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Full Length Research Paper

A study of breadfruit processing and its performance in biscuit production

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Breadfruit was processed into flour and used to supplement wheat flour, in the percentages of 0, 5, 10, 15, 20 and 25, for biscuit production. The proximate composition, sensory evaluation and microbiological quality, in terms of aerobic plate count, were evaluated. The crude fibre and ash contents (%) increased with increase in the proportion of breadfruit flour (BF) level, with the 25% BF level having the values of 4.98 and 6.78 respectively. Lowest values of 11.54, 24.15, and 40.80 were however observed for the biscuit with 25% BF level in terms of crude protein, ether extract and carbohydrate respectively, showing decrease with corresponding increase in the BF levels. The microbiological analysis indicated that the aerobic plate count (APC, log CFU/g) ranged between 1.00 and 1.75. The sensory evaluation showed that breadfruit supplemented biscuits (BSBs) were not significantly different ($p<0.05$) from whole wheat biscuits (WWB) with respect to sensory attributes of texture, appearance and general acceptability, at all levels BF supplementation. In terms of crispiness, aroma and taste, significant differences were not observed only up to 20% BF level, at the same level of probability ($p<0.05$).

Key words: Breadfruit flour, wheat flour, proximate composition, composite biscuit, sensory evaluation, aerobic plate count.

INTRODUCTION

Biscuits are nutritive snacks produced from unpalatable dough that is transformed into appetizing product through the application of heat in an oven (Kure et al., 1998*).* They are ready-to-eat, convenient and inexpensive food product, containing digestive and dietary principles of vital importance (Kulkarni, 1997). The principal ingre-dients are flour, fat, sugar and water; while other ingre-dients include milk, salt, flouring agent and aerating agent (Wade, 1988).

Biscuits are a rich source of fat and carbohydrate, hence are energy giving food and they are also a good source of protein and minerals (Kure et al., 1998).

Breadfruit is a fruit tree that is propagated with the root cuttings and the average age of bearing first crop is bet-ween 4 to 6 years (Amusa et al., 2002). It produces its fruit up to three times in a year and the number of fruits produced is very high. The fruit has been described as an important staple food of a high economic value (Soetjipto and Lubis, 1981). It is commonly cultivated in several other tropical countries like West Indies, Ghana, Sierra Leone, Jamaica and Nigeria. The breadfruit pulps are made into various dishes; it can be pounded, fried, boiled or mashed to make porridge; it can also be processed into flour and used in bread ands biscuit making (Amusa et al., 2002). Breadfruit has also been reported to be rich in fat, ash, fibre and protein (Ragone, 1997). Despite the importance of this fruit, its production is faced with several problems including short shelf life and poor yield due to diseases (Cook, 1975). The fruits are thus utilized in Nigeria within 5 days of harvesting because of their short shelf lives.

The use of composite flours in bread making has been reported by many researchers. Olaoye et al. (2006), investigated the use of supplementation of flours of soybean and plantain in wheat in the production of bread. The research workers were able to obtain acceptable bread samples with up to 15% supplementation of wheat with plantain flour. Also Mepba et al. (2007), produced composite breads and biscuits from mixed flours of wheat and plantain, with up to 30% supplementation of plantain flour. However, the quality attributes of the products tend to decrease with corresponding increase in the percent-

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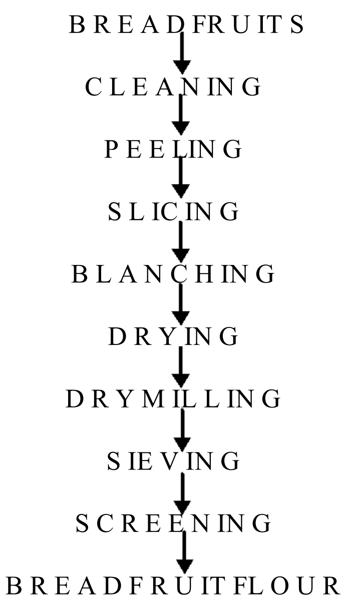

Figure 1. Flow chat for the production of breadfruit flour

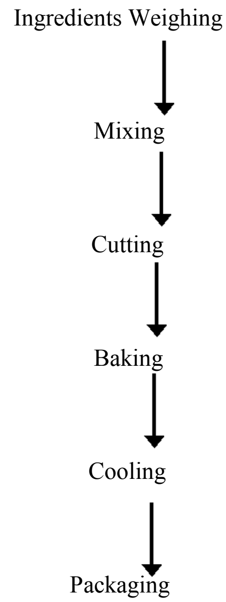

Figure 2. Flow chart for biscuit production.

age substitution with plantain flour. Notwithstanding a successful substitution of up to 15% of composite flour in the production of baked products will go a long way in reducing cost and enhance utilization. In their own findings Giami et al. (2004), were able to successfully make acceptable bread from composite flour of kernels of roasted and boiled African breadfruit.

