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Proximate Composition and Organoleptic Properties of Complementary Food Formulated from Millet (*Pennisetum psychostachynum*), Soybeans (*Glycine max*) and Crayfish (*Euastacus spp*)

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Abstract: Complementary foods were formulated from millet, soybeans and crayfish and evaluated for proximate composition and organoleptic properties. The different flours were combined in ratios of 78.5:20:1.5, 81.6:15:3.4 and 84.6:10:5.4 (protein basis) of millet, soybeans and crayfish. Nutrend, a commercial complementary food, served as control. Porridges were prepared from the composite blends for organoleptic evaluation. Standard methods were used to analyze the composite flour for proximate composition. The composite flours contained higher moisture, protein and carbohydrate than the control. The protein and carbohydrate levels of the blends ranged between 15.9-16.7% and 67.5-68.75% respectively. The result of the sensory evaluation showed no significant difference in the appearance of the porridges and that of the control. Composite blend sample 84.6:10:5.4 was generally preferred over the others and control. Sample 84.6:10:5.4 was also more tasteful than the others including the control. The study showed that porridges prepared from blends of millet, soybeans and crayfish are nutritionally adequate to support child growth and well being.

Key words: Complementary food, organoleptic properties, millet, soybeans, crayfish

INTRODUCTION

Malnutrition during early life leads to permanent stunting in growth (Onis and Blossner, 1999) and there may also be irreversible sequence from micronutrient deficiencies that affect brain development and other functional outcomes (Martorell *et al*., 1995). During the first two years of life, malnutrition has a profound effect on child development particularly during the first phase of complementary feeding (6-12 months) when foods of low nutrient density begin to replace breast milk and rates of diarrhea illness due to food contamination are at their highest. When breast milk is no longer enough to meet the nutritional needs of the infant, complementary foods should be added to the diet of the child (WHO, 2001).

Complementary foods are the traditional foods consumed between the time the diet consists exclusively of mother's milk and the time when it is mostly made up of family foods (Yeung, 1998). Mensah *et al*. (1991), Branca and Rossi (2002) defined complementary food as those which are appropriately timed, nutritionally adequate and hygienically prepared foods that are given to infants along with continued breast feeding from six months of age.

In Nigeria as in most developing countries, the infant complementary foods are grossly inadequate (Nnam, 2002). About 40% of Nigerian population live below the poverty line and so cannot afford commercial feeding formula for their infants (Wardlaw and Hampl, 2006). As a result of this most of the infants are feed high carbohydrate gruels made from cereals, which frequently are not nutritious and too watery to meet the nutrient requirements of the fast growing infant. Adequate processing and judicious blending of the locally available foods could result in improved intake of nutrients to prevent malnutrition related problems (Nnam, 2001).

In Nigeria, millet is the third most important and readily available cereal, ranking behind maize (FAO, 1995) and the fourth most important cereal crop in the world (Okoh, 1998). Millet is relatively rich in some mineral elements particularly calcium, phosphorus, magnesium and iron. It is also a rich source of B-vitamins particularly thiamin (FAO, 1995). The protein content of millet is similar to that of sorghum and maize, with lysine as the most limiting amino acid (FAO, 1995). This accounts for the prevalence of protein malnutrition among children fed exclusively on millet diet.

Soybeans is rich in protein (40%) and fats (20%) (Bender and Bender, 1999). Soybeans contain moderate quantities of tryptophan and threonine. Crayfish is one of the cheapest sources of animal protein in Nigeria. Fish flesh generally contains mainly water, protein and fat with traces of carbohydrates, amino acids and other non-protein nitrogenous extracts, various minerals and vitamins (Onimawo and Egbekun, 1998). The production of composite flours from millet, soybeans and crayfish could help to improve the nutritional status of the infants. Fermentation and blanching of plant foods provide means through which their nutritional worth can be improved upon (Nnam, 1995; Obizoba, 1998; Nnam, 1999). As part of effort to produce nutritionally adequate foods from blends of Nigerian indigenous food crops, the study was designed to formulate composite flours from fermented millet, blanched soybeans and crayfish for possible use as complementary food for older infants and young children; prepare porridges from the composite flours and evaluate their sensory properties.

