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Nutrient Analysis of Indigenous Fortified Baby Weaning Foods from Nigerian Cereals

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Abstract

Complementary food blends based on some cereals and legumes that are sold in Plateau State, Nigeria were formulated for baby weaning foods and were analyzed. The cereals used included *Zea mays* (white corn), Pennisetum typhoides (millet) and Digitaria exilis (acha). The legumes included *Voandzeia subterranean* (Bambara nuts), *Arachis hypogaea* (groundnuts) and *Glycine max* (soyabeans). The different blends were analyzed for their proximate nutrients and then the amounts of nutrients available in a meal (50g) of each of the blends. Results obtained showed that the different blends contained higher protein (18-20.4g) and energy (525-540kcal) than the control (16g, 400kcal) respectively. The different blends per meal (50g) did not meet the Recommended daily allowance (RDA), however, administering it three times per day will help meet the RDA's. All the amino acids that were found in the control were also detected in the different blends. The complementary blends compared well with the standard formula and can be suggested for use as home made, less expensive infant foods during the complementary feeding period as breast feeding continues.

Key Words: Baby Weaning, *Zea mays*, *Voandzeia subterranean*, *Arachis hypogaea, Glycine max*

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Introduction

Breast milk is a satisfactory food for the first few months of life, but after about 4 months, some semi-solid foods such as infant cereal products may be introduced into the infant diet (Gaman and Sherrington, 1983). The period of weaning is described as the period of transition from an exclusive milk diet to the complete range of food eaten by adults (Gaman and Sherrington, 1983).

Malnutrition in Nigeria is as a result of limited sources of protein, vitamins, and minerals of high biological values, particularly those of animal origin. The situation has been aggravated by poverty and high population growth rate. One of the short term measures for overcoming the inadequacy of a balanced diet, for the vast majority of the poor masses of the growing population of Nigerians is the production of weaning foods, with the desirable nutritive qualities (Banigo *et al.*,1974).

The adequacy of a complementary diet to meet the nutrient requirements depends on the type of foodstuff used in the formulation. Studies have shown that traditional home- based complementary foods used in most developing countries are poor in nutrients (Prentice and Paul, 2000; Dewey and Brown, 2003).

Cereals are members of the grass family, Poaceae that are grown for their edible starchy seeds (Kochhar,1986) and can be eaten for breakfast or are used for making flours for pastas (Oxford Dictionary of Current English,1996). In Nigeria, the food-based dietary guideline prepared for the country has recommended the use of available foodstuff in various communities and home levels to prepare diets for infants and children. Many developing countries use supplementary foods made from cereals and

vegetable protein source such as legumes and oil seeds. The latter are high in lysine an essential limiting amino acid in most cereals. Jos in Plateau State of Nigeria is known to cultivate abundant cereals and legumes which have been found to have nutrient potentials that can complement one another if properly combined and blended (Badamosi *et al*. 1995).

The groundnut is known to contain about 27% protein and groundnut cake, the residue produced after extracting groundnut oil contains 51% protein. The protein of Soyabeans and Bambara nuts are also of high biological value with a high amount of lysine and other essential amino acids.

The problem involved in using cereals and legumes as weaning foods includes the bulky nature of the porridge, which discourages many children from eating it. Thus attempts have been made to modify the starch structure to reduce its bulky nature. This has been achieved through fermentation and malting of cereals and legumes (Banigo *et. al*, 1974).

A dietary survey carried out in two villages, Barkin-ladi and Bokkos in Plateau State of Nigeria showed that maize and acha (*Digitaria exilis Stapf*) provided about 80% and 35% respectively of their total energy intake particularly among children of 4 to 12 months of age. Similar preparations are extensively consumed in other parts of Africa notably, Kenya, Tanzania, Malawi and Zimbabwe (WHO, 1998).

As a result of the high price of the industrially processed tin foods which cannot be afforded by the middle and low-income class citizens, indigenous weaning foods with high nutrients have been formulated. Much work has not been done on combination of different indigenous cereals with other local raw materials in order to improve their taste and nutritive values. This work was, therefore, designed to formulate different blends of weaning foods based on three cereals and three legumes found in abundance in Jos Plateau State of Nigeria. The nutritive value of the various blends were then evaluated and compared with a standard formula.

