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EVALUATION OF COMPLEMENTARY FOOD, PREPARED FROM MAIZE, PLANTAIN AND SOYBEAN FLOUR BLENDS

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Three infant complementary formulas were developed from three levels of combinations of soybean, maize and plantain flours. The combinations (protein basis) were (A) soybean 30% + maize 54.8%, (B) soybean 40% + plantain 44.8% and (C). Soybean 35% + maize 29.8% + plantain 4.8%. The developed formulas were fortified with premixed minerals (Ca, P and Mg) were comparatively evaluated with a proprietary formula (Nutrend) in terms of proximate nutrient compositions, functional properties and sensory qualities. Two of the developed formular (A) and (C) had higher protein contents (17.50% and 19.69% respectively) than the control (16.0%); and (B) had 15.31%. The formulated food had higher moisture and fat contents than the proprietary formula. The developed formulas were evaluated by 20 panelists on a 9-point hedonic scale, and statistically analyzed were found to be acceptable ($P < 0.05$) and compared favourably with the commercial (Nutrend). In conclusion, the study revealed that it is possible to prepare nutritionally adequate and acceptable complementary food from readily available and affordable local food items, maize, plantain and soybean.

Keywords: Complementary, Soybean, Plantain, Malnutrition, Cereal

INTRODUCTION

For the first six months of life, the human infants depend solely on its mother to provide and select its food. The first nine months in uterus is spent abstracting from the mother's blood stream what ever materials are required. While an adult's food is continuous, that of a baby is selective. This, according to Tebat (1989), is because of up to six months the mother's breast milk serves the baby, as it contains all nutrients and sufficient energy needed at that age.

An infant is regarded as a child during the first year of its life. The growth of an infant within one year is very rapid, and breast feeding alone will not meet the child's nutritional requirements after six months. Breast milk from a well-nourished mother is inadequate to meet nutritional needs of an infant after the first six months of life; therefore, there is need for complementary food (UNICFF, 1998).

According to (Saskia and Annoek, 1997; and Iggor *et al.*, 2011), weaning is a process whereby a baby is gradually trained to become accustomed to a normal adult's diet for the purpose of adequate nutrition. The period of weaning is the most critical period in the life of a young child. The necessity for weaning is evident as the infant grows because there will be an increased demand for various new activities like sitting, crawling, walking, teething and other physical developments. Failure to introduce complementary food at the required time or deficient complementary food will lead to malnutrition (Bogert *et al.*, 1993; and Joan *et al.*, 2013). The incidence of malnutrition rises sharply during the period from 6-18 months of age in most countries Nigeria inclusive, and the deficits acquired at this age are difficult to compensate for later in childhood (Martonel and Habich, 1994).

A wide range of complementary foods and infant formulae has been reported (Calvi and Mwalongo and

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Anigo *et al.*, 2010). However, some of these foods though every nutrious are either not readily available in the market or unaffordable especially to the rural dwellers. There is need to develop nutritious (adequate supply of amino acids), cheap and acceptable complementary foods from the local cheap and readily available food stuff such as cereals and legumes using simple but adequate processing techniques that can be easily adopted by many families. The product that is chap for the rural dwellers and readily available.

MATERIALS AND METHODS

The new materials which were maize soybean, unripe plantain and horney were purchased from Rivers State main market at Port Harcourt, Rivers State Nigeria. The chemical and reagents used in the analyses were of analytical grade and sourced from the department of food science and technology, Rivers State University of Science and Technology, Port Harcourt, Nigeria.

