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Utilization of Bambara Groundnut Flour Blends in Bread Production

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Abstract: Blends of Bambara Groundnut Flour (BGF) and Wheat Flour (WF) were used at various ratios (100:0, 20:80, 25:75, 50:50, 0:100), respectively in the production of bread samples. The 100% Wheat Flour (WF) bread served as control. Proximate composition of bread samples produced from the flour blends was determined and they were subjected to sensory evaluation. Results of proximate composition showed a significant increase ($p<0.05$) in protein, crude fiber and ash contents of bread of WF/BGF blends. However, there was a significant decrease ($p<0.05$) in crude fat and carbohydrate contents of the bread samples of WF/BGF blends. Moisture content of bread samples from supplemented WF (10.05-11.0%) was lower than control (12.50%), a factor desirable for keeping quality of bread. Sensory evaluation of all test samples was generally acceptable as none scored less than the minimum acceptable score in the 9-point hedonic scale used.

Key words: Bread, *Vigna subterranea*, flour, blends, sensory attributes, proximate

INTRODUCTION

One of the most disturbing and prevalent nutritional problems in the developing countries particularly Nigeria is protein-energy malnutrition (FAO, 2001). The cause has been attributed to many factors including as high cost of first class proteins. The use of cereal-legume based food is therefore advocated as alternative protein and energy source for infant and adult food products. The nutritional complementarity of cereals and legumes has long been recognized (Aykroyd, 1981; Mensah and Tomkins, 2003). Cereals are deficient in total nitrogen and the essential amino acids, lysine and tryptophan (Davidson *et al*., 1980). On the other hand, legumes are deficient in sulphur containing amino acids, methionine and cystine but rich in tryptophan and lysine. When cereals and legumes are judiciously selected and combined, a desirable pattern of essential amino acids comparable to or higher than the reference protein is obtained (Nnam, 2001).

Among the legumes widely cultivated in Nigeria, Bambara groundnut (*Vigna subterranea*) is among the underutilized. It has not been adequately exploited, as human food because of constraints like hard to cook phenomenon, strong beany flavour, presence of anti-nutrients and poor dehulling and milling characteristics (Enwere and Hung, 1996). The freshly harvested semi ripe Bambara groundnut seeds can be consumed boiled, while dry seeds can be roasted and eaten with palm kernel as a snack. Novel products like vegetable milk (Obizoba and Egbuna, 1992) and fermented condiments (Amadi *et al*., 1999) have been developed from Bambara groundnut. However, it is most commonly milled to flour and consumed in different forms as moimoi or okpa (paste steamed into a gel), akara (bean balls), soup thickener and as composite flour (Obizoba, 1983; Enwere and Hung, 1996; Echendu, 2004). It is reportedly high in protein (14-24%) (National Academy of Science, 1998) and phosphorus (380 mg/100 g) (Elegbede, 1998). The seed contains fair amount of iron (7.6 mg/100 g) and significant level of calcium (73 mg/100 g). The seed grain has a good balance of essential amino acids with a relatively high proportion of lysine (6.6%) (Elegbede, 1998). Stephens (2003) noted that Bambara groundnut protein contain higher essential amino acid, methionine than other grain legumes, while the oil content is less than half of the amount found in legumes like peanuts. Thus, Bambara groundnut could be used to complement cereal grains in order to provide a balanced amino acid profile.

Consumption of wheat and wheat-based products is grossly increasing in Nigeria as a result of working conditions and rural-urban migrations. The most popular and widely available one is bread. Bread is produced from wheat flour, which has low protein content and like most cereals is limiting in lysine. Baking with wheat alone does not provide the necessary amino acids, thus, the need to blend with legume flour.

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In the light of the above, this study was designed to complement the amino acid content of wheat flour with Bambara groundnut by providing a complete blend of all the essential amino acids in the flour and their products. The blends of wheat and Bambara groundnut flour could have the potential of improving the nutritive value of bread thereby enhancing the adequacy of the nutrient intake of the population.

The result of this study will provide a recipe in acceptable form that will increase the utilization of Bambara groundnut vis a vis reducing wheat importation.

MATERIALS AND METHODS

Source of materials: Bambara groundnut and wheat flour were purchased from Calabar main market (Watt) in Cross River State, South Eastern part of Nigeria.