If such researches are encouraged and commerciallized, it will help in reducing wastage normally associated with our local crops in West Africa and Africa as whole, as well as maximizing their utilization. It is therefore a serious challenge to researchers in Africa to help in finding out how many of our crops could be maximally utilized to prevent associated waste due to lack of proper storage facilities.

This study was aimed at processing breadfruit into flour and to examine its performance in biscuit production, in terms of proximate composition, sensory and microbiological qualities, when used as composite with wheat flour.

MATERIALS AND METHODS

Materials

The breadfruits used for this study were collected from a local market in Ile- Ife, South-Western Nigeria. They were taken to the laboratory for immediate use and processing, in clean polythene bags.

Processing of breadfruit into flour

The breadfruits seeds were processed into flour as shown in Figure 1. The breadfruits were thoroughly washed to remove any dirt and unwanted materials. They were then peeled and washed with clean water. The breadfruits were sliced, blanched for about 5 min and then dried in the oven at 105^{o} C for 1 - 3 h, after which they were milled into flour. The flour was screened through a 0.25 mm British standard sieve (Model BS 410) (Giami et al., 2004)

Blend formation

Six blends were prepared by mixing breadfruit flour with wheat flour in the percentage proportions of 0:100, 5:95, 10:90, 15:85, 20:80 and 25:75 respectively, using machine food processor (Kenwood KM 201, England).

Biscuit production

Biscuits were produced from the six blend formulations using the two stage creaming-up method (Figure 2). The baking formula is as described by Ihekoronye (1999) (modified) . All ingredients except flour and sodium bicarbonate were added with continued mixing. The dough was then placed on a cutting board, rolled out until uniform thickness and textures were obtained. Biscuit cutter was used to cut the sheet of rolled dough into desired shapes and sizes. The shaped dough pieces were then baked at about 220^{o} C for 15 min, allowed to cool, packed and stored (Kure et al., 1998).

Proximate analysis

The proximate composition of the breadfruit supplemented biscuit (BSB) samples was 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 crispiness, aroma, 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 perform-

Table 1. Proximate composition and Aerobic plate count of whole wheat and breadfruit supplemented biscuit samples

Parameter/Biscuit sample	A	B	C	D	E	F
Crude protein (%)	12.50	12.35	11.90	11.75	11.67	11.54
Crude fibre (%)	1.03	1.36	2.27	2.73	3.45	4.98
Ether Extract (%)	26.50	26.35	25.27	24.81	24.23	24.15
Ash (%)	3.09	4.37	5.11	5.90	6.15	6.78
Moisture (%)	11.50	11.45	11.40	11.49	11.67	11.75
Carbohydrate	45.38	44.12	44.05	43.32	42.83	40.80
APC (log CFU/g)	1.00	1.15	i.25	1.25	1.65	1.75

A – Biscuit produced from 100% wheat flour. **B** - Biscuit produced from composite flours of 95% wheat and 5%breadfruit. **C** - Biscuit produced from composite flours of 90% wheat and 10% breadfruit. **D** - Biscuit produced from composite flours of 85% wheat and 15% breadfruit. **E -** Biscuit produced from composite flours of 80% wheat and 20% breadfruit. **F** - Biscuit produced from composite flours of 75% wheat and 25% breadfruit. **APC** – Aerobic plate count.

ed 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 BSB samples using the method of Fawole and Oso, (1988). 10 g of each sample was taken aseptically and homogenized in 90 ml sterile distilled water; in a blender (Philips Type HR 2815i) for about 2 min. 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^{O}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 whole wheat biscuits (WWB) and breadfruit supplemented biscuits (BSB) samples are as presented in Table 1. The crude protein decreased with increase in the proportion of the breadfruit flour (BF) level in the biscuit samples. The highest crude protein (%) of 12.50 was recorded for the WWB (that is, 0% BF level) and this value decreased gradually to the lowest value of 11.54 recorded for the 25% BSB. The protein content of wheat has been reported to be higher than its breadfruit counterpart and this could be responsible for the lower values of crude proteins in the biscuit samples, as the amount of breadfruit flour increases (Morton and Miami, 1987; Asiedu, 1989; Udio et al., 2003).