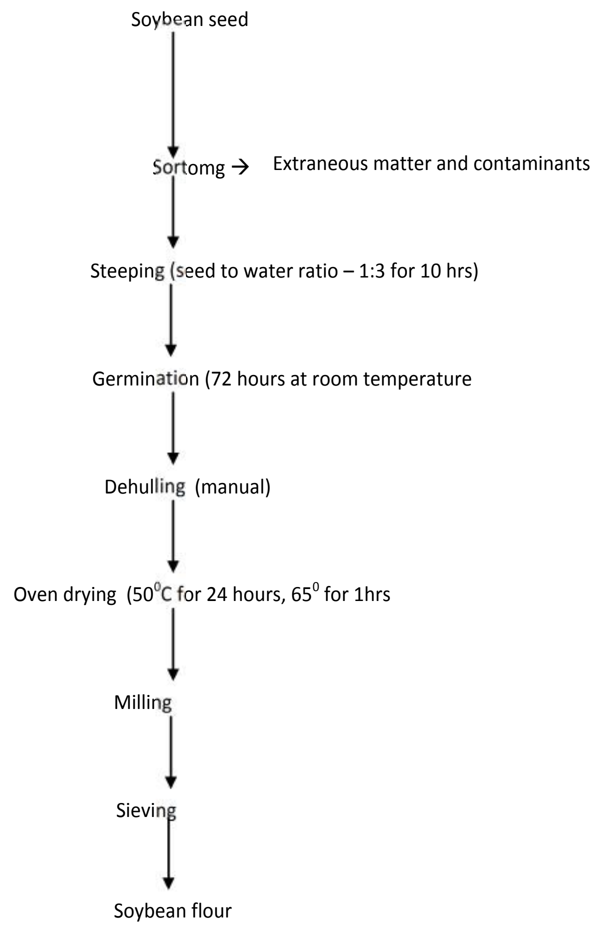
SAMPLE PREPARATION

The production of malted soybean flour was done according ot the method of Nzerem (2002). The seeds were carefully sorted to separate dirts, stones and other extraneous matters and contaminants. The clean seeds were steeped in water in a dark room for 10 hours in the ratio of seeds to water of 1:3. The seeds were subsequently drained and thereafter spread thinly on wet jute bags and covered with muslin cheese cloth. The seeds were left to germinate at room temperature (28-32 °C) for 72 hours. They were dehulled manually and air oven dried at 50 °C for 24 hours, and later at 65 °C for one hour to both reduce the moisture content and prevent microbial activity. They were then ground to flour using, an attribution mill and sieved through a 500 µn mash. Figure 1 present a flow chart of the process steps.

Maize Flour

The maize grains were sorted to rid them of all extraneous matter. They were washed and soaked in water at a seed to water ratio of 1:3 for 18 hours. The seeds were drained and spread on wet jute bags, covered with muslin cloth and allowed to sprout at room temperature for 48 hours. The germinated grains were dried at 50 °C for 24 hours, and subsequently at 65 °C for 30 minutes in an oven. They were then milled to fine flour, and the flour sieved through a mesh of aperture 500 µm. Figure 2 shows the flow chart for the production of matted maize flour.

Figure 1: Flow Chart for the Production of Malted Soybean Flour (Nzerem, 2002)



Formulation of Composite Flours

Three levels of mixture were empirically designed to realize three infant complementary foods.

A: 30% soybean + 54.8% maize, based on the formulation of complementary foods have been based on legume cereal ratio of 30%: 70% (Ossai and Malomo, 1988).

B: 40% soybean + 44.8% plantain based on Ogazi (1996) recommended studies on the application of unripe plantain flour in the formulation of complementary foods.

C: 35% soybean + 29.8% maize + 4.8% plantain. The three developed formulae were then analysed for their proximate nutrient compositions. The premix of calcium, phosphorus and magnesium formulated by bio-organic nutrient systems, Lagos, Nigeria, was added and uniformly mixed with each of the formulas to fortify them according to the recommended rate as shown in Table 1.