Materials and Methods

Preparation of complementary blends: The method used in the preparation and mixing of the complementary blends was a modified method of Solomon and Ubom (2007). The cereals *Zea mays L.* (white corn), *Pennisetum typhoides (*Burm.*f.)* Stapf *and* Hubbard (millet), were washed separately with sterile distilled water and were fermented for 48 hours, and then sun dried for 72hours. The *Digitaria exilis* (acha) was washed with sterile distilled water and air dried for 12 hours. The legumes, *Glycine max (L.)* Merr. (soyabeans) and *Voandzeia subterranean* Thouars (Bambara nuts) were precooked for 2 hours, dehulled and were sun dried for 72 hours. *Arachis hypogaea* L. (Groundnut) was picked, roasted slightly at 70^0C for 30 mins in hot air oven. *Ziziphus spina christi* (Magariya) was employed as sweetner. It was picked, washed in sterile distilled water and dried for 72 hours. *Daucus carota L.*(Carrot) and *Musa sapientum L.* (Banana) were washed, peeled, grated and air dried for 72 hours. *Macro branchium* (crayfish) and table salt were added to further enrich the blends. The processed foodstuffs were mixed on protein basis as follows:

Blend 1: white corn: bambara nut: carrot: magariya: crayfish: salt (CBC) 50:20:10:10:10% w/w.

Blend 2: millet: groundnut: carrot: magariya: crayfish: salt (MGC) 50:20:10:10:10% w/w.

Blend 3: Acha: soyabean: carrot: magariya: crayfish: salt (ASC) 50:20:10:10:10% w/w.

Blend 4: Nestle nutrend (control). 500mg salt was added per 100g blend.

Mixtures were ground in a laboratory grinder into fine homogenous powder.

Analysis of different blends for nutritive values: The nutritive values of the different blends of the complementary foods were analyzed using standard methods (AOAC, 1990). This included the analysis of energy (kcal), crude protein, crude fat, Ash, moisture, mineral. One way analysis of variance (ANOVA) was used to establish any significant difference between the different blends and the control. Also the amount of nutrients present in 50g (per meal) estimate of the daily intake of local weaning foods by a six –twelve months old infant of the blend were calculated and compared with recommended daily allowance to see if the local blends could meet the requirement.

Result

The result of the proximate nutrient analysis of the different blends and the control showed that the nutrients in blend1 and blend 2 were significantly higher

($p<0.05$) than in the control. Results indicate that except for ash and moisture, there were significant differences between energy, crude protein, crude fat and minerals values of the different blends and that of control. The results are presented in Table 1. It was also observed that there were significant differences between the energies of blends 1 and 2 to that of blend 3.

The result of the analysis of 50g (per meal) of the different blends for daily intake by a six to twelve months infant also showed that there were significant differences($p<0.05$) between the nutrients in the three blends and that of the control. The values of the energy (265g-271g), crude protein (10.3g-12.5g), crude fat (2.2g-4.4g), ash (1.7g-1.9gg), moisture (3.2g) and minerals (0.9g-1.3g) were significantly different ($p<0.05$)from that of the control (blend 4). It was also observed that there were significant differences between nutrients in the blends and those of the recommended daily allowance (RDA). The result as presented in Table 2 showed that the amount of energy that can be provided by 50g (220g-271g) of the different blends fell far below that of recommended daily allowance and that the amount of protein that can be provided by 50g of the blends (10.3-12.5g) was close to the amount for required daily allowance. Also fat in 50g of the blends (2.2g-4.4g) as well as that of control (5.4g) fell far below that of the RDA (10g-25g).Table 3 presented the amino acid composition of the different blends and that of the control. All the amino acids that were present in the control were also found to be present in the different blends.

Table 1: Proximate nutrient analysis of the different blends.

