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Full Length Research Paper

Quality characteristics of bread produced from composite flours of wheat, plantain and soybeans

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The use of soy flour (SF) and plantain flour (PF) substitution in wheat flour (WF), from 0 to 15% each, for the production of bread was investigated. The proximate analysis, sensory evaluation and aerobic plate count (APC) of the bread samples were determined. The crude protein, crude fiber, ether extract and ash contents of the soy supplemented breads (SSBs) increased with progressive increase in the proportion of soy flour, with the 15% SSB having highest values of 8.39, 0.14, 2.46 and 1.17%, respectively, while lowest values were recorded for the whole wheat bread (WWB). The carbohydrate content was observed to decrease with corresponding increase in the percentage of soy flour in SSBs. The sensory evaluation shows that no significant differences were observed between the WWB and the 5% SSB in the sensory attributes of aroma, internal texture, taste and general acceptability ($p<0.05$), but differences were significant in crust, shape and appearance. The crude protein of the plantain supplemented breads (PSBs) and the WWB ranges between 6.88 and 7.01%, with the WWB recording the highest value. The ash content increased with progressive increase in the proportion of the PF, the highest value (0.95%) was recorded for the 15% PSB. There were no significant differences ($p<0.05$) between the WWB and the PSBs up to 10% PF substitution in all the sensory attributes tested; crust, taste, aroma, shape, internal texture, appearance and general acceptability. Hence the PSBs had comparable sensory and nutritional qualities to the WWB, while the SSBs had higher proteins contents than the latter. However the WWB had highest Hedonic mean scores in all the sensory attributes tested.

Key words: Soy flour, plantain flour, proximate analysis, sensory evaluation, aerobic plate count, nutritional quality.

INTRODUCTION

Bread is an important stable food, the consumption of which is steady and increasing in Nigeria. It is however, relatively expensive, being made from imported wheat that is not cultivated in the tropics for climatic reasons (Edema et al., 2005). Efforts have been made to promote the use of composite flours in which flour from locally grown crops and high protein seeds replace a portion of wheat flour for use in bread, thereby decreasing the demand for imported wheat and producing protein-enriched bread (Giami et al., 2004). Although there is now a substantial amount of available composite bread technology, such breads still require at least 70 percent wheat flour to be able to rise (Satin, 1988; Eggleston et al., 1992).

Soyabean (*Glycine max)* is an excellent source of protein (35-40%), hence the seed is the richest in food value of all plant foods consumed in the world (Kure et al., 1998). It is used in the fresh, fermented or dried form. It is also rich in calcium, iron, phosphorus and vitamins. It is the only source that contains all the essential amino acids (Ihekoronye and Ngoddy, 1985). Its use in the production of bread as composite flour has been reported (Kure et al., 1998; Dhingra and Jood, 2002; Basman et al., 2003).

Plantain (*Musa paradisiacea*) belongs to the family of banana and is popularly called cooking banana, since it is seldom eaten raw. It is widely grown in the southern

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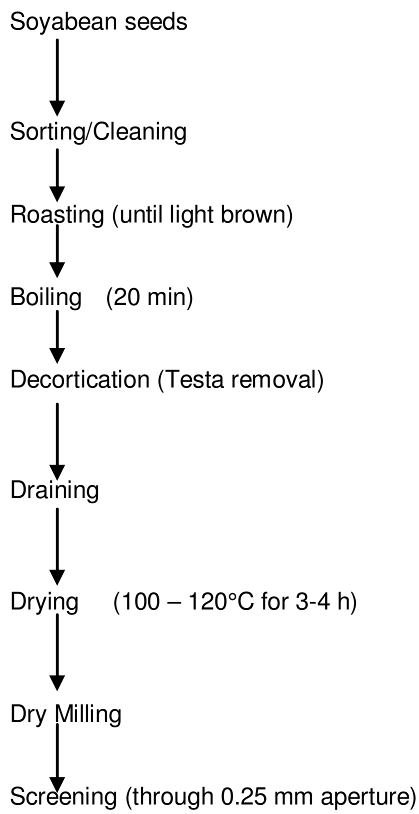

Figure 1. Flow chat for the production of soy flour.

