wanted me to share in the burdens of his administration. As Head of Department, I have made several requests through the Dean to the Vice-Chancellor and approval was given to all of these requests. One of such requests involved a substantial grant to enable my Department to move its offices to our main building. The work is still in progress. For all these and many other supports that I cannot enumerate here. Sir, I am very grateful. May the Lord bless you and your family.

I also want to pay tributes to my colleagues in the Department and within the University at large with whom I have worked to produce the data presented in this lecture. My appreciation goes to my students who have laboured in the laboratories and whose cooperation has contributed to the success of the research projects. The role of my supervisors during my student days is greatly acknowledged particularly Professor D. M. Hegsted of Harvard University who supervised my Doctoral thesis, Professor Peter Furst of Hohenheim University, Stuttgart, Germany and Professor Bruce Baker of MacDonald College of McGill University, Montreal, Canada.

Finally, you all know, as well as I do that there is no "Dele" without "Nike". Having been born a lone child, I really had no choice but to share my life equally with my loving wife. The Lord provided me with not only a wife but a sister, a partner and a mother. She and my children have shared in the agonies and joys of my students days. I thank them all.

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To all of you present here tonight, Ladies and Gentlemen, I say thank you for your patience and may God bless you all.

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