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Full Length Research Paper

Storability of breadfruit and its hazard analysis in Nigeria

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Breadfruit (*Artocarpus altilis*) was dried using a multipurpose dryer (MPD) developed by researchers at Nigerian Stored Products Research Institute (NSPRI). Proximate composition of dehydrated flour and those stored for eight and twelve months was carried out. Moisture content was determined by air-oven method, while protein value was determined by Kjeldahl method. There were reductions in the moisture contents of breadfruit and protein values during the course of storage. Moisture contents were found to range between 4.48 and 6.26% within one year of storage, while protein levels were reduced to 4.19 from 8.42%. Mineral profile was determined for calcium, magnesium, zinc, iron, phosphorus and copper at the end of 8-month storage. Hazard analysis and critical control points (HACCP) procedures were developed and applied for producing high quality as well as safe breadfruit flour for both local consumption and export.

Key words: *Artocarpus altilis*, storability, proximate composition, hazard analysis, multipurpose dryer.

INTRODUCTION

Breadfruit (*Artocarpus altilis*) is a highly perishable tropical fruit which can be packaged in sealed polythene bags and stored under refrigeration. It is also a staple food in South Pacific. The tree grows between 12 and 18 m in height and has large oval glossy green leaves, three to nine lobed towards the apex. In the green stage, the fruit is hard and the interior is white, starchy and somewhat soft, the interior is cream or coloured and pasty, also sweetly fragrant (Morton, 1987). The seeds are irregularly oval, round at one end, pointed at the other, about 2 cm long, dull–brown with dark stripes. In the centre of seedless fruits, there is a cylindrical or oblong core in some types covered with hairs bearing flat, brown, abortive seeds of about 3 mm long (Morton, 1987).

Although breadfruit is highly nutritious, cheap and readily available in overwhelming abundance, especially at the peak of the two fruiting seasons, May and August; Bravo et al. (1983) found that breadfruit seeds is constituted of 30.1 to 46.8%, pulp 33.2 to 46.7%, skin 14.3 to 16.0% and the core 5.4 to 6.7% respectively, of the whole fruit. Udoh (1981) compared breadfruit – based diets with cassava and maize- based diets for rearing pullets and laying hens. He showed that feed intakes on breadfruit – based diets were higher than on cassava and maize – based diets, whereas the growth rate of pullets fed on a breadfruit – based diet was low compared to growth rates on the other diets. Anon (2008) had found that mature breadfruit can be boiled, steamed or baked and replace potatoes in many recipes, while small immature fruits can be boiled, pickled or marinated and have a flavour similar to that of artichoke hearts.

Oladunjoye et al. (2010) investigated the effects of processing on the anti nutritional factors in breadfruit and found that cooking completely eliminated trypsin inhibitor and haemaglutinin and reduced the concentration of oxalate and tannin, while phytic acid was unaffected. Breadfruit has for long been underexploited in Nigeria due to its low social esteem (Omobuwajo and Wilcox, 1989). Because of its underexploitation, there is need for further work on its nutritional quality and mineral

