Applied Tropical Agriculture
Volume 21, No.2 (Special Issue), 39-43, 2016.
© A publication of the School of Agriculture and Agricultural Technology, The Federal University of Technology, Akure, Nigeria.

Nutritional Qualities of Weaning Foods from Protein-Rich Food Mixtures Using Bioassay Method

Adepeju, A.B.,[1*] Abiodun, A.O.[2] and Esan, Y.O.[1]

[1]Department of Food Science and Technology, Joseph Ayo Babalola University, PMB 5006, Ikeji Arakeji, Osun State, Nigeria.
[2]Department of Food Science and Technology, Osun State Polytechnic, P.M.B 301 Iree, Osun State, Nigeria.
*Corresponding author: Email: adepeju98@icloud.com or adepejuadefisola@gmail.com

ABSTRACT

The study evaluated the effect of crayfish and soybean protein enrichment on the quality of formulated weaning foods. The evaluation was done using both in vitro and in vivo (animal models) methods. The nutrient composition results showed that the protein and fat contents of then crayfish-ogi, soy-ogi and control diets of all the diets were 17.66, 14.16, 16 and 12.6, 18 and 9 g/100 g, respectively. The ash content of the experimental diets ranged from 2.14 to 4.85 g/100g. These values were in the FAO standard ranges recommended for infant weaning diet. The bioassay analysis showed that crayfish- ogi diet had higher protein efficiency ratio (PER) and net protein ratio (NPR) than soy –ogi diet. The animals fed with crayfish- ogi diet showed increased in weight when compared with others. The organs (tissues, liver and kidney) of animals in the crayfish-ogi group weighed higher and contained total protein level than those of the control diet group.

Keywords: carbohydrate; crayfish; protein; soybeans; weaning food

INTRODUCTION

The nutrition in the first two years of life has long-term consequences on the health and productivity of such newborns. At this stage of rapid development, infants require higher energy and protein in their diets so as to meet the increasing demand for metabolism (FMOH, 2005). Infants in developing countries generally show satisfactory growth during the first six months of life when they are almost exclusively breastfed (Pelto *et al*., 2003).Therefore inappropriate complementary food to breast milk has been identified as a contributing factor to the high incidence of malnutrition in developing countries (WHO/UNICEF,1998).Over these formative years, the insufficient quantities and inadequate quality of weaning foods, poor child-feeding practices and high rates of infections have posed a detrimental impact on health and growth of the infants. Even with optimal breastfeeding, children become stunted if they do not receive sufficient quantities of quality complementary foods from six months of age (FMOH, 2005).Past study recommended prevention of an estimated six percent or six hundred thousand under-five deaths through thorough optimal complementary feeding (Davis, 2001).Among many approaches needed to improve child survival and growth in developing countries therefore, is the provision of safe and nutritious infant foods (Peltro *et al*., 2003). Infant mortality rate in Nigeria has increased from 86 in 2000 to 111in 2005 (UNFPA, 2005; Ojofeitimi, 2008). Also, among the under-five children, the rate of stunting, wasting and underweight were reportedly exceeded 40%, 9%, and approximately 25% respectively (Wardlaw, 2000).Meanwhile, most of the other factors (diarrhea, measles and malaria) responsible for infant mortality can be controlled if infants are adequately fed with foods that me*et al*l the nutritional requirements (FMOH, 2005).

Traditionally, infant porridges in developing countries are usually made from local staples and the resulting gruels may have low nutritional value in terms of micronutrients and macronutrients (Dewey and Brown, 2003). In most developing countries, like Nigeria, the traditional complementary foods that are commonly introduced to infants are based on some local staples which are usually cereals such as maize, sorghum, millet, wheat, oat and barley made into gruels. The nutrient contents of this product, however is far below the recommended values for infant and cannot meet the nutritional "demands" of an infant (Brown *et al*., 1998). Although a number of commercial infant foods exist but, most families in the low and middle income-earning groups cannot afford them. It is therefore expedient to formulate foods from local staples that are nutritious, fit into the traditional culinary and child feeding practices of the region and are very affordable (Dewey and Brown, 2003).This research work, those aimed at producing and evaluating formulated weaning foods from fermented corn, crayfish and soybean flours.

MATERIALS AND METHODS

Sweet corn, and soybean were purchased at the Ife Central Market, fresh crayfish was obtained from Eko-ende in Ikirun, Nigeria while Nutrend (control diet) was purchased from Infinity grace supermarket, Obafemi Awolowo University in Ife. The vitamin and mineral mix used were from Pfizer Nigeria Plc. Twenty- five male and female albino rats (Wister strain) were obtained from the Department of Pharmacy, Obafemi Awolowo University, Ile Ife, Nigeria.

