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EVALUATION OF THE NUTRITIONAL VALUE OF A COMPOSITE MEAL PREPARED FROM PEARL MILLET (*PENNISETUM TYPHOIDEUM*) AND COWPEA (*VIGNA UNGUICULATA*)

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ABSTRACT
Cereal/legume weaning food blends prepared in ratios of 70:30 and 60:40 from fermented pearl millet/roasted cowpea were evaluated for their nutritional values. The pearl millet used are SOSAT C – 88, an improved variety and a local (unimproved) variety while cowpea used is the Borno red. Standard methods were used for the analysis. The protein contents of the weaning food blends met the Recommended Dietary Allowance (RDA) for infants (0 – 1 year), though the fat contents were low. It is expected that the low moisture contents exhibited by all the weaning food blends might give good storage stability. Mineral element levels were comparable to commercial weaning foods Nutrend® and Frisocrem®, except for calcium and zinc. All the weaning food blends were satisfactory in meeting the FAO/WHO essential amino acid reference pattern for infants 0 – 1 year. Even though, the 70:30 ratio has been used in most literatures, the 60:40 ratios used in this study is superior to the 70:30 ratio in terms of nutritional value.

Keywords: Nutritional, Composite meal, Millet, Cowpea, Weaning

INTRODUCTION

Protein energy malnutrition is a major problem in many developing countries which affects infants during transitional phase of weaning. It actually occurs as a result of ignorance and exorbitant cost of animal source of protein thereby making it out of reach of the common man (Patrick, 1998). Exclusive breast feeding is usually adequate up to three to four months in most African countries, but it may become necessary to introduce other soft easily swallowed foods along side breast milk as from four months, because breast milk alone cannot meet the infant's nutritional requirement (Oniofiok and Nnanyelogo, 1992). In Nigeria, traditional weaning foods consist of monocereal grains prepared from either millet, maize or sorghum referred to as "Ogi" or "Kamu", which is of poor nutritional value (Hellstrom *et al.,* 1981). Supplementation of our locally available cereals with legumes, which are good sources of protein rich foods, will give rise to a weaning food which is cheaper, easily digestible and acceptable to children (Marero *et al.,* 1988). The objectives of the work reported here are firstly to prepare a high protein weaning food from pearl millet and cowpea that will be adequate to meet the nutritional needs of infants during weaning period and to evaluate the proximate composition and the mineral element level of the weaning food. Secondly, to determine the amino acid content of the weaning food blend.

MATERIALS AND METHODS

Source of Pearl Millet and Cowpea

The improved variety of pearl millet SOSAT C-88 was obtained from the Lake Chad Research Institute, Maiduguri, while the local (unimproved) variety of pearl millet and cowpea seed (Borno Red) were purchased from the Maiduguri Monday Market.

Preparation of the 'Kamu'

The 'Kamu' (ogi) was prepared by the method described by Akingbala *et al.* (1981). One hundred grams (100g) of the cleaned pearl millet (raw grain) was cleaned and steeped in 200cm^3 of distilled water (1:2 ratios) for 72 hours. At the end of the 72 hours, the top water decanted and 200cm^3 of distilled water was added and milled with a warring blender for 4min at rheostat setting of 120. The slurry obtained was sieved through a nylon cloth to separate the bran after adding 6000cm^3 of distilled water. The 'Kamu' was then allowed to stand for 24 hours for the starchy part to settle, after which the water the water was decanted and the Kamu was sun dried to a constant weight.

Preparation of the Cowpea

One hundred grams (100g) of the cowpea was cleaned of dirt and soaked in distilled water for 20 minutes. The cowpea was then dehulled using a pestle and mortar. It was then washed to separate the husk, after which it was dried to a constant weight. The cowpea was roasted and then ground into a fine powder.

Preparation of the Weaning Food Blend

The blending of the weaning meal was done in two ratios 70:30 and 60:40 as described by Akpapunam (1984) i.e 70 parts of fermented pearl millet ('Kamu') and 30 parts of roasted cowpea, and 60 parts of fermented pearl millet ('Kamu') and 40 parts of roasted cowpea.

The proximate composition of the two weaning food blends was determined by AOAC (2000) methods. Atomic Absorption Spectrophotometer (AAS) AA 6800 series Shimazo corp. was used for the determination of mineral elements. The amino acid profile was determined using methods described by Sparkman *et al.* (1958).

