American Journal of

Food Technology

ISSN 1557-4571

Academic
Journals Inc.

www.academicjournals.com

American Journal of Food Technology 9 (2): 104-110, 2014
ISSN 1557-4571 / DOI: 10.3923/ajft.2014.104.110

Formulation of Infant Weaning Foods from Vegetable Proteins and Cereal

Samson Ishola Ibironke
Department of Food Science and Technology, Obafemi Awolowo University, Ile-Ife, Nigeria

ABSTRACT

In developing countries, researchers have focused their attention on the possibility of formulation of infant weaning food from locally available, vegetable proteins and cereal to reduce frequent maternal morbidity and mortality. The investigation was set to prepare a new baby food using locally available legumes and cereal. The legumes that were used included sesame and soy beans seeds proteins. Energy was supplied by the application of corn flour. This was to complement the protein contents such that the amino acid profile would be close to that of egg protein. Soya bean and corn were obtained from local supermarket, Ile-Ife, while sesame seed was purchased from Benue state, Nigeria. The protein seeds were processes into slurry at the proportional below: (1) Basal diet, 100% Carbohydrate (2) Vegetable base commercial diets, (3) Milk base commercial diets, (4) Corn flour 85, 15, sesame 5%, diet and (5) Corn flour 85, soya beans 15, sesame 5%, fortified with minerals and vitamins diet. The new baby food produced was tested biologically by feeding it to experimental rats. The performance in terms of protein efficiency ratio, nitrogen retention and tissue weights were comparable with those of similar commercial products such as milk-based diet and vegetable protein-based protein diets. The results showed that the preparation of this new diet gave a potentials viable product that may be applied to curb maternal morbidity and mortality in the developing countries.

Key words: Sesame seed, milk-based diet, vegetable protein

INTRODUCTION

Childhood and maternal mortality rate in Nigeria are of public health concern and are reportedly to be the root cause of malnutrition. It accounts for over 50% of deaths of children in this age bracket and represent 25 percent of the total number of deaths of children under-five (UNICEF. and WHO., 2011). Sesame seed plant is classified as an oilseed with botanical identification (*Sesamum indicum*) is a rich vegetable protein, deficient in lysine but is valuable sources of methionine an amino acid which is limiting in most diets of many tropical areas (Self Nutrition Data, 2010). Sesame is widely consumed in Africa, the Middle East and Asia as a paste or in confection. The sesame products are usually made from dehulled seeds, satisfactory for low cost commercial processes for dehulling either sesame on a large scale have not been developed (FAO, 2009). The residue from whole seeds crushed from oil production is commonly used in animal feeds; more investigations are needed to assess the suitability of this residual material for child feeding and the feasibility of modifying the oil production process if necessary. Sesame seed otherwise known as ancient condiment is healthful nutrient-dense, medicinal foods, nutritional content, in seed form, highly valued for their rancid-resistant oil (FAO and WHO, 1989a). The seed has high value micronutrients such as Manganese, Copper, Calcium, Iron, Magnesium,Tryptophan, Zinc, Fiber, Thiamin, Vitamin B6. Phosphorous and met the Recommend Daily Allowance. Health benefits include bone health therapy, lowering of blood pressure, panacea for cancer prevention, Iron deficiency anemia promotion of healthy skin. It helps to prevent headaches and migraines, reducing stress, prevention of constipation, prevent diabetes, lowering cholesterol. Other health benefits include improving heart health, insulating against radiation-induced DNA damage and also acts an antioxidant. Besides it helps oral health therapy, preventing cavities, removal of dental plaque. Its High-protein content made possible to be an enrichment for vegetarian (Self Nutrition Data, 2010). Detoxifying agent to body reduces PMS symptoms intestinal parasites and lactation disorders. Other protein supplement include soybean (*Glycine max*) is a species of legume originated from East Asia, widely grown for its edible bean protein content accounts for about 60% of dry soybeans by weight protein at 40 and oil at 20%, carbohydrate 35, ash 5% (FAO and WHO, 1989a). Hence, the objective of this research is to formulate and evaluate infant weaning foods from vegetable proteins including sesame seed, soybean and maize that could usurp morbidity and maternal mortality in the developing countries.

