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Nutritive Value of Sorghum Ogi Fortified with Groundnut Seed (*Arachis hypogaea* L.)

[1]K.O. Ajanaku, [1]C.O. Ajanaku, [1]A. Edobor-Osoh and [2]O.C. Nwinyi
[1]Department of Chemistry, School of Natural Sciences, College of Science and Technology, Covenant University, Km 10 Idiroko Road, Canaan Land, PMB 1023 Ota, Ogun State, Nigeria
[2]Department of Biological Sciences, School of Natural Sciences, College of Science and Technology, Covenant University, Km 10 Idiroko Road, Canaan Land, PMB 1023 Ota, Ogun State, Nigeria

Corresponding Author: K.O. Ajanaku, Department of Chemistry, School of Natural Sciences, College of Science and Technology, Covenant University, Km 10 Idiroko Road, Canaan Land, PMB 1023 Ota, Ogun State, Nigeria Tel: +234 (0)8033575624

ABSTRACT

The utilization of groundnut seed as a constituent of sorghum ogi was investigated by preparing mixtures of ogi with increasing level of groundnut in 0, 25, 50, 75 and 100% addition. The product, sorghum groundnut-ogi was evaluated for proximate composition, titratable acidity and vitamins B. A taste panel evaluation was conducted to evaluate the acceptability of the products. The data obtained indicated an increase in protein, ash and fat content. There were no apparent effect of groundnut addition on pH and titratable acidity in the mixtures. The taste panel evaluation and the amylograph pasting characteristics of the groundnut-ogi blends concluded that blends with 50% groundnut addition and beyond were acceptable in improving the nutritive value of ogi for neonates.

Key words: Groundnut seed, sorghum ogi, proximate composition, amylograph pasting

INTRODUCTION

Malnutrition is one of the major concerns to most countries in Africa, particularly in developing countries where there are shortages in nutritious foods for the young ones. Unexplainably and naturally as new born grows older, the demand for nutrient increases and breast milk alone becomes inadequate to sustain the baby's demand. Sequel to this, many mothers begin the introduction of other foods such as imported cereal food, for those that can afford while some with financial inadequacy employ fermented cereal food porridge made from the staple. In as much that this watery porridge has very little nutritive value there is need to improve the nutritive by supplementing with fresh cow's milk, pawpaw, egg yolk, edible oil and fruits (Nwasike *et al*., 1979).

Cereals have become one of important sources of food throughout the world. Sorghum has achieved the highest growth rate of any major food crops in western Africa and it is believed to have the greatest potential among food crops for attaining technological breakthroughs that will improve food production in any region (Manyong *et al*., 1996). Sorghum constitutes about 75% of the cereals consumed in all parts of Nigeria today (Ekpenyong *et al*., 1977). The grain is often processed into a fermented product known as ogi which can also be called as "ogi-baba" is consumed in many parts of West Africa. In the traditional processing technique, the grain is steeped in water for 1-3 days, washed, wetmilled, sieved to remove bran and the sievate is allowed to settle to obtain

ogi. During ogi manufacture, nutrients including protein and minerals are lost from the grain thereby affecting nutritional quality adversely.

A number of studies have been carried out to improve the nutritive value of ogi. Fortification of sorghum-ogi can be achieved locally by addition of sugar, milk, chocolate in order to enhance the sour taste. Afolayan *et al.* (2010) observed sorghum-ogi generally as one of the malnutrition food among infant and this led many researchers attempt to enrichment its nutritional value with plant sources such as soy bean, soy flour, okra, cashewnut, cowpea and pawpaw (Ajanaku *et al.*, 2010; Owuamanam *et al.*, 2011; Egounlety *et al.*, 2002; Plahar *et al.*, 1983; Ekpenyong *et al.*, 1977). The nutritive value of ogi was also improved by fortification with amino acids (Adeniji and Potter, 1978). It is also commonly recommended to add palm oil to weaning gruel to improving the Vitamin A content.

