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Chemical and microbial qualities of weaning food produced from mungbean (*Vigna radiata*) and maize (*Zea mays*)

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ABSTRACT

A study was conducted to enhance the nutritional quality of a widely used infant weaning food 'Maize gruel' with mungbean (Vigna radiata). Toasting as a treatment was applied in processing mungbean seed to flour (MBF), while the maize gruel (Akamu) was processed using the standard method, later dried in an oven at 60^0C for 24 hours to obtain flour sample (MG). A composite flour of different proportion levels were obtained from mungbean /maize flour, representing sample A (50 MG: 50 MBF); B (60 MG: 40 MBF); C (70 MG: 30 MBF) and D (100 % MG). The different food samples were subjected to chemical analysis (proximate, minerals and anti nutrient); sensory evaluation of reconstituted weaning food samples and analysis of microbial load on storage. The chemical composition analysis revealed protein content of 15.35 %, 13.55%, 14.76%, and 4.25% for samples A, B, C, and D, respectively. The anti-nutrient (phytate, saponnin, tannin and alkaloids) contained in the weaning food samples were minimal and not harmful for infant food. Sensory evaluation result on reconstituted products revealed that sample C ((70 MG: 30 MBF) was more acceptable to the panelist in all the parameters tested, though not significant at ($P < 0.05$) for taste and aroma. It was observed that the isolated organism (Aspergillus niger, Apergillus flavus, Penicillum spp. and Fusarium spp) increased on weekly basis for both sealed and unsealed samples after 4 weeks of storage, average microbial load in the weaning food ranged from $3.0 \times 10^3 - 18.0 \times 10^3$ cfu/ml. The practice of cooking the weaning food to about 95^oC for 5 minutes prior to serving will significantly reduce the the microbial load. Further research on enhancing the flavor of maize/mungbean weaning food is recommended to boost acceptability.

Keywords: mungbean, maize gruel, enhancing, chemical, microbial load, sensory evaluation, weaning, toasting

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INTRODUCTION

Weaning period of an infant is the period when exclusive breast feeding is stopped and baby is gradually introduced to solid foods. At six months, baby's weight is expected to have doubled requiring extra nutrient from other food source other than breast milk to meet her nutritional need. Feeding of young infants must closely match nutrient needs, since growth is the most sensitive and readily measured indicator of health and nutrition for individual child. The most commonly used weaning food in Africa is a thin cereal gruel that is called by different names depending on the type of cereal or country. In Nigeria, this weaning food (pap) is called '*ogi*' or '*akamu*' made from maize

(*Zea mays*) millet (*Pemisetum americanum*) or guinea corn (*Sorghum spp.*). Ideally, weaning period is between the first six months to 2 years of the infant life. However, due to ignorance and poverty, some urban poor and rural women in West Africa commence the weaning of babies between 2 to 3 months of age (Okeke and Okafor, 1998). Early introduction of weaning food is not encouraging, pap has been implicated in the etiology of protein – energy malnutrition (PEM) in children during weaning period due to the low nutritive value characterized by low protein, low energy density and high bulk (Fashankin and Ogunsoola 2002). The protein content of maize and guinea corn is of poor quality low in lysine and tryptophan, these two amino acids are indispensable to the growth of the young child (Oyenuga, 2004). Fortified infant formula has played a small part in solving protein malnutrition problems, but is not usually affordable to low income earners in the urban and poor rural dwellers (Kazimi and Kazimi, 2000). The use of foods high nutrient density can provide adequate food for growth and activity (Eka and Edijala, 2002). Cereals are deficient in lysine but have sufficient sulphur- containing amino acids that are limited in legumes. The combination of cereal and legumes has been found to produce amino-acid that adequately promote growth (Ene-Obong, 2001). Many researchers have worked extensively on cereal legumes combination in Nigeria (Fashakin and Ogunsoola, 2002). The present research work is designed to supplement the already existing weaning food (Maize gruel) with mungbean (*Vigna radiata*) to enhance the protein- energy content

MATERIALS AND METHODS

The mungbean seeds used for this work was procured from the Agronomy Department of Michael Okpara University of Agriculture Umudike, Abia State, while the maize grains was purchase from Eke Umuagwo market Ohaji, Imo State.

Processing of sample materials

The sample materials (mungbean seeds and maize grain) were thoroughly cleaned, removing the bad ones from the lot. Below are flowchart for the production of flour from mngbean seed and maize grain, respectively.