MATERIALS AND METHODS

Soya bean and corn flour were obtained from local Markets in Ile-Ife, while the sesame seed was purchased from local market Benue state, Nigeria. The albino rats used in the investigation were obtained from faculty of pharmacy animal breeding center, Obafemi Awolowo University, Ile-Ife. Two commercially baby foods milk based and vegetable based were used as controls and were obtained from local supermarket, Ile-Ife.

Preparation of corn flour: Dried corn was cleaned by sorting and winnowing and thereafter soaked to ferment in cold water 1:3 w/v at room temperature for 24 h. The corn was wet milled using disc grinder, sieved, drained, oven dried at 80°C and ground to fine powder with pin disc grinder, the later was neatly packed in a container that is free of water.

Preparation of soya bean slurry: Soybean was cleaned and oven dried at 110°C for 1 h to remove the ant nutritional factors. Thereafter, it was soaked in cold water, dehulled manually, at 121°C for about 1 h. Steammed soy bean was wet milled and squeezed with muslin cloth to effectively remove the water in it and mixed with Hobart mixer.

Preparation of sesame slurry: Sesame seed was cleaned with cold water and oven dried at 110°C for 1 h to remove the ant nutritional factors. It was further soaked in cold water for 20 min and then autoclave at 121°C for about 1 h for 15 min. Seed shaft was removed mechanical to reduce the level of oxalic. The seed was wet milled using disc grinder. Boil water was mixed with grinded sesame seed to allow the oil to float. The floated oil was carefully skimmed out of the mixture. The sesame residues were dewatered using muslin cloth.

Preparation of the weaning food: Moisture compositions in sesame, soy protein and maize slurries were determined respectively using Galenkamp Oven. The total solid were used to calculate the formulations of the diets in the proportion of (80:15:5, w/w/w) maize soy and sesame slurries.

The formulated diets was dried and ground to fine powder with pin disc grinder the later was neatly packed in a container that is free of water, humidity and corrosion.

Chemical analysis: Chemical analysis such as protein (nitrogen×6.25), moisture, fat, crude fibre, carbohydrate and vitamins of the diets were determined according to AOAC (2000) methodology. Caloric values were determined using bomb combustion calorimeter, model e2K.

Animal bioassay: The Fifty weaning albino rats were obtained from, faculty of pharmacy animal breeding center, Obafemi Awolowo University, Ile-Ife, Nigeria. The rats were weighed and randomly allocated to metabolic cages. The average weight and aged ranged from 58.20 to 58.59 g and three to six weeks old, respectively. The rats were assigned to metabolic cages attached with a cup and a small plastic bottle to supply food and water ad libitum. The animals were adapted to the new environment by feeding them on normal diets for seven days. The animals were then reweighed and group into five of ten per each group in such a way that the weights were similar. For example, groups, 1, 2, 3, 4, 5 have the weights 58.59, 58.20, 58.47, 58.59 and 58.31, respectively. The groups were placed on experimental diets for 28 days. They were given a weighed quantity of each experimental diet, in a feeding cup and water was supplied ad libitum via a plastic bottle attached to the cage. Consumption of samples was carefully recorded daily and the weights were noted. Changes in weight of the experimental animals were taken every three days. At the end of 28 days, the experimental animals were sacrificed in similar way as control. Organs including kidney, liver and muscle of the hind leg were obtained, weighed and frozen at -10°C for nitrogen determination (Fashakin and Ogunsola, 1982; Fashakin *et al*., 1986; AOAC, 2000).

Ethical consideration: This study was approved by the Animal Ethical Welfare Review Committee of the Obafemi Awolowo University, Osun State and Ile-Ife, Nigeria.