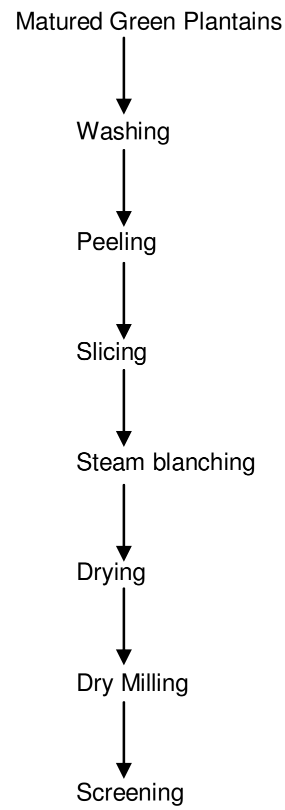

Figure 2. Flow chart for the production of plantain flour.

states of Nigeria where there is adequate rainfall distribution (Oyenuga, 1972). The fruit is an excellent source of nutrient when eaten as food. It contains carbohydrate (32%), protein (1%), fat (0.02%), water (60%), some vitamins and mineral elements (Kure et al., 1998). It is recommended to produce plantain flour from green fruits, since it has high starch content of about 35% on wet weight basis (Simmond, 1976).

This study is aimed at determining the proximate composition, sensory and microbiological qualities of breads produced from varying substitutions of soybean and plantain flours as composites of wheat flour.

MATERIALS AND METHODS

Materials

The soybeans matured green plantains and wheat flours used for this study were obtained from a local market in Offa, south-western Nigeria. They were taken to the laboratory for immediate use and processing.

Processing of soybeans and plantains into flour

The soyabean seeds were processed into flour, using the method of IITA (1990) (Figure 1). The process ensures effective removal of most anti-nutritional factors. Plantain flour was also produced by adopting the method of Kure et al. (1998) (Figure 2). Plantains were washed, peeled and sliced to about 5 mm diameter using a slicer. The slices were then steamed for 15 min to inactivate enzymes. The pulp was drained and dried in a cabinet drier at 60°C for 24 h, after which it was milled into flour. The flours were screened through a 0.25 mm sieve (Model BS 410).

Blend formation

Four blends (each of plantain and soybean flour) were prepared by mixing with wheat flours in the proportions of 100:0, 95:5, 90:10, and 85:15 using machine food processor (Kenwood KM 201, England).

Baking process

The eight blend formulations were baked using the straight dough method (Chuahan et al., 1992). The baking formula was 56% wheat flour or the blend, 36% water, 3.4% sugar, 1.6% shortening, 1% skim milk powder, 1% salt and 1% yeast (Ihekoronye, 1999). All ingredients were mixed in a Kenwood mixer (Model A 907 D) for 5 min. The dough were fermented in bowls, covered with wet clean muslin cloth for 55 min at room temperature (29°C), punched, scaled to 250 g dough pieces, proofed in a proofing cabinet for 90 min at 30°C, 85% relative humidity and baked at 250°C for 30 min (Giami et al., 2004)

Proximate analysis

The proximate composition of the soy supplemented bread (SSB),

Table 1. Proximate composition and microbial count of soy supplemented and whole wheat bread samples.

Parameter/Bread sample	A	B	C	D
Crude protein (%)	7.01	7.26	8.03	8.39
Crude fibre (%)	0.03	0.06	0.08	0.14
Ether Extract (%)	0.76	1.29	2.32	2.46
Ash (%)	0.64	0.89	1.01	1.17
Moisture (%)	30.98	34.10	35.50	35.59
Carbohydrate	60.58	56.40	53.06	52.25
APC (log cfu/g)	3.20	4.50	4.10	4.30

A - Bread produced from 100% wheat flour
B – Bread produced from composite flours of 95% wheat and 5% soyabean
C – Bread produced from composite flours of 90% wheat and 10% soyabean
D – Bread produced from composite flours of 85% wheat and 15% soyabean
APC – Aerobic plate count

plantain supplemented bread (PSB) and the whole wheat bread (WHB) samples were determined using the methods of Egan et al. (1981). The samples were analyzed for moisture, ash, crude fibre, crude protein, crude fat and carbohydrate (by difference).