Groundnut (*Arachis hypogaea* L.) provides an inexpensive source of high quality dietary protein and oil It supplies about 5.6 calories grain^{-1} when consumed raw and 5.8 calories grain^{-1} when consumed roasted. It is a rich source of essential amino acids, minerals and vitamins. The seed consists of two cotyledons, germ and thin skin called testa. The seed testa constitutes 4-5%, cotyledon 92-94% and the germ 3-4% of the seed mass. The testa is composed of carbohydrates, cellulose, protein and phenolic compounds while cotyledons have mainly oil and protein (Nagaraj, 1988; Savage and Keenan, 1994; Abdel-Rahman, 1982). In view of the benefits this study investigated the supplementation of ogi with groundnut seed with the intent to improve the nutritive value of the porridge used as food for neonates.

MATERIALS AND METHODS

Materials: Fresh groundnut seeds and Sorghum grains (Brown Variety) were obtained from IITA, Ibadan, Nigeria.

Sample preparation

Preparation of sorghum ogi and groundnut slurries: The sorghum grain was cleaned and 2 kg were steeped in 5 L of tap water for 2 days at room temperature (28+2°C). The steeped grains were recovered by draining off the steeping water and then wet-milled on a premier mill. Excess water was added and stirred to make slurry and passed through a vibrating shaker with a 600 nm sieve. This was followed by souring for 12 h and decantation of the supernatant to obtain sorghum-ogi slurry.

The groundnut seeds were washed and cooked for 10 min. The seeds were then cooled and blended in a Kenwood mixer to form slurry.

Preparation of sorghum groundnut-ogi meal: Groundnut (*Arachis hypogaea* L.) provides an inexpensive source of high quality dietary protein and oil (Table 1). One hundred grams of sorghum ogi (dry basis) was mixed with 0, 25, 50, 75 and 100 g of groundnut slurry (dry basis) as shown in Table 2. The mixtures were blended in a Hobart mixer for 5 min after adding 1 L of the supernatant (souring water) earlier obtained from the ogi. After blending, the sorghum groundnut ogi slurry was allowed to ferment for 2 days at room temperature, after which the supernatant was discarded and the resulting slurry pressed to dryness. The final cake obtained was dried at 55-60°C for 24 h in a cabinet dryer, cooled, milled and packaged in thick polythene bags and labeled appropriately.

Table 1: Nutrient value per 100 g of *Arachis hypogaea* L.

Constituents	Appropriate value
Protein	25.00 g
Fat	48.00 g
Carbohydrates	21.00 g
Calcium	62.0 mg
Iron	2.0 mg
Magnessium	184.0 mg
Phosphorus	336.0 mg
Potassium	332.0 mg
Vitamin B_1	0.6 mg
Vitamin B_2	0.3 mg
Vitamin B_3	12.9 mg
Vitamin B_5	1.8 mg
Vitamin B_6	0.3 mg

Source: USDA Nutrient Database for Standard Reference, Release 18 (2005)

Table 2: Various proportion of each component in each mixture blend (g)

	Sample				
Proportion (g)	A	B	C	D	E
Groundnut	0	25	50	75	100
Sorghum	100	100	100	100	100

Experimental: Moisture content, ash content, crude fat and total nitrogen by the standard micro-kjeldahl method were determined using the method of AOAC (1984, 1975). The percent nitrogen was converted to crude protein by multiplying with a factor of 6.25. The carbohydrate was determined by difference. The pH of the sample blends were measured on a unican model pH meter which had been previously standardized with buffer solutions of pH 4 and 9. Titratable acidity was determined by method of Banigo and Muller (1972). Diastatic activity was determined using Blish and Sandstedt method as described by Kent-Jones and Amons (1967). Vitamin B was determined by the method described by Davis and Worley (1973) which describe fully automated method for microbiological measurement using chloramphenicol-resistance strain. The bulk density of the samples was determined by method of Narayana and Narasinga-Rao (1984) while Water Absorption Capacity was calculated by method of Soulski (1962) Pasting viscosity was determined on a brabender Amylograph by method described by Adeyemi (1983) and Banigo *et al.* (1974). Assessment by a ten-man panelist comprising of tasters who were familiar with the product was carried out on the ogi porridge prepared from the samples. Assessment was on a 6 - point Hedonic scale for taste, appearance, texture, colour and acceptability. All the laboratory analyses were carried out in duplicate following the AOAC (1990) protocol. The five diets formulated were analysed to determine their proximate composition (Table 3). The data obtained were subjected to analysis of variance. The level of significance was $p<0.05$.