RESULTS AND DISCUSSION

Figure 1 shows the initial grouping of the rat at zero days and the growth response during 22 days of the animal experiment.

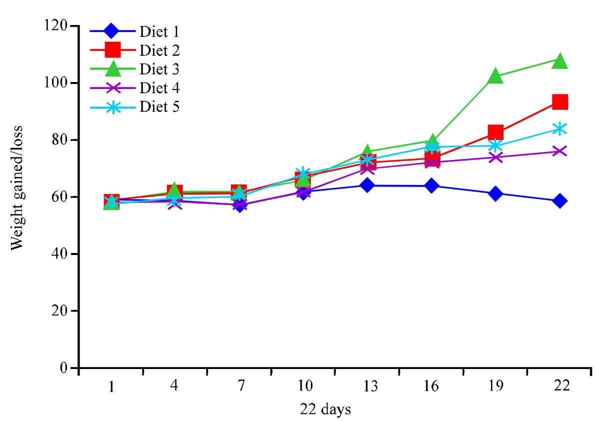

Fig. 1: Growth response during 22 days of the experiment. Basal diet, (1) 100%, Carbohydrate, (2) Vegetable base commercial diets, (3) Milk base commercial diets, (4) Corn flour 85%, soya bean 15%, sesame 5% diet and (5) Corn flour 85%, soya beans 15%, sesame 5% fortified with minerals and vitamins diet

The results were shown as in Table 1-7; Table 1 shows the different composition of the various diets. Table 1 shows the nutrient composition of the diet per 100 g. It may be observed that basal that was produced according to (Fashakin *et al.*, 1986), with no protein (FAO and WHO, 1989a).

Table 2 shows amount of food consumed over 22 days of the experimental period. Amount of foods consumed were in decreasing order, diet (2), 107.78, diet (3) 93.09 g, diet (5) with vitamin and minerals 84.05, plain diet (4) 76.27 and basal diet (1) 58.53 g. This conformed to previous findings (Ibironke *et al.*, 2012a).

Table 3 shows the average growth in weight of the animal over the experimental period and this was highlighted that the results showed that commercially available diets 2 and 3 promoted the optimum growth rate among the experimental animals (Fashakin and Ogunsola, 1982; Fashakin *et al.*, 1986). This was followed by those feed on the newly formulated diets fortified with mineral and vitamin and the animals fed on plain diets lost weight progressively over the experimental period (FAO and WHO, 1989b; Ibironke *et al.*, 2012a). Growth rate agreed with the

Table 1: Nutrient composition of the diets 100 g^{-1}

Constituent	Protein (%)	Moisture (%)	Fat (%)	Ash (%)	Crude fibre (%)	CHO (%)
Diet 1	-	2.50±01	8.0±01	3.30±01	2.30±01	83.90±02
Diet 2	15±03	2.50±02	9.0±01	4.50±02	2.50±01	65.0±04
Diet 3	16±01	2.50±03	10.0±01	4.20±03	2.30±01	65.0±01
Diet 4	17±04	7.50±02	6.0±01	4.30±01	2.30±02	62.9±02
Diet 5	17±01	6.20±01	6.5±01	4.20±01	2.20±04	63.9±01

Data is Mean±SD value of three determinations with different superscript in a column are significantly different (p<0.05), Basal diet, (1) 100%, Carbohydrate , (2) Vegetable base commercial diets, (3) Milk base commercial diets, (4) Corn flour 85%, soyabean 15%, sesame 5% diet and (5) Corn flour 85%, soya beans 15%, sesame 5% fortified with minerals and vitamins diet

Table 2: Food consumption in grams during 28 days of the experimental period

	Days		
Dietary sample	7	14	21
1	28.17±01	37.76±04	58.53±01
2	39.83±03	79.82±01	107.78±04
3	35.07±02	70.98±01	93.09±03
4	29.24±03	37.23±03	76.27±02
5	32.05±01	75.54±02	84.05±01