Determination of Amino acid Profile (Sparkman *et al.*, (1958)

The amino acid profile in the known sample was determined using methods described by Sparkman *et al.* (1958). The known sample was dried to constant weight, defatted, hydrolyzed, evaporated in a rotary evaporator and then loaded into the Technicon sequential Multi sample Amino Acid Analyzer (TSM).

Defatting of Sample

A known weight of the dried sample was weighed into extraction thimble and the fat was extracted with chloroform/methanol (2:1 mixture) using soxhlet extraction apparatus as described by AOAC (1980). The traction lasted for 15 hours.

Hydrolysis of the Sample

A known weight of the defatted sample was weighed into glass ampoule. 7ml of 6NHCl was added and passing nitrogen into the ampoule expelled oxygen. This is to avoid possible oxidation of some amino acids (Methionione and Cysteine) during hydrolysis. The glass ampoule was the sealed with Bunsen burner flame and put in an oven preset at $105^0C +5^0C$ for 22 hours. The ampoule was allowed to cool before broken, opened at the tip and the content was filtered to remove the humins. The filtrate was then evaporated to dryness at 40^0C under vacuum in a rotary evaporator. The residue was dissolved with 5ml of acetate buffer (pH 2.0) and stored in plastic specimen bottles which were kept in the freezer.

Loading of the Hydrolysate into the TSM Analyzer

The amount loaded was between 5 to 10 microliters. This was dispensed into the cartridge of the analyzer. The TSM analyzer is designed to separate and analyzer free acidic, neutral and basic amino acids of the hydrolysate. Each analysis lasted for 76 minutes.

Statistical Analysis

All the analysis was done in triplicate and the data obtained were subjected to One way Analysis of Variance (ANOVA) and SPSS for windows (Vetrsiion 9.0) was used to separate the means.

RESULTS

Table 1 shows the proximate composition of the weaning food blends compared with commercials weaning foods. The moisture, fat ash and crude fiber contents of the weaning food blends prepared from the unimproved millet variety/cowpea showed higher values (P>0.05) than that of the improve variety/cowpea. The 60:40 ratios of the weaning food blends exhibited higher values than the 70:40 ratios.

The 60:40 ratio of the weaning food blends prepared from the improved millet variety/cowpea showed a higher protein contents than the 70:30 ratio. The weaning food blends prepared from the unimproved variety/cowpea also showed the same trend. However, the 60:40 ratios of the weaning food blends prepared from the improved millet variety/cowpeas and the unimproved variety/cowpea did not show any statistical difference (P>0.05). Likewise, the 70:30 ratios of the weaning food blends did not show any significant difference.

The values of the protein contents of the weaning food blends were low when compared with commercial weaning foods Nutrend® and Frisocrem®. However, the protein contents of the weaning food blends compared favorably with the Recommended Dietary Allowance (RDA) for infants (0-1 year) for protein as presented in Table 2.

Table 1: Proximate Composition of the Weaning food Blend Compared with Commercial weaning Foods.

	SOSAT C-88millet/Cowpea		Unimproved variety millet/Cowpea		Commercial cereals	
	70:30*	60:40**	70:30*	60:40**	Nutrend[1] (maize & Soya bean/g100g	Frisocrem[2] (Rice)g/100g
Moisture (%)	3.37±1.23[a]	3.47±1.26[a]	4.50±1.35[b]	4.70±1.22[b]	4.0	2.0
Protein (%)	13.26±1.21[a]	14.58±1.36[b]	13.87±1.19[a]	14.96±1.26[b+]	16.0	16.3
Fat (%)	2.60±1.21[a]	4.40±1.36[b]	3.60±1.26[c]	4.60±1.31[b]	9.0	13.2
Ash (%)	1.37±1.35[a]	2.30±1.27[b]	1.70±1.27[b]	2.50±1.33[b]	ND	ND
Crude fibre (%)	2.90±1.53[a]	4.60±1.21[b]	4.10±1.66[b]	5.60±1.31[c]	5.0	ND
Carbohydrate %	75.50±2.55[a]	70.65±1.13[b]	72.23±2.22[c]	67.64±3.11[d]	63.7	65.1
Energy (Kcal/100g)	382.44±2.22[a]	380.52±1.31[b]	376.80±1.31[c]	371.80±2.27[d]	400	445