RESULT AND DISCUSSION

There are quite a number of food preparations involving the use of groundnut to improve the protein level which has helped in reducing malnutrition in developing countries. The special taste and flavour of the resulting foods is important in the acceptance of these food preparations. Groundnut protein is increasingly becoming important as food and feed sources, especially in

Table 3: Proximate composition of groundnut-ogi blends

Sample	Moisture (%)	Carbohydrate (%)	Protein (%)	Fat (%)	Ash (%)
A	13.10±0.21	86.5±4.21	4.11±0.28	0.31±0.001	0.10±0.002
B	12.10±0.22	82.3±4.54	5.22±0.42	4.10±0.77	0.43±0.22
C	12.50±0.11	81.2±3.15	8.63±0.16	8.22±0.84	0.62±0.001
D	12.11±0.91	78.4±4.82	12.1±0.720	9.12±0.81	0.66±0.02
E	11.92±0.34	68.1±5.16	14.7±0.470	10.11±0.71	0.84±0.003

Table 4: The pH, titratable acidity, diastatic activity, water absorption capacity and bulk density of groundnut-ogi blends

Sample	pH	Diastatic activity (mg maltose/100 g)	Water absorption capacity (mL)	Bulk density (g mL^{-1})
A	4.11±0.01	21.8±3.02	84.00±3.71	0.728±0.002
B	4.88±0.01	31.2±4.11	61.18±2.16	0.612±0.023
C	5.21±0.02	41.4±2.11	52.15±5.12	0.523±0.062
D	5.72±0.01	50.6±4.15	46.34± 2.29	0.445±0.013
E	6.18±0.02	51.6±3.68	41.19±3.32	0.413±0.071

developing countries where protein from animal sources are not within the means of the majority of the populace.

Effect of groundnut addition on the proximate composition of ogi: The result of the proximate composition of the groundnut/pawpaw Ogi blends is presented in Table 3. The moisture content of the blends was in the range between 11 and 13%. At this moisture range, the samples might keep for at least 4 months if properly stored. The fat content of the sorghum grain, as expected, was higher than that of the ogi samples sequel to removal of the germ where most of the fats are concentrated. It could be inferred that additions of groundnut might not have any significant effect on the fat content. The amount of fat present in the blend is adequate (0.31-10.11%) in that any diet that provides 1-2% of its caloric of energy as fat is said to be sufficient to human beings (Antia *et al*., 2006). The ash content increased with level of groundnut addition. This was expected since one of the most important contributions of fruits to human diet is the provision of minerals. However the ash content obtained for sorghum grain mixture was higher than that of pure ogi sample due to removal of most of the minerals which are concentrated in the bran and germ by the wet-sieving process. The protein content did also increased significantly with groundnut addition in the blends. The starch content in all the ogi samples were higher than the starch content of the whole sorghum grain as the wet-sieving process must have removed the major part of the cotyledon and germ leaving mainly the starch fraction.

The pH of ogi samples were found to range between 4.11 and 6.18 (Table 4). There was no apparent effect of groundnut addition on the pH. Changes in diastatic activity of ogi samples were observed with increasing level of pawpaw addition, with values of 21.8±3.02 to 51.6±3.68 mg maltose/100 g, respectively for sorghum ogi at 0% level of substitution and sorghum groundnut-ogi at 100% level of blending. The bulk density of the samples obtained decreased from 0.728 to 0.413 g mL^{-1}, with 100% blend having the smallest bulk density which shows that it will occupy the smallest space (Table 4). The water absorption capacity of the groundnut-ogi blends decreased with increased additional level of groundnut, hence it will aid digestibility of the food in the systemic canal of the neonates which is in accordance with Amankwah *et al*. (2010) suggesting the use of different composite diets as weaning food to improve the nutritional and health status of growing infants.

Table 5: Results of analysis of taste panel scores

Quality attributes	A	B	C	D	E	LSD	"F" value
Taste	5.1[a]	5.0[c]	4.8[c]	4.2[c]	4.1[b]	1.42	3.71
Colour	6.3[a]	6.1[a]	5.8[ab]	6.6[a]	6.2[a]	1.10	1.10
Texture	4.7[a]	3.2[b]	3.4[b]	2.1[c]	2.2[dc]	2.11	3.10
Flavour	3.9[b]	4.3[c]	5.7[c]	7.2[b]	7.4[a]	1.62	6.72
Sourness	4.4[a]	5.2[a]	6.1[a]	6.3[c]	6.3[a]	1.14	6.91
Appearance (dry sample)	6.2[a]	6.3[a]	6.4[a]	6.4[a]	6.4[a]	0.90	3.82