Data is Mean±SD value of three determinations with different superscript in a column are significantly different (p<0.05), Basal diet, 100% (1) Carbohydrate, (2) Vegetable base commercial diets, (3) Milk base commercial diets, (4) Corn flour 85%, 15%, sesame 5% diet and (5) Corn flour 85%, soya beans 15%, sesame 5% fortified with minerals and vitamins diet

Table 3: Mixture of the diets and their various proteins level

Dietary samples	Initial protein (%)	Weight of food (g)	Weight of basal diet (g)	Final protein (%)
1	-	500	500	-
2	15.5±01	500	33.34±0.1	10±0.4
3	16.0±03	500	37.50±0.2	10±0.3
4	16.0±02	500	37.50±0.3	10±0.1
5	17.0±01	500	41.18±0.1	10±0.1

Data is Mean±SD value of three determinations with different superscript in a column are significantly different (p<0.05), Basal diet, (1) 100% Carbohydrate, (2) Vegetable base commercial diets, (3) Milk base commercial diets, (4) Corn flour 85%, soyabean 15%, sesame 5% diet and (5) Corn flour 85%, soya beans 15%, sesame 5% fortified with minerals and vitamins diet

rate of daily food intake for the animal fed on the commercially available diets 2 and 3; basal diet did not show any appreciable growth, because it lack essential amino acid (Ibironke *et al*., 2012a). This was due to the fact that the diet was not well balanced with adequate nutrient.

Table 4 shows the average weight from commercial available groups 2 and 3 were the highest followed by formulated diet with vitamins and minerals, basal and the least is plain diet. In contrast commercial available 2 and 3 had the biggest kidney and plain diet was lower in size than the kidney of the animals fed with commercial diet 3 weight followed basal. Perhaps needs to be fortified with essential minerals and vitamins (FAO and WHO, 1989b; Ibironke *et al*., 2012a).

The Table 6 indicates that protein levels in tissue of rats fed with the commercial available diets 2 and 3 had the highest retention of protein in the various body organs. These were followed by tissues of animal in group 4 fed by basal and the least was produced in tissue of animals fed with plain diet. This may be because the diet lacked adequate nutrient such as quality protein, deficient in essential amino acids such as lysine and tryptophan, hence was not nutritionally adequate to enhance growth. This result agrees with the nitrogen retention as shown in Table 5 (FAO and WHO, 1989b; Ibironke *et al*., 2012a; Hoppe *et al*., 2004).

Table 7 shows the calculated value for Protein Efficiency Ratio (PER) and Net Protein Retention (NPR). In the order of magnitude, the descending PER and NPR values were nil 3.53, 3.21, 2.43,

Table 4: Average tissue weights of the experimental animals

Dietary samples	Liver (g)	Kidney (g)	Muscle plantaries (g)
1	2.24±01	0.64±01	1.07±01
2	3.87±01	0.75±03	1.19±02
3	3.15±03	0.76±01	1.18±01
4	2.65±03	0.73±02	0.52±03
5	3.80±04	0.73±01	0.96±01

Data is Mean±SD value of three determinations with different superscript in a column are significantly different ($p<0.05$), Basal diet, (1) 100% Carbohydrate, (2) Vegetable base commercial diets, (3) Milk base commercial diets, (4) Corn flour 85%, soyabean 15%, sesame 5% diet and (5) Corn flour 85%, soya beans 15%, sesame 5% fortified with minerals and vitamins diet

Table 5: Total nitrogen retained mg g^{-1} in various tissue of experimental animal

Dietary samples	Liver	Kidney	Muscle plantaries
1	24.37±01	42.03±01	35.03±01
2	48.36±03	48.01±04	46.05±01
3	48.27±01	43..53±01	48.00±01
4	40.59±01	35.48±04	45.64±01
5	43.17±02	41.52±03	40.72±01