Sensory evaluation

The sensory attributes, including crust, aroma, shape, internal texture, taste, appearance and general acceptability, were evaluated by a semi trained 10-member panel, using a 9-point Hedonic scale with 1 representing the least score (dislike extremely) and 9 the highest score (like extremely). Analysis of variance (ANOVA) was performed on the data gathered to determine differences, while the least significant test was used to detect significant differences among the means (Ihekoronye and Ngoddy, 1985).

Microbiological examination

The aerobic plate count was carried out on the SSB, PSB and WWB samples using the method of Fawole and Oso, 1988. Ten grams of each sample was taken aseptically and homogenized in 90 ml sterile distilled water, in a blender (Philips Type HR 2815i) for about 2 mins. Serial dilutions (using 1 ml of homogenates) were made in 9 ml sterile distilled water, dispensed in test tubes. One milliliter of each dilution was pour plated in sterile Petri dishes, using the plate count agar (PCA, oxoid), incubated at 37°C for 24-36 h. Counts of visible colonies were made and expressed as log cfu/g sample.

RESULTS AND DISCUSSION

The proximate composition and aerobic plate count (APC) of the soybean flour supplemented bread (SSB) samples are presented in Table 1. The bread produced from 15% soy flour substitution had the highest crude protein content of 8.39%. The protein content was observed to increase with progressive increase in proportion of soybean flour in the SSBs, indicating that supplementation of wheat flour with soy flour would greatly improve the protein nutritional quality of bread. This could obviously be due to the significant quantity of protein in soyabean seeds (Asiedu, 1989; Kure et al., 1998; Basman et al., 2003). This high protein content in the soy supplemented breads would be of nutritional importance in most developing countries, such as Nigeria, where many people can hardly afford high proteinous foods because of their expensive costs. This similar observation was made in a research study by Akpapunam and co-workers (1997) who recorded increase in the protein content with corresponding increase in the proportion of soy flour supplementation in maize flour, during the production of *Agidi*, a fermented cereal product.

The ash and fat contents of the soy supplemented breads were also noted to assume the same trend as the protein content. The highest fat and ash contents of 1.46 and 1.17% were recorded for the 15% SSB while lowest contents of 1.06 and 0.64% were obtained for the whole wheat bread (WWB), respectively. Other research workers have reported similar findings (Yanez et al., 1981; Kure et al., 1998; Edema et al., 2005). Soyabean seeds have been reported to contain appreciable amount of minerals and fat (Ariahu et al., 1999; Onyeka and Dibia, 2002; Plahar et al., 2003). The carbohydrate contents decreased with increase proportion of the soy flour in the SSBs, supporting the claims of Akpapunam and co-workers (1997).

The mean sensory scores obtained for the soy supplemented breads (SSBs) and whole wheat breads (WWBs) ranges between 4.8 and 7.6% (Table 2). The analysis of variance (ANOVA) shows that the WWB did not differ significantly from the 5% SSBs ($p<0.05$) in the sensory attributes of aroma, internal texture, taste and general acceptability. However at higher soy flour supplementation, varying significant differences occurs in comparison with the whole wheat breads at the same probability level. Hence soy flour substitution at 5% in bread making would therefore make a good and acceptable sensory attributes with probably no significant differences from the whole wheat bread.

The ranking test conducted reveals that the WWB was preferred in terms of all attributes tested followed by the 5% SSB samples. This could be as a result of the familia-

Table 2. Hedonic sensory mean scores of the soy supplemented and whole wheat bread samples.

Attribute/Bread sample	A	B	C	D
Crust	7.5^{a}	5.7^{bc}	6.4^{ac}	4.9^{b}
Aroma	6.6^{a}	5.7^{a}	5.7^{a}	5.3^{a}
Shape	7.3^{a}	5.7^{bc}	6.2^{ab}	4.8^{c}
Internal texture	6.6^{a}	5.8^{a}	5.5^{a}	4.6^{b}
Taste	6.6^{a}	5.4^{a}	5.4^{a}	5.9^{a}
Appearance	7.6^{a}	5.3^{b}	5.3^{b}	5.3^{b}
General acceptability	6.9^{a}	6.1^{a}	5.4^{b}	5.1^{b}

Mean scores in rows with same letters are not significantly different ($p<0.05$).
A, B, C and D are as defined in Table 1

Table 3. Proximate composition and microbial count of plantain supplemented and whole wheat bread samples.