Nutrient (%dm)	Blend 1*	Blend 2	Blend 3	Blend 4 (Control)
Energy	540 ±1.73[a]	543 ± 3.00[a]	525 ± 2.52	400±1.73
Crude protein	20.2±2.00	20.4±1.00	18±2.00[a]	16±2.00[a]
Crude fat	6.2±1.74[a]	4.2±0.36[a]	3.5±0.46	9±1.32
Ash	2.4±0.30[a]	2.6±0.90	2.0±0.46[a]	2.3±0.35[a]
Moisture	4.2±0.44[a]	4.2±0.10[a]	4.3±0.82[a]	4.0±0.17[a]
Mineral	3.3±0.10[a]	2.3 ±0.10[a]	1.2±0.17	2.3±0.61[a]

Means of three readings ± SD. Means not followed by the same letter on horizontal row are significantly different ($p<0.05$) from each other.

*Blend1=White Corn: Bambara nuts: Carrot: Magariya: Crayfish: Salt (CBC)

Blend2=Millet: Groundnut: Carrot: Magariya: Crayfish: Salt (MGC)

Blend 3= Acha: Soyabean: Carrot: Magariya: Crayfish: Salt (ASC)

Blend 4= Nestle Nutriend (Control)

Table 2: Proximate nutrient analysis of 50 grams per meal of different blends

Nutrient (%dm)	Blend 1*	Blend 2	Blend 3	Blend 4 (Control)	RDA* for months 8-12
Energy	270 ± 5.00	271 ± 4.36	265 ± 2.65	220±1.00	650[a]
Crude protein	12.2 ± 0.17	12.5±1.00	10.3±0.75	8.2±1.05	13-14[a]
Crude fat	4.4±0.56	3.03± 0.11	2.2±0.10	5.4±0.10	10-25[a]
Ash	1.8±0.10	1.9± 0.10	1.7±0.10	1.5±0.10	
Moisture	3.2[a]±0.10	3.2±0.26	3.2±0.2	2.5±0.10	
Mineral	1.3 ±0.10	1.3±0.20	0.9±0.10	1.3±0.10	

Means ± SD. Values not followed by the same letter on horizontal row are significantly different ($p<0.05$) from the RDA.

*RDA= Recommended Daily Allowance.

*Blend1=White Corn: Bambara nuts: Carrot: Magariya: Crayfish: Salt(CBC)

Blend2= Millet: Groundnut: Carrot: Magariya: Crayfish: Salt (MGC)

Blend 3= Acha: Soyabean: Carrot: Magariya: Crayfish: Salt (ASC)

Blend 4= Nestle Nutriend (Control)

Table 3: Amino Acid Content of the Different Blends

Aminoacid (g/100g protein)	Blend1 (CBC)*	Blend2 (MGC)	Blend3 (ASC)	Blend4 (control)
Alanine	4.1	7.4[a]	3.2	3.5
Arginine	1.9	5.1[a]	4.0	4.2
Aspartic acid	5.3	7.5[a]	5.9	6.2
Glutamic acid	19.4	20.2	18.4	20.1
Glycine	2.4	2.9	3.2	3.0
Histidine	2.0	2.4	2.1	3.2
Isoleucine	5.2	4.4	5.1	5.8
Leucine	4.0	9.1[a]	4.0	5.7
Lysine	5.1	3.8	3.7	4.2
Phenylalanine	3.3	4.9	3.4	3.7
Proline	2.1	6.3[a]	2.5	2.0
Tyrosine	2.6	3.3	5.3[a]	3.7
Cystine	1.0	2.3	1.3	1.9
Methionine	2.2	2.5	2.2	2.4
Serine	3.2	2.2	2.9	2.7
Threonine	1.5	4.3	2.1	1.9
Tryptophan	0.4	1.2	1.1	1.4
Valine	3.8	5.5	3.5	4.2

Values in the same row that do not share the same superscript are not significantly different ($p<0.05$) from the control

*Blend1= White Corn: Bambara nuts: Carrot: Magariya: Crayfish: Salt(CBC)

Blend2= Millet: Groundnut: Carrot: Magariya: Crayfish: Salt (MGC)

Blend 3= Acha: Soyabean: Carrot: Magariya: Crayfish: Salt (ASC)

Blend 4= Nestle Nutriend (Control)