Data is Mean±SD value of three determinations with different superscript in a column are significantly different ($p<0.05$), Basal diet, (1) 100% Carbohydrate, (2) Vegetable base commercial diets, (3) Milk base commercial diets, (4) Corn flour 85%, soyabean 15%, sesame 5% diet and (5) Corn flour 85%, soya beans 15%, sesame 5% fortified with minerals and vitamins diet

Table 6: Average protein level in various tissues

Dietary samples	Liver (%)	Kidney (%)	Muscle plantaries (%)
1	25.07±01	23.62±01	27.02±02
2	30.16±01	27.21±02	00.30±02
3	27.10±03	23.76±01	27.74±01
4	25.37±02	22.18±03	28.54±03
5	26.98±01	25.95±01	25.45±01

Data is Mean±SD value of three determinations with different superscript in a column are significantly different ($p<0.05$), Basal diet, (1) 100% Carbohydrate, (2) Vegetable base commercial diets, (3) Milk base commercial diets, (4) Corn flour 85%, soaya bean 15%, sesame 5% diet and (5) Corn flour 85%, soya beans 15%, sesame 5% fortified with minerals and vitamins diet

Table 7: Biological assay of the experimental animal

Diet	Initial weight (g)	Final weight (g)	Gain/loss in weight (g)	Protein consumed (g)	PER	NPR
1	58.59±03	58.53±01	-0.06±02	-	-	-
2	58.47±02	107.78±01	49.31±01	13.978±01	3.53±02	3.54±02
3	58.20±01	93.09±02	34.89±03	10.860±04	3.21±03	3.23±02
4	58.59±02	76.27±01	16.68±02	6.853±02	2.43±02	2.45±03
5	58.31±01	84.05±03	25.74±01	10.032±01	2.56±01	2.58±01

Data is Mean±SD value of three determinations with different superscript in a column are significantly different ($p<0.05$), Basal diet, (1) 100% Carbohydrate, (2) Vegetable base commercial diets, (3) Milk base commercial diets, (4) Corn flour 85%, soyabean 15%, sesame 5% diet and (5) Corn flour 85%, soya beans 15%, sesame 5% fortified with minerals and vitamins diet

and 2.50: nil 3.54, 3.23, 2.45, 2.58 for commercial available diets 2 and 3, diet 4 basal diets respectively. However, the recorded (PER) Net Protein Retention (NPR) values agrees with the data for Table 3 (FAO and WHO, 1989b; Ibironke *et al.*, 2012a). Table 7 shows the values of PER (Protein Efficiency Ratio) and Net Protein Retention (NPR). It reveals that commercial diet 2 has the highest (PER) followed by commercial diet 3, formulated diet with minerals and vitamins, similarly NPR followed the same trend (Institute of Medicine, 2000a, b; Hurrell, 2003). Basal diet and plain diet promoted the least growth. This is because it lacked essential amino acid as previously reported (FAO and WHO, 1989b; Ibironke *et al.*, 2012a). Table 6 shows the results of the protein levels in the various organ of the body. The results indicated in Table 6 and 7 showed that commercial available diet 2 promoted the highest N-retention in animal tissues. During the 22 days of the experiment, it was observed that the rats fed on plain diet lost weight irregularly (diet 4). They became lean, less active though the hair on their skin was observed to be intact. Expect for animal of the latter group which was dead on the 22nd day of the experiment, it can be deduced that diet 5 is nutritional adequate because it was fortified with mineral and vitamin and met recommended daily requirement. On the other hand the rats in groups 2, 3, 5 feeding on control diets and formulated diet with mineral and vitamin were observed to be active and healthy (FAO, 2009; Ibironke *et al.*, 2012a, b). They increase progressively with time and were all very active. It was highlighted that commercial available diets however promoted the highest growth rate among the experimental animals. This was followed by those placed on the newly formulated diets (FAO, 2009; Ibironke *et al.*, 2012a). The performance of the animal fed on newly formulated diets was not adequate as satisfactory as that of animal that were placed on commercial available diets. Table 6 shows the results of the protein level in various organs of the animals. This showed that the protein levels in the tissue of rats fed on commercial available products retained the highest protein in their liver and muscle, respectively. This agrees with amount of food consumed as shown in Table 2 (Hurrell, 2003; FAO, 2009; Ibironke *et al.*, 2012a).