Figure 2: Flow Chart for the Production of Malted Maize Flour

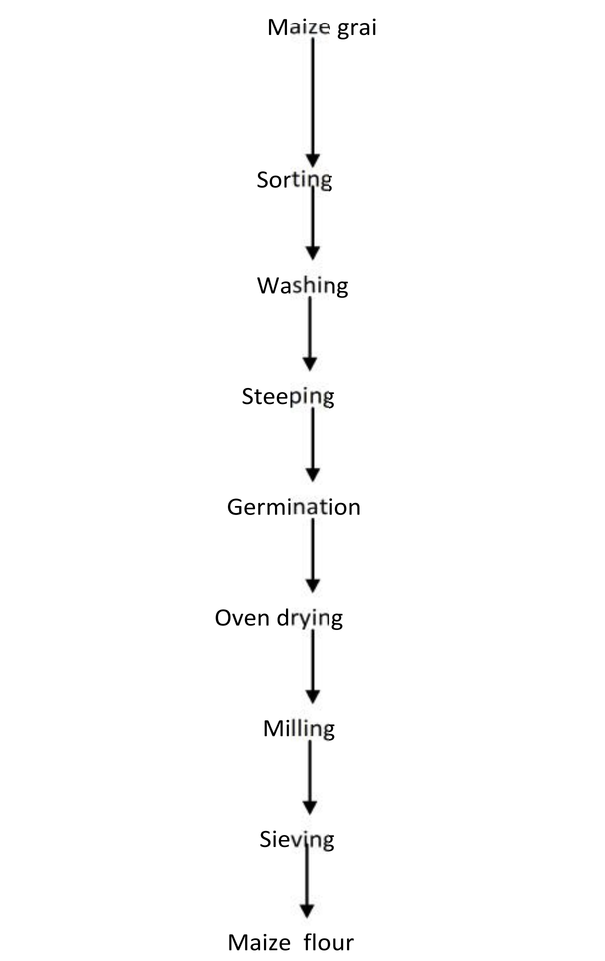
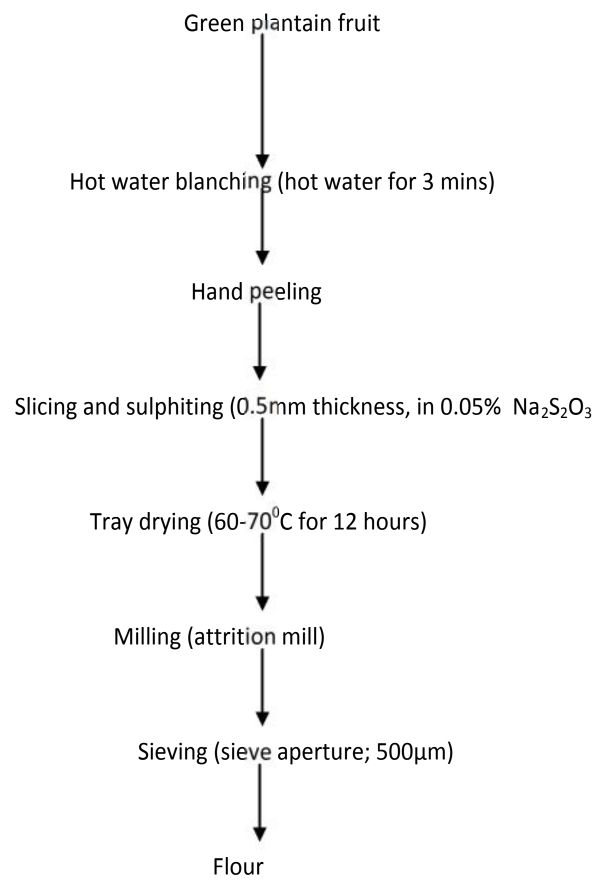


Figure 3: Stages in Plantain Flour Production



Source: Ogazi and Adeyemi (1985)

Proximate analysis of formulated complementary foods, moisture content, crude protein, crude fat, and ash content were all determined by the method of AOAC (2000); while carbohydrate was determined by difference (Ihekoronye and Patrick, 1985). Calorie value was calculated using standard factors according to Marero *et al.* (1988).

Functional Properties

The functional properties, water and oil absorption capacity, gelatinization and boiling temperature capacity, bulk density, of the formulated complementary foods were analysed according to the methods as described by Onwuka (2005).