Parameter/Bread sample	A	B	C	D
Crude protein (%)	7.01	6.67	6.91	8.39
Crude fibre (%)	0.03	0.03	0.02	0.14
Ether Extract (%)	0.76	1.04	1.03	1.03
Ash (%)	0.64	0.71	0.84	0.95
Moisture (%)	30.98	31.50	32.71	33.84
Carbohydrate	60.28	59.75	58.49	57.28
APC (log cfu/g)	3.20	4.30	4.10	4.10

A, B, C and D are as defined in Table 1.
APC – Aerobic plate count.

Table 4. Hedonic sensory mean scores of the plantain supplemented and whole wheat bread samples.

Attribute/Bread sample	A	B	C	D
Crust	8.1^{a}	7.0^{a}	6.4^{ac}	4.8^{b}
Aroma	7.3^{a}	7.0^{a}	6.5^{ab}	5.4^{a}
Shape	6.7^{a}	6.9^{bc}	6.3^{a}	7.0^{a}
Internal texture	7.3^{a}	7.4^{a}	7.5^{a}	5.4^{a}
Taste	7.9^{a}	7.0^{ab}	7.2^{ab}	5.7^{a}
Appearance	7.8^{a}	6.5^{a}	5.8^{b}	6.7^{a}
General acceptability	8.4^{a}	7.9^{a}	7.3^{a}	6.8^{a}

Mean scores in rows with same letters are not significantly different ($p<0.05$).
A, B, C and D are as defined in Table 1.

rization of the consumers to the normal whole wheat bread. It is believed that public enlightenment on the nutritional importance of soy fortified foods would help enhance the acceptability of the soy supplemented breads.

The proximate composition of the plantain flour supplemented breads (PSBs) and the WWBs shows that the highest ash content (0.95%) was recorded for the 15% plantain supplemented breads (Table 3). The ash content increased with progressive increase in the proportion of plantain flour. This could probably be due to the higher ash content of green plantains than in their wheat counterparts (Asiedu. 1989; Ogazi, 1998).

It is interesting to note that the crude protein, crude fibre, and ether extract (fat) obtained for the WWB are comparable to the PPBs, implying that their nutritional qualities are similar. These findings are thus supportive of those reported in the literature on the use of partial substitution of green plantain flour in bread making (Ogazi, 1998; Kure et al., 1998; Pacheco-Delahaye and Testa, 2005).

The mean sensory scores obtained for the whole wheat bread and plantain supplemented breads (PSBs) ranges between 4.8 and 8.4% (Table 4). There were no significant differences ($p<0.05$) in the sensory attributes of shape, appearance and general acceptability between the bread samples at all levels of plantain flour substitutions. Also the reference bread (WWB) did not show significant difference from the soy substituted breads, up to 10%, in the sensory attributes of crust, aroma, taste and internal texture at the same level of probability ($p<0.05$). The implication of this is that plantain flour possesses similar sensory characteristics with the wheat flour (Ogazi, 1998).

The aerobic plate counts (log cfu/g) of the SSB, PSB and the WWB samples range from 3.20 to 4.50. These counts are minimal and within safe levels and cannot constitute health hazards provided the bread samples are well kept, to prevent contamination and microbial proliferation, after processing (Jay, 1987; Fawole and Oso, 1988).

In conclusion, breads produced with soy flour substitution, up to 15%, were nutritionally superior to that of the whole wheat flour. Breads of good nutritional and sensory qualities could be produced from up to 10% soy flour substitution in wheat flour. The nutritional qualities and sensory attributes of plantain flour substituted breads are comparable to that of the whole wheat. It is recommended that up to 15% plantain flour substitution could be adopted in bread making processes, without affecting quality adversely. This will accrue in great savings in the scarce resources of most developing countries, where wheat cultivation does not thrive for climatic reasons.