CONCLUSION

This investigation has shown that vegetable proteins have potential source of adequate protein for the formulation of weaning foods. It is an evident from the results that attention should be paid to the mixture of vegetable proteins to meet the adequate nutritional quality needed for the promotion of growth of infants. The result further expatiates in terms of nitrogen retention in various tissues of the body. It might be inferred from the result that there was optimum nitrogen retention in animal tissue fed with control diets. Food consumption, nitrogen retention, average protein level and optimum growth rate were found to be inter-related. However, if economic cost and health benefits were put into consideration, newly formulated diets could be produced in a much cheaper rate than the commercial available product. This would mean that investigation of this nature will be useful to the industries and common people in general to alleviate protein energy malnutrition in developing countries.

REFERENCES

AOAC, 2000. Official Methods of Analysis of the Association of Official Analytical Chemists. 17th Edn., AOAC, Washington, DC., USA.

FAO and WHO, 1989a. Expert consultation: Protein quality evaluation. Report of the Joint Food and Agriculture Organization of the United Nations/ World Health Organization, Food and Nutrition Paper No. 51, Bethesda, MD., USA.

FAO and WHO, 1989b. Key statistics of food and agriculture external trade: FAOSTAT database. Food and Agriculture Organization and World Health Organization, USA.

FAO, 2009. FAOSTAT database 2009. Food and Agriculture Organization of The United Nations. http://faostat.fao.org/site/567/default.aspx#ancor.

Fashakin, J.B. and F. Ogunsola, 1982. The utilization of local foods in the formulation of weaning foods. J. Trop. Pediatr., 28: 93-96.

Fashakin, J.B., M.B. Awoyefa and P. Furst, 1986. The application of protein concentrates from locally available legumes in the development of weaning foods. Zeitschrift fur Ernahrungswissenschaft, 25: 220-227.

Hoppe, C., T.R. Udam and L. Lauritzen, 2004. Animal protein intake, serum insulin-like growth factor I and growth in healthy 2.5-y-old Danish children. Am. J. Clin. Nutr., 80: 447-452.

Hurrell, R.F., 2003. Influence of vegetable protein sources on trace element and mineral bioavailability. J. Nutr., 133: 2973S-2977S.

Ibironke, S., J.B. Fashakin and A.O. Badmus, 2012a. Nutritional evaluation of complementary food developed from plant and animal protein sources. Nutr. Food Sci., 42: 111-120.

Ibironke, S., J.B. Fashakin and M.M. Ige, 2012b. Growth pattern and nutritional status of school children aged 6-14 years of selected schools in Osun State, Southwest-Nigeria. Nutrition and Food Science, UK.

Institute of Medicine, 2000a. Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin and Choline. National Academy Press, Washington, DC., USA.

Institute of Medicine, 2000b. Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium and Carotenoids. National Academy Press, Washington, DC., USA., ISBN: 9780309069359, Pages: 506.

Self Nutrition Data, 2010. Seeds, sesame seeds, whole, roasted and toasted. Nutrition Facts. The Self Nutrition Data, USA. http://nutritiondata.self.com/facts/nut-and-seed-products/3071/1.

UNICEF. and WHO., 2011. Estimates of prevalence and numbers for child stunting, underweight, overweight and wasting United Nations, Millennium Development Goal, UNICEF, WHO regional and World Bank income group classifications. UNICEF. and World Health Organization, USA.