Sensory Evaluation

Gruels of the formulated complementary foods and the controls (commercial nutrend) were saved to 20 panelists

Table 1: Formulation of the Complementary Foods

Components	Formula A %	Formula B %	Formular C %
Soybean flour *	30	40	35
Maize flour *	54.8	-	29.8
Plantain flour *	-	44.8	4.8
** Mineral mix	3.2 g	3.2 g	3.2 g
Honey	12 g	12 g	12 g
Vegetable oil	10 ml	10 ml	10 ml
Vanilla	0.4 ml	0.4 ml	0.4 ml

Note: * The flour of component in each formulation is as per 100 g of composite; ** Mineral mix: content per 100 g serving (50% RDI) calcium 500 mg Phosphorus 500 mg Magnesium 200 mg (mothers consisting of workers, university students and house wives between the age of 27 and 42 years) for evaluation of colour, flavour, mouthfeel, and overall acceptability. The four gruels which were appropriately coded (XYZ, BBC, JKI, and ACB were presented to each of the judges in different transparent tea cups of evaluation. Each panelist evaluated the gruels using a 9-point hedonic scale which was coded to correspond with the codes in the samples. The 9-point hedonic scale of scoring is as follows:

9 - like extremely

8 - like moderately

7 - like slightly

6 - like

5 - neither like nor dislike

4 - dislike

3 - dislike slightly

2 - dislike moderately

1 - dislike extremely

Statistical Analysis

The results of the sensory evaluation were computed into means and subjected to analysis of variance based on all the sensory attributes fisher's Least Significant Difference (LSD) test was used to separate the means. All data were determined in triplicate and averaged.

RESULTS

Chemical Composition

Table 1 shows the proximate chemical composition of the formulated complementary foods and the control (Nutrient). The moisture content of the formulations were fairly high ranging from 6.40% (B) to 7.25% (A) and differ signifncantly (P<0.05) from the control D (4%).

The total ash content of formulations without the mineral premixe varied from 2.33% (A) to 2.61% (B). The ash content of the formulations fortified with mineral premixes were much higher, varying from 6.51% (A) to 6.74% (B), and not differing significant (P>0.05). The protein contents of the formulated foods ranged from 15.31% (B) to 19.69 (C). The values of two of the formulation, A (17.50%) and C (19.69%) were significantly higher (P>0.05) than the control, D (16%), while B (15.31%) was lower than the control. The fibre contents of the formulated foods ranged from 1.75% (B) to 2.85% (C) and all were significantly lower (P<0.05) than the control, D (5%). The fat content of the formulated foods was lowest in A (10.8%) and highest in B(12.13%) and were both significantly higher (P<0.05) than the control D (9.0%), The carbohydrate contents of the formulated bleds were not very high ranging from 52.92% (C) to 57.67% (B) they were all slightly lower than the control, D (63.7%). The food energy value ranged from 38887 kcal (A) to 401.09 kcal (B) while the control, D was 400 kcal/100 g.

Table 2: Chemical Composition of Formulated and Control Complementary Foods

Component	Sample			
	A	B	C	D
Moisture Total ash wilt	7.24 ± 0.14^b	6.3 ± 0.1^C	7.04 ± 0.1^b	39.00^a
Mineral per mix % Total ash (with mineral)	7.32 ± 0.10^b	2.60 ± 0.10^a	2.60 ± 0.4^b	2.49^a
Premix %	6.50 ± 0.12^a	6.74 ± 0.00^a	6.70 ± 0.1	-
Crude protein	17.50 ± 0.50^b	15.31 ± 0.5^d	19.69 ± 0.1^a	16.00^c
Crude fibre	2.20 ± 0.30^c	1.75 ± 0.26^d	2.85 ± 0.20^b	5.00^a
Ether extract	10.80 ± 0.20^c	12.13 ± 0.31^a	11.39 ± 0.3^b	9.00^d
Carbohydrate	55.41 ± 0.70^b	57.67 ± 0.60^c	52.91 ± 0.41^c	63.70^a
Calorific value kcal/100 g)	388.84 ± 0.35^b	401.09 ± 1.35^a	392.91 ± 0.78^b	400.00^a

Note: * Mean + standard deviation of the mean for three determinant of each of the samples on dry basis; [abcd] means with different superscripts in the same vow are significantly different (P< 0.05). A - Soybean flour (30%) + maize (54.8%); B - Soybean flour (40%) + plantain flour (44.8%); C - Soybean flour (35%) + maize flour (45%) + plantain flow (4.8%); D - Commercial nutrient.