MATERIALS AND METHODS

Millet (*Pennisetum psychostachynum*) grains, soybeans (*Glycine max*) and crayfish (*Euastacus spp*) were purchased from North-Bank market in Makurdi, Benue State, Nigeria.

Preparation of materials: Four kilograms of sorted millet grains were cleaned and soaked in clean tap water in a covered container. The soaked grains were allowed to ferment at room temperature (37°C) for 24 h. After fermentation, the water was drained and the grains rinsed with 500 ml of water and oven dried at 80°C for 3h. Three kilogram of soybeans were sorted, cleaned and blanched at 100°C for 10 min. The blanched grains were drained, dehulled and rinsed with 500 ml of water to remove the seed coat. The rinsed seeds were then oven dried at 80°C for 5 h. Two kilograms of sorted and cleaned crayfish was sun dried. All the dried samples of millet, soybeans and crayfish were separately milled and sieved with 30 mm particle size sieve.

Formulation of composite flours: The protein content of the materials was determined by material balancing based on their chemical composition: soybeans (34.1%), millet (10.4%) and crayfish (69.5%). The composites were formulated from the processed flours in the ratio of 78.5:20:1.5, 81.6:15:3.4, 84.6:10:5.4 (protein basis) of millet, soybeans and crayfish. Nutrend, an industrially prepared infant food served as the control.

Chemical analysis: The nutrient composition of the flour blends was determined according to the standard assay methods of AOAC (1995). Crude protein was determined by the Microkjeldah method. Fat and ash content were determined by Soxhlet extraction and dry ashing method respectively. Carbohydrate was determined by difference while gross energy was calculated using Atwater conversion factors. All assays were performed in triplicate.

Preparation of porridges: Porridges were prepared from each of the composite four samples and nutrend (control). One hundred and fifty grams of each flour sample were reconstituted with 500 ml of clean tap water. The slurry was heated slowly with constant stirring for 10 min to obtain smooth textured porridges. One tablespoon of sugar was added to each sample.

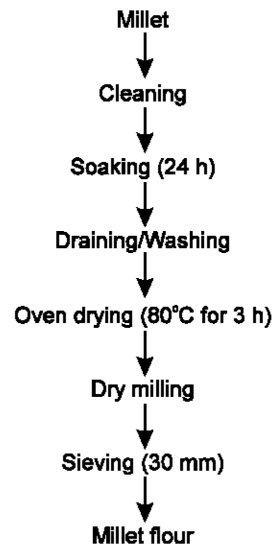

Fig. 1: Flow chart for the production of millet flour

The porridges were kept separately in thermos flask (to keep them warm and prevent them from congealing) for sensory evaluation.

Organoleptic evaluation: Twenty mothers were randomly selected from the University of Agriculture, Makurdi staff pay roll and semi trained to perform the sensory evaluation. The judges (mothers) were divided into two groups of ten each. However, each group performed its sensory evaluation on a separate day but taken in sets of five. Each panelist was seated separately and free from distraction. The judges evaluated the samples using a five point Hedonic scale (5 = Liked Extremely to 1 = Unacceptable) (Iwe, 2000). Each judge was provided with five clean plastic cups and spoons for use in the sensory evaluation (a cup and spoon for each sample and control while the fifth cup was provided to enable the judges rinse their mouth in between testing of the porridges to avoid carry over effect). The panelist evaluated the samples for appearance, taste and general acceptability.

Statistical analysis: The means and standard deviation of the data obtained from the study were determined while analysis of Variance (ANOVA) and Least Square Difference (LSD) tools were employed to test the significant difference between means ($p<0.05$).

RESULTS AND DISCUSSION

The percentage moisture, crude protein, carbohydrate, fats, crude fiber and ash content of the formulated complementary food blends is shown in Table 1. The blend samples showed no significant difference in their moisture content except for sample 84.6:10:5.4 ($p<0.05$). The values varied between 3% and 4.6%. The low

Table 1: Proximate composition of the formulated complementary food samples and the commercial food (Nutrend)