Value are recorded as mean ± SD of three determinations
Values in the same row with different superscript are significantly different (P<0.05)
* 70 parts of millet to 30 parts of cowpea
** 60 parts of millet to 40 parts of cowpea
[1]Nestle Foods Nigeria
[2]Friesland Coberco Dairy Foods Holland
ND – Not Determined

The carbohydrate and energy values of the weaning food blends prepared from the improved variety/cowpeas are higher than the unimproved variety with the 70:30 ratio of the weaning food blends higher values than the 60:40 ratios. The carbohydrate and energy values of all the weaning food compared favorably with commercial weaning foods Nutrend® and Frisocrem®

Table 2: Recommended Dietary Allowance (RDA) for Infants (0-1 year)

Protein (g)	14
Calcium (mg)	600
Magnesium (mg)	60
Phosphorous (mg)	500
Iron (mg)	10
Zinc (mg)	5

Source: Food and Nutrition board, National Academy of Sciences. Recommended Dietary Allowance Revised, 1989.

Table 3 presents the mineral element composition of the weaning food blends compared with commercial weaning foods. The levels of phosphorous, iron and magnesium compared favorably with commercial weaning foods Nutrend® and Frisocrem® while the levels of calcium, potassium, sodium and zinc were low. The weaning food blends prepared from the unimproved millet variety showed higher values in the level of phosphorous, magnesium and calcium than the weaning food prepared from improved millet variety. The levels o iron and potassium in the weaning food from the two varieties of pearl millets/cowpea did not show any statistical variation.

Table 3: Mineral Element Composition of the Weaning Food Blends Compared with Commercial Weaning Foods

	SOSATC-88 millet/Cowpea		Unimproved variety millet/Cowpea		Commercial weaning foods	
Mineral elements (ppm)	**70:30***	**60:40****	**70:30***	**60:40****	**Nutrend(R) (maize & Soya bean/g100g**	**Frisocrem(R) Rice (based)g/100g**
Phosphorous	351.01±2.02[a]	367.07±2.37[b]	373.02±2.27[c]	379.01±2.81[d]	260	425
Iron	7.035±0.51[a]	8.05±0.42[b]	7.04±0.11[c]	8.04±0.35[b]	10	9
Calcium	130.17±1.35[a]	147.85±1.12[b]	150.93±1.27[c]	152.27±1.17[d]	52-	52
Potassium	103.17±3.22[a]	113.38±3.56[b]	120.39±2.51[c]	129.55±2.21[d]	390	500
Sodium	220.01±3.22[a]	290±2.11[b]	280±1.97[b]	300.10±3.33[d]	570	665
Zinc	85.03±1.27[a]	86±1.35[a]	86.07±1.41[a]	90.05±1.21[b]	220	180
	Nil	Nil	Nil	Nil	7.0	1.6

Value are recorded as mean ± SD of three determinations
Values in the same row with different superscript are significantly different (P<0.05)
* 70 parts of millet to 30 parts of cowpea
** 60 parts of millet to 40 parts of cowpea

The amino acid composition of the weaning food blends is presented in Table 4. From the results obtained, the level of lysine (one of the limiting amino acid in cereal grains) has improved when compared with the FAO/WHO value (5.8g/100g Protein). The values for the weaning food blends ranged between 4.95-5.30g/100g. The weaning food blends had higher of Histidine and Isoleucine as compared to the FAO/WHO values. The levels of methionine and cysteine in the weaning food blends were also comparable to the FAO/WHO values.

Table 4: Amino acid Composition of the Weaning Food Blends

Amino acid (g/100g protein	SOSAT C-88 millet/Cowpea		Unimproved millet variety/Cowpea		FAO/WHO
Lysine*	4.99	5.30	4.95	5.26	5.80
Histidine *	2.60	3.00	2.72	3.03	1.90
Arginine	4.11	5.05	4.17	5.13	-
Aspartic acid	7.48	8.92	8.65	9.09	-
Threonine *	3.13	3.25	2.97	3.02	3.40
Serine	2.24	3.09	2.30	3.10	-
Glutamic acid	16.11	16.70	15.92	16.01	-
Proline	4.11	4.37	3.23	3.72	-
Glycine	3.03	3.15	3.01	3.12	-
Alanine	5.02	5.61	2.98	3.50	-
Cysteine	1.97	2.37	1.84	2.11	2.50
Valine *	4.21	4.52	3.01	3.20	3.50
Methionine *	2.19	2.30	2.15	2.20	2.50
Isoleucine *	3.40	3.60	2.80	3.10	2.80
Leucine *	8.25	8.70	8.11	8.65	6.60
Tyrosine	3.04	3.14	3.09	3.18	6.30
Phenylanine *	4.55	4.61	4.37	4.50	6.30

FAO/WHO (1985)
* Essential Amino Acid

The level of tyrosine and phenylalanine were low when compared to the FAO/WHO values of infants. Analysis of the amino acid composition of the weaning food blends show that there were no significant differences in the amino acid content of the 70:30 and 60:40 ratios.