Physical Characteristics

Table 3 shows the water and oil absorption capacities of the formulations and the control. The water absorption capacity of the diets ranged from 2.21 g/g (b) to 4.50 g/g/ (A). The developed formula (A0 which had the highest water absorption capacity did not differ significantly (P>0.05) from the control (D0 (3.98/g).

The bulk density, swelling index, gellation and boiling temperatures of the formulation and control are shown in Table 4. The bulk densities of the formulation were low ranging from 0.43 g/m (B) to 0.46 g/ml (A); and did not differ significantly (P<0.05) from the control, D (0.45 g/ml).

Table 3: Water and Fat Absorption Capacities of Formulated Complementary Foods

Sample	Water Absorption Capacity (g/g)	Fat Absorption Capacity (g/g)
A	4.50±0.6^{a}	2.26±0.02^{a}
B	2.21±0.006^{c}	2.64±0.02^{a}
C	2.65±0.02^{b}	2.42±0.01^{a}
D	3.98±0.01^{a}	2.55±0.03^{a}

Note: * Mean + standard deviation of the mean for duplicate determinations of each of the samples; ^{abc} means of different superscripts within the same column do not significantly differ (P<0.05). A - Soybean flour (30%) + maize flow (54.8%); B - Soybean flour (40%) + plantain flour (44.8%); C - Soybean flour (35%) + maize flour (45%) + plantain flour (4.8%); D - Control commercial nutrient.

Table 4: Bulk Density Swelling Index, Gelation and Boiling Points of Formulated Complementary Foods*

Sample	Bulk Density	Swelling Index	Gelation Point	Boiling Point (^{o}C)
A	0.46 ±0.02^{a}	2.90±0.007^{a}	76±0.7^{a}	90±2.0^{b}
B	0,43±0.007^{a}	3.49±007^{a}	74±0.7^{a}	82±0.7^{b}
C	0.44±0.01^{a}	3.30±0.006^{a}	73±1.3^{a}	92±1.5^{a}
D	0.45±0.03^{a}	2.95±0.003^{a}	7.5±1.5^{a}	9.0±1.3^{b}

Note: * Mean ± standard deviation of the mean for duplication determination of each of the samples; ** Means with different superscripts within the same column significantly differ (P<0.05). A - Soybean flour (30%) + maize flour (54.8%); B - Soybean flour (40%) plantain flour (44.8%); C - Soybean flour (35%) + maize flour (45%) + plantain flour (4.8%); D - Control: commercial nutrient.

The swelling index of both the formulations which ranged from 2.90 ml (A) to 3.49 ml (B) and the control (D) (2.95 ml) did not differ significantly (P<.0.05). The same was true of the gellation temperatures of the formulations, 73 °C (C) to 76 °C (A) and the control (75 °C). The boiling point of the formulations ranged from 82 °C (B) to 92 °C (C). while formula (C) differed significantly. However they differed significantly (P<0.05) from B.

Sensory Characteristics

The mean scores resulting from the sensory panelists scors of the colour mouthfeel, flavour and overall acceptability as shown in Table 5. The mean scores on colour of the formulated foods ranged from 5.15 (B) to 7.15 (A), and all differed slightly (P<0.05) from the control (D) 8.7. The scores for mouthfeel varied from 4.05 (B) t0 6.85 (C) for the formulated diets, and all were significantly lower (P<0.05) than the

Table 5: Water and Fat Absorption Capacities of Formulated Complementary Foods

Sample	Water Absorption Capacity (g/g)	Fat Absorption Capacity (g/g)
A	4.50±0.6^{a}	2.26±0.02^{a}
B	2.21±0.6^{a}	2.64±0.02^{a}
C	2.65±0.02^{b}	2.42±0.01^{a}
D	3.98±0.01^{a}	2.55±0.03^{a}

Note: * Mean ± standard deviation of the mean for duplicate determinations of each of the samples; ^{abc} means of different superscripts within the same column do not significantly differ (P<0.05). A - Soybean flour (30%) + maize flour 54.8%; B - Soybean flour (40%) + plantain flour 48.8%; C - Soybean flour (35%) + maize flour (45%) + plantain flour 4.8%; D - Control commercial nutrient.