Maize
↓
Sorting
↓
Washing
↓
Soaking (for 48 hrs)
↓
Rinsing (24 hourly)
↓
Milling (wet milling)
↓
Sieving
↓
Bagging/pressing
↓
Oven drying
↓
Fine flour (maize gruel)
↓
Packaging

Figure 1: flow chart for maize flour production

Mungbean seeds
↓
Sorting/grading
↓
Washing
↓
Drying

↓
Toasting
↓
Milling
↓
Sieving
↓
Fine mungbean flour
↓
Packaging

Figure 2: flow chart for mungbean flour production

Table 1 Sample code designations

Samples	Designations
A	50 MG: 50 MBF
B	60 MG: 40 MBF
C	70 MG: 30 MBF
D	100 % MG

MBF = Mungbean flour; MG = Maize gruel

Chemical composition
The protein content was determined by Kjeidahl method described by James (1995). The total nitrogen was determined and multiplied with the factor 6.25 to obtain the protein. Fat content of the samples were determined by the continuous solvent extraction method using a soxhlet apparatus, the method described by Pearson (1976) and James (1995). Crude fibre was determined by the Wende method (James 1995). Total ash content was determined using the furnace incineration gravimetric method (AOAC, 1990).

The carbohydrate content was estimated by measuring protein, fat, ash, and moisture and subtracting the sum from the total weight of food, the remainder is considered to be carbohydrate Southgate (1991).

Determination of Anti nutritional factors
The trypsin inhibition activity (TTA) was determined by the spectrophotometric method described by Arntpield *et al* (1985). The phytate content of each sample was determined using the method of Griffith and Thomas (1981). The determination of the concentration of alkaloid in flour compositions was carried out using the alkaline precipitation gravimetric method described by Harborne (1973).Determination of tannin and saponin was calculated in percentage (Obodoni and Ochuko, 2001).

Microbial analysis
The microbial load of the different samples packed in nylon and plastic containers was determined using the method of Fawole and Oso (1988) for 4 weeks.

Sensory evaluation
The weaning food samples were properly reconstituted for consumption adapting the standard method of reconstituting pap, further cooked to about 95 ^{o}C for 5 minutes prior to serving as recommended (EI Ikeh *et al*,2001). The prepared weaning foods were subjected to sensory evaluation by 15 trained panelists using 7 points hedonic scale (Iwe,2000). Parameters tasted include; taste, appearance/color, aroma, mouth feel/texture and general acceptability.

Statistical analysis
Data collected from sensory evaluation analysis was subjected to Analysis of Variance (ANOVA), using statistical Analytical system (SAS), 2000 version. The differences in mean were determined using Fishers Significant Difference (LSD).

RESULTS AND DISCUSSION

The result of proximate composition on maize and mungbean flour blends is presented in Table 2. From the table the protein content were 15.35%, 13.55 %, 14.76 % and 4.356% for samples A, B, C and D, respectively. It was observed that the protein content increased with increase in mungbean composition. The protein content of the weaning food products meet the recommended protein intake for infant 0-1 years (Guthrie, 1999; FAO/UNU, 1985). Crude fiber content of 0.30% was observed for samples B and C, sample A has the highest fiber content of 0.57. Low fiber content observed with the weaning foods corresponds with the recommendations of (Dwyer, 1995). Fat content recoded for different weaning food ranges from 1.40-2.70 %. Highest fat content of 2.70 obtained for sample D (100%) could be attributed to processing. Sample A (50 MG: 50 MGB) recorded the highest ash of 3.23, which was higher than that reported by Akinrele and Edward (2001) for maize gruel plus soy formation. The moisture content for samples A, B, C and D was 3.58, 3.60, 3.40 and3.85 respectively. However, the samples are below the minimum limit of moisture content for flour (Ihekeronye and Ngoddy, 1985). The moisture content of food products goes a long way in suggesting the shelf life of the products. It was observed that the carbohydrate content of samples increased with increase in the maize gruel flour. The carbohydrate content ranges from 73.87- 87.53. High carbohydrate content observed corresponds with the findings of Fashakin and Ogunshola (2002) for cereal based weaning food.

Table 2. Proximate composition of mungbean/maize gruel weaning food products

	CONSTITUENTS						
SAMPLES	Moisture (%)	Protein (%)	Crude fiber (%)	Fats (%)	Ash (%)	CHO (%)	Energy (kcal)
A	3.58	15.35	2.57	1.40	3.23	73.87	369
B	3.60	13.35	2.30	1.60	2.17	76.98	376
C	3.40	14.76	2.30	1.70	2.18	75.82	378
D	3.85	4.56	0.13	2.70	1.23	87.53	387

Sample A (50 MG: 50MBF); B (70MG: 30MBF); C (60 MG: 40 MBF): D (100% MG)

Anti nutrient composition of the weaning food products is presented in Table 3 from the result,
Saponin, tannins, and Alkaliods contained in the weaning food products were quite low. Phytate content of the different weaning food products was observed to range from 0.59 (sample B) to 1.20 mg/g (sample A), which corresponds with the recommended levels of phytate for infant weaning foods [Erdman, 1979]. The levels of phytate in the food products are low enough to avoid any detrimental effects. Trypsin inhibitor activity for the different weaning food products ranged from 4.95TU/g (sample C) - 9.26 TU/g (sample A).