Sample	Moisture	Carbohydrate	Protein	Fats	Fiber	Ash
78.5:20:1.5	4.6±0.1^{a}	67.5±0.05^{a}	15.9±0.01^{a}	7.0±0.2^{a}	3.3±0.02^{a}	1.7±0.1^{a}
81.6:15:3.4	4.4±0.2^{a}	67.6±0.05^{a}	16.2±0.02^{b}	6.4±0.2^{b}	3.5±0.03^{a}	1.9±0.2^{b}
84.6:10:5.4	3.0±0.1^{b}	68.7±0.05^{b}	16.9±0.02^{c}	5.2±0.2^{c}	4.5±0.02^{b}	2.1±0.1^{c}
Control	4.0± 0.1^{c}	63.0±0.01^{c}	16.0±0.01^{a}	9.0±0.1^{d}	5.0±0.01^{c}	2.3±0.1^{c}

Mean values with the same superscript in the same roll are not significantly different. Values are mean results of triplicate determinations

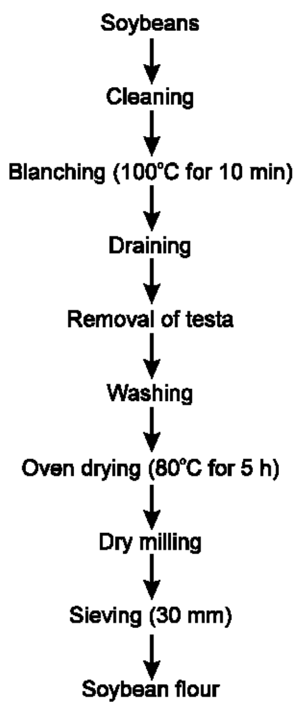

Fig. 2: Flow chart for the production of soybean flour

Fig. 3: Flow chart for the production of crayfish flour

moisture content of the formulated samples could be due to the drying temperature (80^{o}C) the materials were subjected to. The protein content of the blend samples conformed to that of the control (16%). Sample 84.6:10:5.4 had the highest protein content (16.9%) among the blend samples, even higher than that of the control (16%). The inclusion of soybeans in the production of the samples may have accounted for their high protein content. However, the percentage increase in crayfish in the various blend samples compensates for decreases in the quantity of protein supplied by soybeans. Thereby, maintaining a high protein content among the various composite samples. Carbohydrate content was highest in sample blend 84.6:10:5.4. The high carbohydrate values observed among the sample blends could be attributed to the high carbohydrate content of millet (77.9%) (Enwere, 1998) as against that of soybeans (34%). Significant differences existed in the carbohydrate content of the sample blend 84.6:10:5.4 and that of the other blends including the control. Fat content was highest in sample blend 78.5:20:1.5 (7.0%). This was however, below the 9% fat content of the control.

Table 2: Mean organoloptic attributes of the various sample blends

Sample	Appearance	Taste	General acceptability
78.5:20:1.5	3.5^{a}	3.2^{a}	3.6^{b}
81.6:15:3.4	3.2^{a}	3.2^{a}	3.6^{b}
84.6:10:5.4	3.5^{a}	4.2^{b}	4.0^{a}
Control	3.1^{a}	3.2^{a}	3.9^{ab}

Means with different superscript in a column are significantly different ($p<0.05$)

The high fat content of sample blend 78.5:20:1.5 could be accounted for by the high quantity of soybeans in the sample (Enwere, 1998). The high fat content of soybeans upgraded the lipid level of the composite to meet the specific standards (Nnam, 2002). The fiber content varied between 3.3% and 4.5%. The control sample possessed the highest fiber content while sample blend 78.5:20:1.5 had the least fat content (3.30%). In a similar vain, the ash content of the blends varied between 1.7% and 2.1%. Significant differences existed between the ash content of the blend samples ($p<0.05$).

Table 2 presents the organoleptic attribute scores associated with porridges made form the composite flours and commercial complementary food (control). The mean sensory scores of the control porridge and that of composite flour showed no significant difference except in their general acceptability ($p<0.05$). The increases in the quantities of millet and crayfish among the sample blends never resulted in a significant difference in their appearance and taste. The increases however, significantly influenced the preference of sample blend 84.6:10:5.4 above the other sample blends, even including the control.

Conclusion: The study has shown that composite flours made from millet, soybeans and crayfish are nutritionally adequate to meet the nutrient needs of children. The organoleptic attribute of the porridges however, indicated a general preference of sample blend 84.6:10:5.4 above all the other blends and control; in terms of appearance, taste and general acceptability. Nutritionally, sample blend 84.6:10:5.4 was richest in most of the nutrients.

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