Table 6: Mean Scores of Sensory Evaluation of Formulations and Control

Sample	Bulk Density	Swelling Index	Gelation Point	Boiling Point (^{o}C)
A	71.5^{b}	5.60^{c}	6.60^{b}	6.25^{b}
B	5.15^{c}	4.05^{d}	6.10^{b}	5.65^{c}
C	7.11^{b}	6.85^{b}	6.75^{b}	6.45^{b}
D	8.70^{a}	7.70^{a}	8.90^{a}	8.75^{a}

Note: * Mean scores with different superscripts within the same column differ significantly (P<0.05).

control (D) 7.70. The rest of the scores are shown in the Table 6.

DISCUSSION

Table 1 showed the proximate composition of the developed complementary foods and the control (commercial Nutrient). The disparity in the moisture content between the formulated complementary foods (high) and the control (much lower) may be attributed to differences in the efficiency of drying method employed in the formulations (over drying) and control (spray-drying). Moisture content is one of the outstanding qualities and widely used parameters in the processing and testing of foods. The moisture content of any foods is an index of its water activity (a_w) as reported by Frazier and Weslhoff (1978) and Desai and Salunkle *et al.* (1992). This implies that the formulated complementary blends may have a short shelf-life due to the high moisture content.

The protein contents of the formulations (not fortified with mineral premixes) compare favourably with many commercial complementary formulas, even though the were below (approximated, 50% shortfall) the requirements according to the protein Advisory Group which recommend at least 5% total ash. However, the formulation fortified with the mineral premixes (calcium, phosphorus and magnesium) increased their contents both quantitatively and qualitative making them better suited for children than the control and said proprietary formulas in term of bone calcification. The minerals, calcium phosphorus and magnesium are known to be very essential requirements for bone calcification blood clothing and energy release in children (Macrea *et al.*, 1993).

The protein content to the two formulation—A (17.50%) and C (19.69%) are all significantly high (P >0.05) than the control D (16.0%). This shows that the two formulation s are capable of meeting the dietary protein requirements of weanling age children fed on them (Hofrander and Underwood (1987). The results of the protein analysis of the formulation showed that the highest qualities in levels of combinations of the malted soybean, malted maize, and plantain flour were achieved.

The high level of fat in the different formulations coved be due to the supplementation effect of soybean which is an oil seed with high lipid level. Accordingly, to formula, B with the highest percentage of soybean (40%) had the highest fact content (12.13%) C with 35% soybean had 11.39% fat A with 33% soybean had 10.80% fat. Expectedly, the high levels of fat have contributed to the higher caloric value.

The carbohydrate content of the formulations could be due mainly to the percentages of maize and plantain flours in the various composites. However, the carbohydrate yield of these complementary formulation are complemented by their high fats contents making them ideal for babies since they required high every for rapid growth. The carbohydrate also contribute to the bulk of the energy of each of the formulations and still contain fibre. According to Lazsakan (1996) sprouting decreases the carbohydrate levels of flours due to increase in alpha-amylase activity resulting in the breakdown of complex carbohydrates to simpler and more absorbable sugars.

In Table 3, the appreciable quantity of total minerals in the complementary formulas could be described to the low level of phytate which chelate minerals and also the fortification with the premixes of calcium, phosphorus and magnesium. The percentage of some of the HCl-extractable minerals were faily high in some of the formulas white it was low in others. This might be due to the residual phytate and presence of some other antinutritional factors that reduce their bioavailability.