Table 3. Anti nutritional content of mungbean/maize gruel weaning food products

Samples	constituents				
	Phytate (mg/g)	Tannin (mg/g)	Saponin (mg/g)	Alkaloids (mg/g)	Trypsin inhibitor(mg/g)
A	1.20	0.84	1.16	1.40	9.26
B	0.59	0.56	0.69	0.62	5.26
C	0.95	0.49	0.65	0.82	4.95
D	0.62	0.60	0.72	0.85	5.48

Sample A (50 MG: 50MBF); B (70MG: 30MBF); C (60 MG: 40 MBF): D (100%)

Microbial analysis is presented in figure 3. From the result, it was observed that there was no growth of microorganism for the sealed samples during the first week of storage. The growth of microorganisms for both sealed and unsealed samples increased on weekly basis as shown in Figure 3 below.

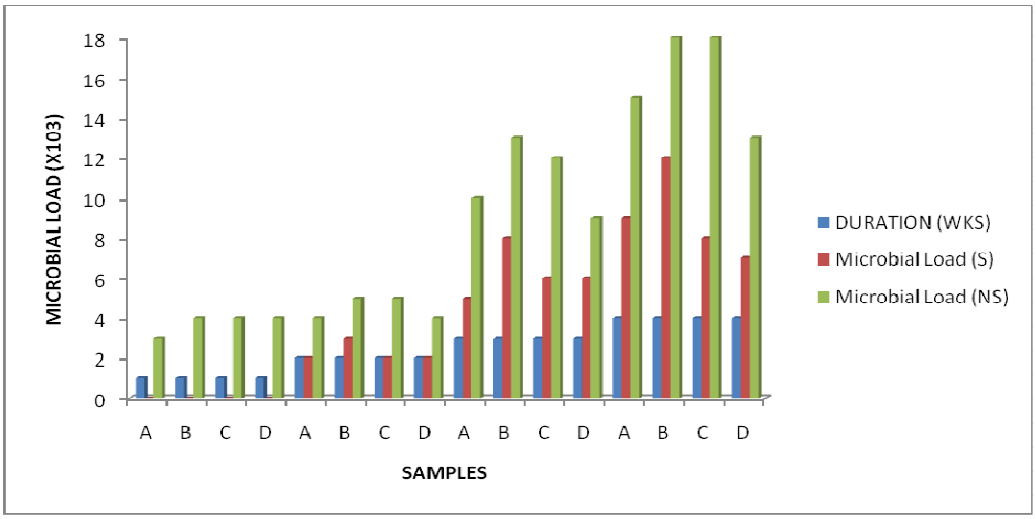

Figure 3: microbial load

Sample B (70 MG; 30 MBF) was found to attract more growth for sealed and unsealed. The growth recorded for the different samples for the duration of 4 weeks range from $3x10^3$- 18 $x10^3$. According to Oluwafemi and Nanna (2011), growth and development of the infant is rapid, and it is, thus, possible that exposure to aflatoxins in weaning foods might have significant health effects therefore further heating of the weaning food to about 95^{o}C for 5 minutes prior to serving can significantly reduce the microbial load (EI Ikeh *et al*,2001). Sensory evaluation result revealed that sample B (70 MG; 30 MBF) was more acceptable to the panelist in all the parameters tested (taste, appearance, aroma, and texture) though not significant from other taste samples. The taste and aroma of sample B (70 MG; 30 MBF) was significantly different from sample D (100% MG). The scores obtained for general acceptability reveal that sample B was significantly different from samples C and D, which lend credence to sample B as the best proportion for producing maize/ mungbean weaning food.

Table 4 . Sensory evaluation result of mungbean/maize gruel weaning food products

Samples	Sensory Attributes				
	Appearance	Taste	Aroma	Texture	General Acceptability
A	5.33^a	5.40^{ab}	4.80^{ab}	5.20^a	5.40^{ab}
B	5.40^a	5.67^a	5.07^a	5.47^a	5.80 ^{a}
C	4.67^a	4.87^{ab}	4.33^{ab}	4.60^a	4.80^{bc}
D	4.93^a	4.60^b	3.93^b	4.80^a	4.33^c
LSD	O.94	0.82	0.90	1.04	0.86

Mean of the same letter on the same row are not significant (P<0.05)
Sample A (50 MG: 50MBF); B (70MG: 30MBF); C (60 MG: 40 MBF): D (100% MG)

CONCLUSION

Generally it was oberved that complementing maize gruel with mungbean flour improved the macro and micro nutreint composition of the weaning food. This food product can be stored in an air tight container for at least a period of one week. Prior to serving, the product must be cooked at 95^{o}C for 5 minutes.

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