The crude fibre (%) ranged between 1.03 and 4.98 and this showed a corresponding increase with increase in the proportion of breadfruit flour. Breadfruit has relatively higher crude fibre than wheat and this could justify the result obtained for the different biscuit samples. This observation is in support of the findings of Esuoso and Bamiro (1995) as well as Amusa and co-workers (2002) . Crude fibre is known to aid the digestive system of human (Ihekoronye and Ngoddy, 1985), indicating that the BSBs could attract good acceptability by many people as well as health organizations.

The fat content (%) of the biscuits followed the same trend with crude protein, though the incremental values were minimal. The highest value of 26.50 was recorded for the WWB while lowest value of 24.15 was obtained for the 25% BSB. Fat plays a significant role in the shelf life of food products and as such relatively high fat content could be undesirable in baked food products. This is because fat can promote rancidity in foods, leading to development of unpleasant and odorous compounds (Ihekoronye and Ngoddy, 1985).

The values obtained for the ash contents indicated that the 25%BSB had the highest value of 6.78. The ash contents were observed to decrease with the percentage decrease in the BF level. Breadfruit contains comparatively higher ash content than wheat (Ragone, 1997) and this could be responsible for the higher ash contents recoded for the BSBs than the WWB counterparts. It then follows that incorporation of breadfruit flour in the process of biscuit making could enhance the mineral intake of many people, as ash is indicative of the amount of minerals contained in any food sample.

The moisture contents of the biscuits ranged between 11.50 and 11.75, with the WWB having the highest value. These values were minimal and may not have adverse effect on the quality attributes of the product (Kure et al., 1998).

The carbohydrate contents were highest for the biscuits in terms of all proximate composition parameters (that is, crude protein, crude fibre, ether extract, ash, moisture and carbohydrate) determined in this study. This was expected as the ingredients composed of mainly carbohydrate rich materials, which are wheat and breadfruit flours.

The microbiological examination, in terms of aerobic plate counts (APC, CFU/g), ranged from 1.00 to 1.75. The counts were minimal and are within acceptable limits (Fawole and Oso, 1988).

Microorganisms play significant role in the determination of shelf lives of food products. They are usually responsible for spoilage of many food items. A high aerobic

Table 2. Hedonic sensory mean scores of the whole wheat and breadfruit-wheat composite biscuit samples

Attribute/Biscuit sample	A	B	C	D	E	F
Crispiness	6.7[a]	6.9[a]	7.2[a]	6.8[a]	6.2[ab]	5.7[b]
Aroma	6.7[a]	7.0[a]	7.2[a]	6.7[a]	6.2[ab]	5.6[b]
Texture	6.8[a]	6.8[a]	7.1[a]	7.0[a]	6.9[a]	6.8[a]
Taste	7.1[a]	7.3[a]	7.5[a]	7.1[a]	6.6[ab]	6.1[b]
Appearance	7.1[a]	7.0[a]	7.3[a]	7.1[a]	6.9[a]	6.7[a]
General acceptability	6.7[a]	7.1[a]	7.2[a]	6.9[a]	6.6[ab]	6.3[a]

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

plate count (APC) could indicate the presence mixed population of microorganisms, which may consist of spoilage types. Limits of microbial counts have been recommendded in most foods to keep them safe for consumption (Porter, 1978). The product should however be well kept after processing in suitable packaging materials capable of preventing contamination and hence subsequent proliferation of spoilage microorganisms.

The sensory hedonic mean scores of the bread samples are shown in Table 2. The mean scores decreased with increase in the proportion of BF in all biscuit samples in terms of all the sensory attributes tested. The analysis of variance showed that the BSBs were not significantly different ($p<0.05$) from the WWB up to 20% in terms of all sensory attributes, and up to 26% with respect to texture, appearance and general acceptability. In terms of crispiness, aroma and taste, the 20 and 25% BSB were not significantly different from each other at the same probability level.

CONCLUSION

This study showed that the quality of biscuits could be improved with supplementation of breadfruit flour, in terms of crude fibre and ash. The whole wheat biscuits were not significantly different from the breadfruit supplemented biscuits up to 15% in all sensory attributes tested. The use of breadfruit in biscuit making, and other food products, would greatly enhance the utilization of this crop in developing countries like Nigeria and West Africa in whole, where the crop has not been optimally utilized.

Further work is necessary in terms of the microbiological examinations of the products. In dept analysis into the microbiological qualities and shelf life will help in improvement in the product.

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