Tables 4 and 5 showed the functional properties of the complementary formulae. The functional properties determine the application and use of food for various food products. The formulations, B and C differed significantly (P<0.05) from each other in water absorption capacity Narayana and Narasinga (1982) attributed increase in water absorption capacity of heat-pressed flours to thermal dissociation of the proteins, gelatinization of carbohydrates in the flour and swelling of the fibre.

The vary slight differences in the bulk density of the complementary formulations may be due to the proportion of the component flours in the blends. Bulk density is found to be a function of flour wet-ability (Sasulki, 1962). It is a reflection of the load the sample can carry if allowed to rest directly on one another.

The slight differences in the bulk density of the complementary formulations may be due to the proportion of the component flours in the blends. Bulk density is found to be a function of flour wet-ability (Sasulki, 1982). It is a reflection of the load the sample can carry if allowed to rest directly on one another. The lower the bulk density value, the higher the amount of flour particles that can stay together thus increasing the energy content that could be drivable from such formulas (Onimawo and Egbekin, 1998).

The swelling index of both the formulations and the control did not differ significantly (P>0.05). Swelling power is an indication of the water absorption index of the gramulas during heating (June *et al.*, 1991) stated that as the temperature of aqueous suspension of starch is raised above the gelatinization range, hydrogen bonds continue to be disrupted water molecules become attached to liberated hydroxyl groups and the granules continue to swell. Swelling index and water absorption capacity are important properties which ultimately determine cooking times.

Variation in gelling properties of different flour may be due to variations in the ratio of different constituents such as carbohydrates, lipids and proteins that make up the flours (Abbey and Ibeh, 1998).

Scores on mouth feel showed significant difference between all the formulations and the control. The control, D had the highest value of 7.70 while A and C which followed the control in the order of preference were liked; B was not liked there was no significant difference a (P>0.05) with respect to flour of the formulations and all were acceptable. However, the control was the most acceptable and different significantly (P<0.05) from the formulations.

The score showed that all the formulations were acceptable overall. There was no significant difference (P>0.05) in the overall acceptability of the formulations, C and A. However, they differed significantly from B of lower score.

CONCLUSION

In conclusion, the study which used local produced product, can be used to substitute the more expensive proprietary formula products. The researcher believe that complementary foods formulated from locally available food commodities, have great potential in this aspect potential in this aspect. The results from this study suggest that proper reformulation and fortification of these local diets can provide nutritious foods that are suitable for weaning of infants in Nigeria and other developing countries.

REFERENCES

- AOAC (2000), *Official Methods of Analysis*, 14th Edition, Association of Official Analytical Chemists, Arlinton, VA Us A., pp. 806-842.
- Abbey B W and Ibeh G O (1998), “Functional Properties of Raw and Hear Processed Cowpea Flour”, *Journal of Food Science*, Vol. 53, pp. 1775-1991.
- Anigo K M, Ameh D A, Ibrahim S and Danbanchi S S (2010), “Nutrient Composition of Commonly Used Complementary Foods in North West Nigeria”, *African Journal of Food Science*, Vol. 4, No. 3, pp. 65-72.
- Bogert J I, Briggs G M and Galloway D H (1973), *Nutrient and Physical Fitness*, 9th Edition, p. 522, WB Sanders Company, London.
- Calvi L G and Mwalongo C J (1995), “Characterization of Wattle Jonnin Base Adhesives”, *Tanzaria Journal of Foods Science*, Vol. 49, No. 2, pp. 289-295.
- Fashakin J B and Ogunsola F (1982), “The Utilization of Local Foods in the Formulation of Warning Foods”, *J. Tripical Paediatrics*, Vol. 28, pp. 93-46.
- Frazier W C and Wesihoff D C (1978), *Food Microbiology*, 3rd Edition, pp. 105-106, McGraw-Hill Inc., New York, London.
- Hofvander and Underwood (1987), “Processed Supplementary Foods for Older Infants and Young Children, with Special Reference to Developing Countries”, *Food Nutr. Bull*, Vol. 9, No. 1, pp. 1-7.
- Igyor M A, Yosufu P A and Senger I A (2011), “Functional and Sensory Properities of Fermented Fura Powder Supplemented with Soy”, *Nigerian ood Journal*, Vol. 29, pp. 113-121.
- Ihekoronye A and Patrick O N (1985), *Integrated Food Services and Technology for the Tropics*, 1st Edition, Department of Foods Science and Technology, University of Nigeria, Nsukka, Macmillan Publishers.
- Joan L, Andy B and Kelly B (2013), “Effect of Poverty on Childhood Brain Development: The Mediating Effect of Care Giving and Stressful Life Events”, *JAMA Pediatric*, Vol. 167, No. 12, pp. 1135-1142.
- June E R, Masako A and Blanshed J M (1991), “The Physiochemical Properties of Cassava Starch”, *Tropical Science*, Vol. 14, No. 4, pp. 323-333.
- Laskan O O (1996), “Effect of Germination on Alpha-Amylase Activities and Theological Properties of Sorghum and Ache Grains”, *Journal of Federal Science and Technology*, Vol. 33, pp. 3329-3333.