Sample preparation

Bambara groundnut flour: Bambara groundnut seeds were sorted, cleaned and toasted at 85°C in an oven for 3 h. The toasted seeds were cooled to room temperature (27±2°C), dehulled, dry milled and sieved into fine flour using a 60 mm mesh sieve (British standard). The flour was stored in an airtight container at room temperature (27±2°C) pending further use. Wheat flour was purchased already milled (as sold in the market) and was sieved using 60 mm mesh sieve as for Bambara groundnut flour to obtain same particle size.

Blending of flour: The composite flours were blended to consist wheat and Bambara groundnut flours in the ratio 80:20 (BW_1), 75:25 (BW_2) and 50:50 (BW_3). The 100% wheat flour served as control. Wheat flour samples were mixed with the Bambara groundnut flour in a Philips blender (HR2811 model) for 5 min at full speed. The flour samples were packed in labeled plastic containers and stored at room temperature.

Proximate composition: Proximate analysis was carried out on flour blends and bread samples. Moisture content, crude protein (Kjeldahl method), crude fat (solvent extraction) crude fiber and ash were determined using methods already described by AOAC (2000). Total carbohydrate was determined by simple difference, while caloric value was calculated using Atwater factors (4, 9, 4 kilocalories for protein, fat and carbohydrate, respectively) to multiply values obtained for protein, fat and carbohydrate and finding the sum of their products.

Preparation of bread samples: The recipe shown in Table 1 was used for making the wheat-Bambara composite bread samples. Bread samples were prepared using the method of Ceserani *et al.* (1995). All dry ingredients were mixed together by rubbing in method. The ingredients were weighed appropriately using a salter weighing scale. The yeast was creamed in a basin with three quarters of the milk and water mixture. A hole was made in the center of the flour blend and dissolved yeast was added. This was covered with a cheese cloth and left at 35°C for yeast fermentation of the mixture. The remaining milk and water mixture, butter, sugar and salt were added and kneaded using a Hobart mixer. The dough was returned to the basin, covered with a cheese cloth and left at 35°C to proof (to double its size) for 90 min. The proofed dough was punched down, kneaded and cut into small rolls, transferred to greased oven pans, allowed to proof for 30 min and carefully brushed with egg. These were baked in a preheated oven at 220°C for 25 min.

Table 1: Recipe used in preparing bread samples

Ingredients	Quantity
Wheat-Bambara flour blend (g)	200
Yeast (g)	5
Liquid (milk and water) (mL)	125
Margarine (g)	10
Sugar (g)	5
Salt (g)	2

Sensory evaluation: Bread samples including those made from 100% wheat and 100% Bambara groundnut flours were evaluated for flavor, colour, texture, taste and general acceptability by a panel of twenty judges on a 9 point hedonic scale (1 = extremely disliked, 9 = extremely liked) as described by Iwe (2002). The judges were randomly selected from amongst the members of staff and students of the department of home economics, Uyo University, Nigeria. The sensory evaluation was carried out in the food laboratory within the department of home-economics, Uyo University, Nigeria under white light in the midmorning (11:00 am). The laboratory was quiet without any interruption. Panelists were seated separately and each had a glass of water to rinse mouth in between evaluations of the five bread samples. Samples were presented in two-digit coded white plastic plates.

Statistical analysis: Data obtained from study were subjected to analysis of variance as described by SAS (1999) and means were separated using Fischer LSD and judged significantly different at 95% confidence level ($p = 0.05$).

RESULTS AND DISCUSSION

The results of proximate analysis of the flour blends are shown in Table 2. The protein content of Bambara Groundnut Flour (BGF) and the various flour blends were

Table 2: Proximate composition of flour blends

Parameters (%)	A WF:BGF 100:0	B WF:BGF 80:20	C WF:BGF 75:25	D WF:BGF 50:50	E WF:BGF 0:100
Moisture	10.75[a]	10.94[a]	11.12[a]	11.04[a]	11.09[a]
Crude protein	12.32[a]	14.05[b]	14.34[b]	16.01[c]	19.06[b]
Crude fat	3.45[a]	3.40[a]	3.81[b]	4.21[c]	4.83[c]
Crude fibre	2.18[a]	2.80[b]	3.04[b]	3.69[c]	5.12[d]
Ash	2.23[a]	2.62[a]	2.72[a]	3.25[b]	4.01[b]
Carbohydrate	6.07[a]	66.19[a]	64.97[a]	61.44[b]	54.54[c]