Preparation of fermented corn flour

The grains were cleaned and steeped for 48 h to encourage fermentation. The fermented corn was then washed dried, milled, sieved and packaged in a polythene bag and stored in the refrigerator for later use.

Preparation of soybean flour

The soybean seeds were sorted, cleaned and boiled for 30 mins. They were dehulled and thoroughly washed and dried in the cabinet dryer (Gallenhamp SM 905, England) at 45 ^oC for 24 h. The dried soybean seed were cleaned by winnowing, milled, sieved, packaged and stored in the refrigerator.

Preparation of crayfish flour

The crayfish was sorted and cleaned in water and unwanted materials were removed. It was dried at 45 ^oC for12 hrs. It was milled, packaged and stored in the refrigerator.

Mineral and vitamin mixtures

The mineral mixture in gram per kilogram of the corn flour contain 5.40g calcium, 4.30g phophorus, 0.01g iron, 1.60g sodium, 6.60g potassium, 0.035g zinc. All these were mixed for 10 min using kenwood mixer (Kenwood, A200, Britain). The vitamin mixture in milligrams per 50 g of corn flour contained 3.0mg vitamin A, 0.60mg vitamin D, 300mg vitamin E, 350mg vitamin C, 0.25 mg folic acid, 8.0mg thiamine, 3.0mg riboflavin, 40mg niacin, 3.0mg vitamin B6, 0.075 mg vitamin B12, 2.5mg biotin, 15.0mg pantothenate and starch to make up to 50g. They were all mixed for 10 min using kenwood mixer (Kenwood, A200, Britain).

Preparation of the experimental diets

The fermented corn flour was mixed in a Kenwood mixer (Kenwood, A200, Britain) for 10 min with sugar, vegetable oil, cod liver oil, mineral and vitamin mix, to obtain the basal diet. Similar processing method was followed for the other diets (Table 1).

Experimental animal

The 25 male and female albino rats were weighed and divided into five groups randomly until each group had approximately same average weight. One group of five animals served as the control for the experimental group and was sacrificed. Tissue from the liver, kidney and plantaris muscle of the hind-leg were removed, weighed and frozen till nitrogen efficiency was determined. The remaining animals were placed on experimental diet fed *ad libitum* over a period of 28days.

Analyses of the formulated diet and experimental animal

Proximate analyses of commercial (control) and experimental diet were carried out using AOAC (2005) methods. The dietary intake and weight of the experimental animals were studied and the organs such as the muscle, liver and kidney were collected and examined. The Net Protein Ratio (NPR) and Protein Efficiency Ratio (PER) were calculated.

RESULTS AND DISCUSSION

The nutrient composition of control and experimental diets were shown in Table 2. The result showed that the protein contents of, the crayfish-ogi (17.66 g/100 g) and soy-ogi (14.16 g/100 g) diets compared well with the 16 g/100 g of control diet.

Table 1: Composition of experimental diet.

Constituents	Basal diet	Crayfish Ogi diet	Soybean Ogi diet
Crayfish flour (g)	-	200	-
Corn flour (g)	809	609	609
Soybean flour (g)	-	-	200
Vitamin premix (mg)	10	10	10
Mineral Premix (g)	16	16	16
Vegetable oil (g)	100	100	100
Cod liver oil (g)	5	5	5
Sugar (g)	60	60	60

Table 2: Chemical composition and energy values of experimental diets in g/100g of diet.

Parameter	Crayfish-Ogi	Soybean-Ogi	Control diet
Protein	17.66±0.88	14.16±0.40	16.00±0.20
Fat	12.60±0.33	18.00±0.20	9.00±0.50
Moisture	7.88±0.35	7.54±0.40	4.00±0.35

Values are Mean±SD

The protein contents of the experimental diets obtained in this study (14-18 g/100 g) meet the normal requirement standards (12-20 g / 100 g) set for infant diet (FAO/WHO, 1992).it is noteworthy that both crayfish and soybean flours increased the protein contents of Ogi by four and five times respectively, since Ogi was reported (Adepeju and Abiodun, 2011) to contain 3.40g/100 g protein. Meanwhile, the fat content of the crayfish-enriched diet (12.60 g / 100 g) is lower than 18 g/100 g obtained for soybean-enriched diet. The difference may be due to the fact that soybean seeds are well known as a good source of vegetable oil production. The fat content also meets the standard requirement (9-10 g/100 g) for infant diet. The ash content of the experimental diets ranged from 2.14 to 4.85 g/100g. The value for crayfish-ogi was higher when compared with that of the control diet (2.00 g/100g) while soy-ogi had a similar value with the control diet (2.00 g/100 g). The moisture contents of all the diets (7.54-7.88 g/100 g) were higher than that of the control diet (4.00 g/100 g). However, these values still fall within the expected range for weaning diet which must not exceed 10%. The carbohydrate content of the diets compared well with the control diet (64.00 g/100 g). The most favourable protein efficiency ratio (PER) and net protein ratio (NPR) were apparent in all the groups. The values of PER in crayfish-ogi exceeded the recommended value which is 2.1 (PAG, 1982) while soy-ogi and control diet fall below the recommended requirement. The result of this work agreed with the report of Ahenkora *et al.*, 1994).