- Macraw R, Robinson R K and Sadler M J (1993), "Encyclopedia of Food Science and Food Technology and Nutrition", Vol. 4, pp. 2502-2515, Academic Press, Harcourt Brace Jovanovieh, Publisher London.
- Martorel R and Habiclif J P (1994), "Growth in Early Childhood in Developing Countries", in *Human Growth: A Comprehensive Treatise Each,* Frank Falkkner and J M Tanner (Eds.), Vol. 1.3, pp. 241-262, Plannum Press, New Yok.
- Mavevo L M, Payuma E M, Librando E C, Lainez W N, Gopz M D and Homma S (1988), "Technology of Weaning Food Formulations Prepared from Germinated Cereals and Legumes", *Journal of Food Science,* Vol. 53, No. 5, pp. 1391-1395.
- Narayana K and Narasinga R (1982), "Functional Properties of Raw and Heat-Processed Winged Bean Flour", *Journal of Fd. Science,* Vol. 47, pp. 1534-1538.
- Nzerem C E (2002), "Development of Wearning Food from Cereal and Legume Sources", A Thesis for ht Award of B.Tech Degree in Food Science and Technology of Fed, University of Technology Owerri, Imo State (Unpublished).
- Ogazi P O (1996), "Plantain: Production: Production, Processing and Utilization", p. 117, Paman and Associates Ltd., PO Box 282, Okigwe, Imo State, Nigeria.
- Ogazi P O and Adeyemis S A O (1985), "The Place of Plantain in Composite Flour Programme", in Semiar on the Place of Plantain in Composite.
- Onimawo A and Egbekun M K (1998), "Comprehensive Food Science and Nutrition", pp. 193-220, Arnbik Publishers, Benin-City Nigeria.
- Onuka G I (2005), "Food Analysis and Instrumentation– Theory and Practice", Vol. 64, No. 8, pp. 133-136, Naphithali Prints, A division of H G Support Nig Ltd., 6 Adenyi Joes Close, Surulere, Lagos, Nigeria.
- Osagie A U (1998), "Nutritional Quality of Plant Foods A U Osagie and O U Eka (Eds.), *Post Harvest Research Unit,* Department of Biochemistry, University of Benin, Benin City, Nigeria.
- Salunkhe D K, Chavan J C, Adsue R W and Kadan S S (1992), "World Oilseeds Chemistry Technology and Utilization: An AVi", Book Published by an Nostrand Reinhold, New York.
- Saskia G V and Annoeke W V (1997), *Small Scale Production of Warming Foods*, 1st Edition, Agro Book Series No. 22, Commissioned by Caritas Nederland.
- Sosulki F W (1982), "The Centriguge Methods for Determining Flour Absorptivity in Hard Red Spring Wheat", *Cereal Chemistry,* Vol. 39, p. 44.
- Talbot J (1989), "Infant Feeling", The First Year London Profile Production.
- UNICEF (1998), "The State of the World's Children Focus on Nutrition", pp. 9 and 10.

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