DISCUSSION

Proximate Composition

A considerable loss of protein was observed during production of 'Kamu' from the two pearl millet varieties and this is similar with earlier reports by Modu *et al.* (2005) and Akingbala *et al.* (1981). It has been reported by Reddy (1981) that natural fermentation of cereals improves protein content only slightly and this is attributed to the loss in dry matter mainly carbohydrates.

The improvements in the fat content of the 'Kamu' prepared from the pearl millet varieties may be due to increase in activity of lipolytic enzymes in the fermentation medium which hydrolyze fat to glycerol and fatty acids. The free fatty acids used by the fermenting organisms in synthesis of new lipids (Ezeokonkwo, 2004).

An increase in carbohydrate content was noticed in the 'Kamu' produced from the two varieties of pearl millet and this is in agreement with the reports of Ikemefuna (1998) and Modu *et al.* (2005) in the production of Ogi from six pearl millet varieties. In terms of proteins, the weaning food blends prepared from the two varieties of pearl millet/cowpea compared favorably with the Recommend Dietary Allowance (RDA) of infants (0-1year) and commercial weaning foods Nutrend® and Frisocrem®.

This therefore shows that there were substantial increase (50% for the 70:30 ratios and 60% for the 60:40 ratios) in protein after blending of the 'Kamu' prepared from the two pearl millet varieties with cowpea. Ikemefuna (1998), Marero *et al.* (1988) and Nkama *et al. (*2001) reported similar increases in protein content.

Mineral Element Composition

The loss in the content of phosphorous, magnesium and calcium observed in the 'Kamu; prepared from the two pearl millet varieties could be attributed to the loss in the ash content during fermentation of pearl millet. Akingbala *et al.* (1981) reported that more than 50% of the ash in sorghum was leached into the steep and wash water and consequently the level of phosphorous was reduced. Also the significant increase in the level of iron in the 'Kamu' could be due to the reduction of phytic acid during fermentation. In quantitative terms, this means that lactic acid fermentation can change a diet of low iron bioavailability into a diet of intermediate to high iron availability (Svanberg and Sandberg, 1988). The fermentation process provides optimal pH conditions for the degradation of phytate. A significant increase in iron occurs once phytate is degraded (Svanberg and Sandberg, 1988).

Supplementation of the 'Kamu' with cowpea improved the mineral content of the weaning food blends. The level of phosphorous, iron and magnesium in the weaning food blends compared favorably with commercial weaning foods Nutrend® and Frisocrem®. The level of calcium is low and zinc was not detected.

Amino acid Composition

The lysine, cysteine and methonine (Limiting amino acids of pearl millet and cowpea respectively) contents of the weaning food blends met the FOA/WHO (1985) reference pattern for infants (0-12months) except for tyrosine and phenylalanine. This therefore shows that supplementation of pearl millet with cowpea improved the amino acids content of the weaning food blends. This is consistent with the reports of Marero *et al.* (1988) and Nkama *et al.* (2001).

Summary and Conclusion

The results obtained indicate that:

The protein content of the weaning food blends pearl millet SOSAT C-88/cowpea: 13.26% (70:30), 14.58% (60:40) and Local pearl millet variety/cowpea: 13.87% (70:30), 14.96% (60:40) met the Recommended Dietary Allowance (RDA) of infants (0-1year). The levels of iron, phosphorous and magnesium of the weaning food blends were comparable to commercial weaning foods (Nutrend® and Frisocrem®) though the level of calcium is low and zinc was not detected. The amino acid content of the weaning food blends met the FAO/WHO reference values for infants (0-1 year). Even though, the 70:30 ratio has been used in most literatures, the 60:40 ratios used in this study is superior to the 70:30 ratio.

Recommendation

There is the need to improve on the calcium and zinc content of the weaning food blends as they are essential for the growing child and this can be achieved by the addition of sources like fish to the formulation.

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