Animal Feeding Experiment

During the 28 days experimental period the adaptation of the animals fed on each dietary sample and utilization of each diet were studied and the result presented in Fig. 1. The animals that depend on the basal diet for survival were found to become leaner and weaker each passing day of the experiment. The physical changes were observed on the skin as well as in their consumption rate. For instance, loss of weight was dramatic from average weight of 67.60 g at day one to 54.22 g at day twenty eight (even animal loss was recorded in this group). On the other hand, the animals fed with other diets increased in weight especially in the crayfish-ogi diet group followed by the control diet group (Fig. 1) and this might be due to the fact that crayfish is very nutritious as compared to other sources of protein. Meanwhile, the lower rates results recorded for soy-ogi diet as compared to the control diet, might be due to the presence of antinutrients (such as oligosaccharides and protease inhibitors) in soybean, which might rendered it bio-unavailable for metabolism. Past works had also reported the decrease in weight of the animal fed on basal diet over a set period of time (Fashakin *et al.*,1991; Adepeju and Abiodun, 2011) . The weight gained was largely influenced by the quality of protein constituents of the diet. Protein is required among other things for growth, healthy living and maintenance and production of tissues and cells of the body (FMOH, 2005). The current results supported the fact that ogi has a protein content of poor biological value which did not support growth in rats. The results of the rate of diet consumption by the rats were presented in Table 3. The rate at which crayfish-ogi, soy-ogi and the control diets were consumed by the animals was low when compared with the basal diet, but highest in the control diet towards the middle and to the end of the experiment than those of the animals from other experimental groups. The tissues of animals fed on basal diet were smaller than those of animals from other experimental groups as shown in Table 4. The livers, kidney and muscle of animals in the crayfish-ogi were found to have the highest total protein level when compared to the control and soy-ogi diet groups (Table 5).This work compared well with the work of Murray *et al.*, (1993) who reported higher body weight and high kidney value for rat fed a high protein diet.

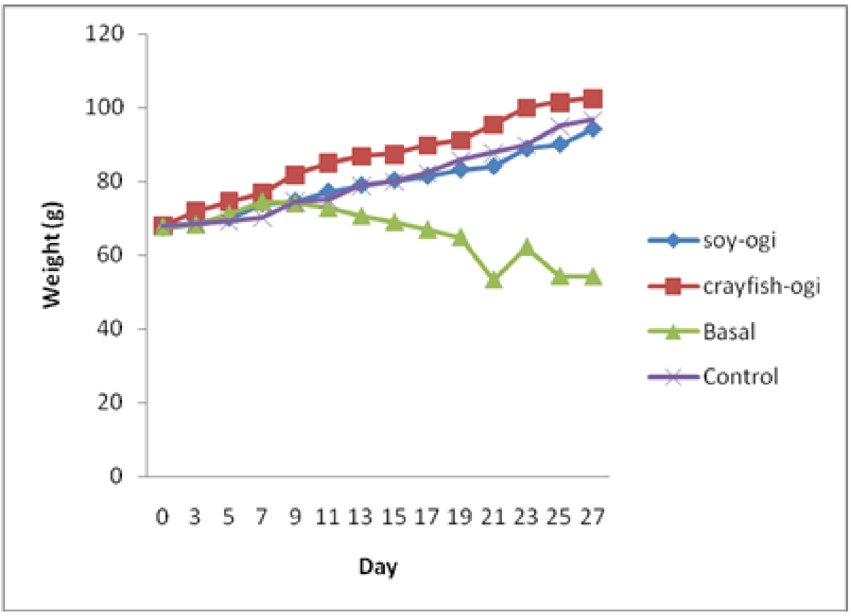

Figure 1. Average weight changes over the experimental period.

Table 3: Food composition (g) over experimental period.