Discussion

The findings of this work have shown that most available household cereals can be used to formulate weaning foods for babies which can substitute expensive and less available formulae and still provide adequate nutritional requirements to the infant. The study has shown that the different blends of the complementary foods contained a cereal base and a legume. The higher energy content of the different complementary blends could be as a result of the cereal base and the legumes, which must have contributed positively as cereals and legumes are known to have carbohydrate in their nutritive content. It is also known that legumes are fairly rich in amino acids and fats, and must have contributed immensely to the number of amino acids detected in the blends. The protein of bambara nuts used in blend 1 is of high biological value and has a high amount of lysine and a fairly well balanced amino acid pattern. Groundnut and soyabean that were used in blends 2 and 3 respectively have been reported to contain large amounts of nutritionally essential amino acids (Oyenuga, 1978).

The *Ziziphus spina christi* (magariya) and *Macro branchium* (crayfish) additives must have also accounted for the higher protein content of the different blends. From the study, both the control and the different blends of the diet fell below the recommended daily allowances (RDA's) for energy, protein and crude fat in one meal of 50g but when the meal is increased to 2-3 times daily then the RDAs will be attained. However, the protein content of the different blends were closer to the RDA than that of the control. Similar observations have been reported by Badamosi *et al.* (1995).

The presence of all the amino acids was detected in the three different blends. This could be as a result of the complementary roles of the cereals, legumes, crayfish and the magariya. Diets of this sort have been reported to be high in amino acids (FAO/WHO 1998). Soya bean is an excellent protein supplement for enriching cereal diet and has earned a special place in the nutritional programme (Kochhar,1986). Groundnut seeds have a very high calorific value (549cal/100g-nearly five times that of a beef) and are easily digestible. The biological value of

groundnuts is among the highest of the vegetable proteins (Kochhar,1986).

In conclusion, the study has clearly demonstrated that the legume based blends compared favourably with the commercial formula (control) used in this study in terms of the nutritional and amino acid composition. Mothers can be advised to prepare these kinds of complementary foods hygienically for their weaning babies. This will go a long way in helping them out of the more expensive commercial formulae as well as improving their infants feeding . This could easily be achieved since all the food materials can be obtained locally and cheaply too.

References

A.O.A.C. (1990). *Official methods of analysis* 15th Ed. Association of Official Analytical Chemists. Washington DC.p348-371

Badamosi, E.J. Ibrahim, L.M. and Temple, U.J. (1995) Nutritional Evaluation of a Locally Formulated weaning food, Juth-pap. *West African Journal of Biological Sciences*. 3:85-95.

Banigo, E.I.O., Deman, J.M. and Duitschaever, C.L. (1974). Utilization of high Lysine corn for manufacture of Ogi using a new improved processing system. *Cereal Chemistry*. 51:549-552.

Dewey, K.G. and Brown, K.H. (2003). Update on technical issues concerning complimentary feeding of young children in development countries and implication for intervention programs. *Food Nutrition Bulletin*.24:5-28

FAO/WHO (1998). Preparation and use of food –based dietary guidelines. A report of joint FAO/WHO consultation. WHO technical report series 880 Geneva.

Gaman, P.M. and Sherrington, K.B. (1983). *The science of food*. *An introduction to food science nutrition and microbiology* (2nd Ed.) Publ. Pergamon, England.166pp.

Kochhar, S.L. (1986).*Tropical Crops: Textbook of economic botany.* Macmillan Publishers Ltd., London, Basingstoke, Delhi. 467pp.

Oyenuga, V.A. (1978). *Nigeria's food and feeding stuff. Their_chemistry and nutritive value*. The Caxton Press (West Africa) limited Ibadan 99pp.

Prentice, A.M. and Paul, A.A. (2000). Fat and energy needs of children in developing countries. *American Journal of clinical nutrition*. 74:12535-12655.

Solomon, M. and Ubom, G.A. (2007). Proximate nutrient and amino acid composition of three complementary foods based on cereals and legumes in Jos, Plateau State. *Nigeria Journal of Nutrition.* 28 (1): 177-183.

The oxford dictionary of current English (1996) Ed: Della Thompson. Publ: Oxford University Press. 1080pp.

WHO (1998). Complementary feeding of young children in developing countries: a review of current scientific knowledge.WHO/NUT/98/1998 WorldHealth Organization Geneva