WF: Wheat Flour; BGF: Bambara Groundnut Flour; [a-d]Values on the same row with different letters are significantly different at $p<0.05$

significantly higher ($p<0.05$) than the control flour (100% WF) with BGF recording the highest value (19.6%). Expectedly, samples with higher content of BGF showed between 14-59% higher crude protein than control sample. Except for carbohydrate and moisture content, all proximate parameters were significantly higher ($p<0.05$) in test flour blends than control. The protein content obtained for Bambara groundnut flour was similar to previous report (Onimawo *et al*., 1998). The higher protein content of BGF makes it a good supplement to wheat flour. The high protein content of the bread samples relative to control could be attributed to the supplementation effect. It has been shown that when legume proteins supplement those of cereals, a protein quality equal to or better than those of animal origin could be obtained (Mensah and Tomkins, 2003).

Table 3 shows the proximate composition of bread samples. The bread samples produced from the flour blends showed significant increase in crude protein, crude fiber and ash contents than control wheat bread. On the average, protein content of bread samples from the flour blends was 15.92% while that from wheat flour was 12%. The blending of Bambara groundnut flour which contains lysine, an essential amino acid that is lacking in wheat flour improves protein quality of the bread sample. A significant decrease was however observed in moisture, fat and carbohydrate contents of bread samples from flour blends compared to control (WF bread). The observed decrease in the moisture, carbohydrate and fat contents are of advantage. The lower moisture content is a desirable phenomenon, as it will enhance the keeping quality of the bread since water for activity is low. The low carbohydrate and fat contents coupled with the high fiber contents of the bread samples make it desirable in weight management and incidence of cardiovascular diseases where this is beneficial.

Results of sensory evaluation presented in Table 4 shows that there is no significant difference in all parameters between the control bread and bread samples supplemented with 20% Bambara groundnut flour. There was no significant difference in the texture, taste and flavor of bread sample supplemented with Bambara groundnut flour at 20 and 25% compared with control. In all parameters, bread samples from flour blends were judged acceptable as none scored below five, which is considered the minimum acceptable score on a 9-point hedonic scale. The nutrients as well as sensory attributes of bread samples were promising. Supplementation enhanced the nutritive value of the products. The use of Bambara groundnut flour to supplement wheat flour was acceptable especially those from 80:20 WF: BGF blend.

Table 3: Proximate composition of bread samples

Parameters	BW_1	BW_2	BW_3	WFB	BGFB
Moisture	10.65[b]	10.25[c]	10.05[c]	12.05[a]	11.0[b]
Crude Protein	15.08[b]	15.95[c]	16.72[d]	12.00[a]	17.3[d]
Crude fat	2.18[b]	2.10[b]	2.00[b]	2.09[a]	4.5[c]
Crude fibre	3.46[b]	3.59[b]	4.30[c]	2.00	5.0[c]
Ash	4.28[b]	4.60[b]	5.97[c]	2.92[a]	6.9[d]
Carbohydrate	63.71[b]	63.01[b]	0.92[b]	67.68[a]	55.3[c]
Caloric value	334.78[b]	334.74[b]	328.56[c]	344.82[a]	330.9[c]

Table 4: Sensory evaluation of bread samples from flour blends

Samples	Parameters				
colour	Texture	Taste	Flavour	Generally	Acceptable
BW_1	7.45[a]	7.54	8.22[a]	7.86[a]	7.62[a]
BW_2	6.93[b]	7.33[a]	7.83[a]	7.52[a]	6.91[b]
BW_3	5.96[c]	6.58[b]	7.50[b]	6.75[b]	5.83[c]
WFB (control)	8.12[a]	8.53[a]	8.14[a]	7.68[a]	7.98[a]
BGFB	6.75[b]	6.36[b]	6.53[c]	6.56[b]	5.53[d]

BW_1-80: 20; BW_2-75:25; BW_3-50: 50 for WF:BGF, respectively. WFB-100%WF; BGFB-100% BGF where WF: Wheat Flour; BGF: Bambara Groundnut Flour; [a-d]Values on the same row with different letters are significantly different at $p<0.05$

CONCLUSION

The consumption of bread produced from wheat flour supplemented with Bambara groundnut flour will increase intake of good quality protein and fiber among Nigerians in an acceptable food medium with a resultant effect of increased consumption and utilization of Bambara groundnut thus, reducing importation of wheat and reduction of weight problems where low caloric and high fiber diet or foods is desirable.

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