Experimental Period (days)	Diets			
	Basal	Crayfish ogi	Soy-ogi	Control
7	33.2	32.44	32.74	31.62
14	74.78	70.62	66	73.34
21	114.7	109.7	110.19	119.88
28	155.54	149.34	148.39	165.54

Table 4: Weight of various tissues of Experimental animals.

Tissues	Zero day Animal	Basal Diet	Crayfish-ogi	Soy-ogi	Control
Liver	2.42±0.11	1.33±0.12	3.60±0.10	2.62±0.12	2.70±0.45
Kidney	0.24±0.03	0.16±0.03	0.34±0.03	0.27±0.06	0.29±0.08
Muscle	0.62±0.42	0.26±0.19	0.72±0.12	0.65±0.24	0.68±0.12

The zero day animals (control) are the animals sacrificed on the first day of the experiment. Values are Mean±SD. The tissues collected from these animals served as the initial level for the other animal's tissues at the end of the experiment.

Table 5: Total protein level (mg/N) in various tissues of experimental animals.

Tissues	Zero day Animal	Basal Diet	Crayfish-ogi	Soy-ogi	Control
Liver	80.47±0.24	37.43±0.12	192.60±0.20	125.11±0.20	132.98±0.20
Kidney	7.28±0.33	3.77±0.40	15.24±0.30	11.40±0.43	12.57±0.15
Muscle	18.31±0.42	6.50±0.20	35.45±0.10	27.94±0.18	31.79±0.20

The zero day animals (control) are the animals sacrificed on the first day of the experiment. Values are Mean±SD. The tissues collected from these animals served as the initial level for the other animal's tissues at the end of the experiment.

CONCLUSION

Based on the findings of the investigation, it may be concluded that locally available protein-rich food resources have great potentials in the formulation and preparation of infant weaning foods. The potential, viability, cheaper sources and readily accessibility of crayfish-ogi and soy-ogi diets as the infant weaning diet formulations were fully exploited in this study. Moreso, this will go a long way in ameliorating the usual symptoms (stunted growth, wasting of muscles, low height for age) associated with protein energy malnutrition (PEM) that are commonly prevalent in the developing country.

REFERENCES

Adepeju, A.B. and Abiodun, O.A., (2011). Effect of protein rich foods mixtures on the quality of formulated weaning food diet. International Research Journal of Biochemistry and Bioinformatics. 1 (5):114-118

Ahenkora, K.S., Iwumasi-Afriyie, W. Hagg and Dzah, B.D., (1994). Ghananian kenkey from normal and quality protein maize comparative chemical composition and fat growth trials. Cereal Research communication. 23(3):299-304.

AOAC, (1990). Official Methods of Analysis. 15th Edn. Association Official Analytical Chemists. Washington D.C

Brown, K.H., Dewey, K.G. and Allen, L.H., (1998). Complementary feeding of young children in developing countries: a review of current scientific knowledge. Geneva: WHO/NUT/98.

Davis, M.K., (2001). Breastfeeding and chronic disease in childhood and adolescence. Ped. Clin. Amer.48:125-142.

Dewey, K.G and Brown, K.H., (2003). Update in Technical Issues concerning complementary feeding of young children in development countries and implications for intervention programs. Food Nutr. Bulletin. 24:5-28.

FAO/WHO, (1992). International conference on Nutrition and Development- A Global Assessement, Rome. FAO.

Fashakin, J.B, Ilori M.O., Olanrewaju I.,(1991). Cost and quality optimization of a weaning diet from plant protein and corn flour using a computer aided linear programming model. Nig. Food J. 9:123-127.

FMOH, (2005). Infant and Young Child Feeding in Nigeria- Guidelines. Federal Ministry of Health, Abuja.

Ojofeitimi, E.O., (2008). A Healthy Life: Your Birth right. An inaugural lecture series 2209. OAU press Ltd. OAU, Ile- Ife. 8th January, 2008.

PAG, (1982). Protein rich mixture for use as weaning foods. Protein Auditory Guidelines. No. 8. Food and Agriculture Organisation of the United Nations Children's funds.1-7.

Peltro, G.H, Levitt, E., and Thairu, L., (2003). Improving Feeding Practices. Current Patterns Common constraints and Design of Intervention. Food and Nutrition Bulletin. 24:24-82.

UNFPA, (2005). Country profiles for population and reproductive health. Policy development and indicators 2005. Population Reference Bureau. 1-9.

Wardlaw, G.M., (2000). Contemporary Nutrition Issues and Insights. 4th ed. McGraw- Hill Higher Education, USA: 450-475.

WHO/UNICEF., (1998). Complementary feeding of young children in developing countries: a review of current scientific knowledge, WHO/NUT/98.1.

*****