Values presented with different letters are significantly different at $p<0.05$

Table 6: Amylograph pasting characteristics of pawpaw-ogi blends

Sample	Tp (min)	Mg (min)	Tvp (°C)	Vp (B.U)	Mn (min)	Vi (B.U)	Vr (B.U)	Ve (B.U)	Mn-Mg (B.U)	Vp-Vr (B.U)	Ve-Vp (B.U)	Ve-Vr (B.U)
A	79	35	91	310	40	270	200	790	5	110	480	590
B	81	35	94	320	36	280	220	800	1	100	480	580
C	84	33	95	325	34	295	230	810	2	95	485	580
D	85	32	95	320	34	300	230	830	2	90	510	600
E	84	31	94	315	35	290	240	845	4	75	530	605

Tp: Pasting temperature; Mg: Gelatinazation time; Tvp: Temperature at peak viscosity; Vp: Peak viscosity during heading; Mn: Time to reach peak viscosity; Vi: Viscosity at 95°C; Vr: Viscosity after 30 min holding at 95°C; Ve: Viscosity on cooling to 50°C; Mn-Mg: Ease of cooling; Vp-Vr: Stability of the starch; Ve-Vp: Set back value; Ve-Vr: Galetinization index and B.U: Bradender unit

Taste panel assessment of groundnut-ogi blends: The taste panel assessment of the blends is shown in Table 5 for quality attribute for all the samples. The results were treated with the analysis of variance method. For sourness, 0 and 75% blends were found to be significantly different from the other samples at 5% confidence level while 25% only was significantly difference from other samples for flavour. Also, 0 and 100% blends were significantly different from the other samples for taste while 75 and 100% blends were significantly different for sourness. For colour and appearance, there was no significant difference in all the samples.

Amylograph pasting viscosity of groundnut-ogi blends: Amylograph pasting viscosity data of the samples is presented in Table 6. The peak viscosity (Vp) ranged between 310 and 325 B.U; indicating that addition of pawpaw did not significantly alter the swelling property of ogi. Stability value of the starch (Vp-Vr) decreased from 110 B.U to 75 B.U at 100% level of groundnut addition which would appear to indicate that groundnut tends to improve stability of sorghum ogi. Set back values (ve-vp) ranged between 480 and 530 B.U. while the gelatinization index (ve-vr) ranged between 580 and 605 B.U. Therefore, it could be inferred that the pasting characteristics of sorghum groundnut ogi are not significantly different from the normal sorghum ogi.

Groundnut cake is fit for human consumption after partial hydrolysis of its component protein by fermentation. During fermentation sucrose is eliminated but this does not change fatty acid composition and protein content of the groundnut (Amro *et al*., 2006). Fermented products are easily digestible, tasty and nutritious. Sorghum grain also composed mainly of carbohydrates and also has substantial amount of minerals and vitamins (Matz, 1991). Thou groundnut contain anti-nutritional compounds including trypsin inhibitors, goitrogens, saponins and phytic acid; all these nutritive factors are reduced to minimum through traditional cooking and processing techniques such as soaking in water and roasting (Apata, 2008). However, pretreatment of cereals utilized for porridge largely depended on the type of cereal, the desired product and the processes involved. Conversely, the processes are rigorous thus affecting the nutritional status of the desired product

(Ajanaku *et al*., 2010). The major drawback to the use of *ogi* as a staple food is its low nutritional value. A protein-enriched *ogi* containing 10% Soya flour was developed by the Federal Institute of Industrial Research (FIIRO), Lagos, Nigeria (Akinrele, 1970). The development of an *ogi* (dogit), having the therapeutic properties to control diarrhoea among infants was also reported by Olukoya *et al*. (1994).

CONCLUSION

Groundnut, like other seeds, is not accorded with the importance it deserves in the diets; rather consumers prefer to take it as snacks hence under-utilization. This work has revealed the possible utilization of groundnut seed as a constituent of traditional weaning meal and as an enriched adult food (ogi). An indication from this study is that groundnut seed which are valuable nutritionally because of the vitamins, proteins and minerals which they contain, could be beneficial as constituent of a staple diet thereby enhancing its use in forming neonate food for infants.

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