REFERENCES

Akpapunam MA, Badifu GIO, Etokudo EP (1997). Production and Quality Characteristics of Nigerian *Agidi* supplemented with soy flour. J. Food Sci. Techno., 34(2):143-145

AOAC(1990). Methods of the Association of Official Chemists. Official Methods of Analysis, 15th ed., Virginia Assoc. Official Analytical Chemists, USA. p. 1141

Ariahu CC, Ukpabi U, Mbajunwa KO (1999). Production of African breadfruit (*Treculia Africana)* and soybean (*Glycine max*) seed based food formulations: Effects of germination and fermentation on nutritional and organoleptic quality. Foods for Human Nutr. 54(3): 193-206

Asiedu JJ (1989) Processing Tropical crops. McMillan Education Ltd. London. 1st edn. p.21

Basman A, Koksel H, Ng PKW (2003). Utilization of Transgluranase use to increase the level of barley and soy flour incorporation in wheat flour breads. J. Food Sci. 68(8):2453-2460

Chauhan GS, Zillman RR, Eskin NAM. (1992). Dough mixing and bread making properties of quinoa-wheat flour blends. Int. J. Food Sci. Technol. 27:701-705

Dhingra S, Jood S (2002). Physico-chemical and nutritional properties of cereal-pulse blends for bread making. Nutr. Health. 16(3): 183-94

Edema MO, Sanni LO, Sanni A.I (2005). Evaluation of maize-soybean flour blends for sour maize bread production in Nigeria. Afr. J. Biotechnol. 4(9):911-918

Egan H, Kirk RS, Sawyer R (1981). Pearson's chemical analysis of foods. 8th ed. Churchill Livingstone, Medical division of Long group Ltd. Great Britain, p. 591

Eggleston G, Omoaka PF, Thechioha DO (1992). Development and Evaluation of products from cassava flour as new alternatives to wheaten breads. J. Food Sci. Agric. 56:377-385

Fawole MO, Oso BA (2001). Laboratory Manual in Microbiology. 3rd ed., Spectrum Books Ltd., Ibadan

Frazier WC (1978). Basic Food Microbiology. 3rd edn. pp 102-150

Giami SY, Amasisi T, Ekiyor G (2004). Comparison of bread making properties of composite flour from kernels of roasted and boiled African breadfruit (*Treculia Africana* decne) seeds. J. Mat. Res.1 (1): 16-25

Ihekoronye A (1998). Manual on small scale food processing. 1st ed., Academic Publishers, Nsukka. p.32

Ihekoronye AI, Ngoddy PO (1985). Integrated food Science and technol. for the tropics. 1st ed. McMillan publishers. pp. 261, 265, 291

IITA(1990). Soybeans for good health: How to grow and use soybeans in Nigeria. IITA publication, ISBN 9781310693. p. 23

Jay MJ (1987). Modern Food Microbiol. 3rd ed. CBS Publishers & Dstributors, New Delhi

KureOA, Bahago EJ, Daniel EA (1998). Studies on the proximate composition and effect of flour particle size of acceptability of biscuits produced from blends of soyabeans and plantain flours. Namoda Tech. Scope J. 3(2): 17-22

Oyenuga VA (1972). Nigerian Food and Feeding stuffs, Ibadan.. University of Ibadan press

Ogazi PO (1998). Plantain storage and processing. Proceeding of a Post-harvest Conference, held 2nd Nov. – 1st Dec., 1998, Accra, Ghana.

Onyeka U, Dibia I (2002). Malted weaning food made from maize, soybean, groundnut and cooking banana. J. Sci. Food and Agric. 82(5): 513-516

Pacheco-Delahaye E, Testa G (2005). Nutritional Evaluation of Bread from plantain-wheat composite flours. *Interciencia*, 30(5): 300-304

Plahar WA, Okezie BO, Gyato CK (2003). Development of a high protein weaning food by extrusion cooking using peanuts, maize and soybeans. Plant Foods for Human Nutr. 58(3): 1-12

Satin M. (1988). Bread without wheat: novel ways of making bread from cassava and sorghum could reduce the 3rd world's dependence on imported wheat for white bread. New Sci. 28: 56-59

Simmond NW (1976). Food uses of Banana. Macmillan Publishers, Ibadan

Yanez E, Ballester D, Wuth H, Orrego W, Gattas V, Estay S (1981). Potato flour as partial replacement of wheat flour in bread: baking studies and nutritional value of bread containing graded levels of potato flour. J. Food Technol. 16: 291-298.