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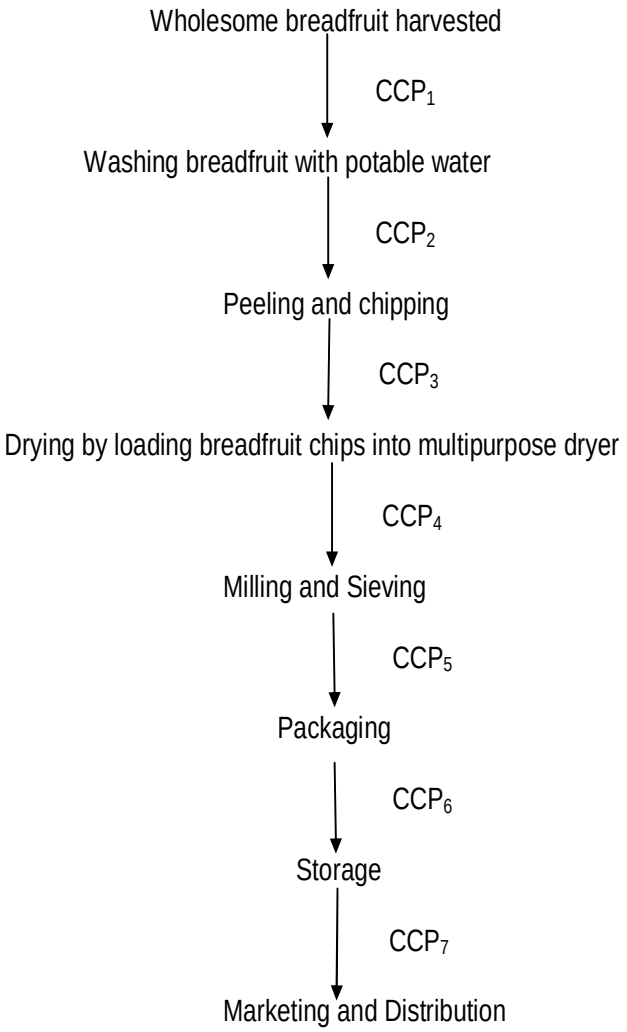

Figure 1. Flow chart for production of breadfruit flour.

composition. Therefore, this work was carried out to furnish this information and also to produce safe breadfruit flour for human consumption and export.

MATERIALS AND METHODS

Breadfruit samples were collected from a farm at Ifewara in Osun State, Nigeria. The outer surface of the breadfruit samples was washed and peeled. The peeled samples were washed, chopped into small bits and dried in a multipurpose dryer at a temperature of 49℃ for a period of 8 h. The dried samples were milled and analyzed for proximate composition before packaging in transparent polythene bags with a gauge of 0.04 mm and stored under hermetic conditions. Samples were also taken for analysis at the end of the 8th and 12th months storage respectively (Figure 1).

Mineral profile of the dried breadfruit flour samples were determined at the end of 8 months using Atomic Absorption Spectrophotometer (AAS) for Ca, Mg, Mn, Zn, Fe, and Cu, while P was determined with the aid of Ultra Violet (UV) – Visible Spectrophotometer. The mean values of 3 replicates with their corresponding standard errors were recorded for all analysis. Proximate determination of samples was carried out using the methods of A.O.A.C. (2000). Hazard analysis procedure was developed and applied in the production of safe breadfruit flour.

RESULTS AND DISCUSSION

Table 1 shows the proximate composition of breadfruit flour in storage. The results indicated moisture reduction and samples were still within safe moisture level. This observation is similar to the work of Mejule and Lameke (1982) who reported moisture reduction of 0.31% during the course of storage of cocoa beans. Similar result in moisture reduction of 0.30% was obtained by Opadokun and Sowunmi (1985) who worked on storability and quality of maize and sorghum stored in metal silos for four years.

There was gradual reduction in protein levels during the course of storage. The crude protein of freshly dried flour was found to be 8.42 ± 0.13%, while reduction noted at the end of the 12-month storage was found to be 4.11 ± 0.06%. This observation is similar to the results obtained by Opadokun and Sowunmi (1985) who found reduction of 0.3% in the crude protein of maize stored in silos at the end of 12 months. These authors also found reduction of 0.9% in crude protein of sorghum stored in silos at the end of three years. There was no definite trend in fibre composition in storage, fibre was observed to range between 0.91 ± 0.05% and 2.92 ± 0.15% in one year storage. It was found that crude fibre composition of dehydrated breadfruit sample in this study was higher than that of yellow maize which was recorded to be 1.32% (Oyenuga, 1968). However, the crude fibre composition of fresh guinea corn (2.94%) as reported by Oyenuga (1968) was found to be higher than 0.91% obtained for dehydrated breadfruit samples stored for twelve months. The total minerals composition (ash) in this study was found to increase from 2.50 to 4.71% during the course of storage. This was in agreement with the results obtained by Opadokun and Sowunmi (1985) who had a range between 2.1 and 3.1% during the course of storage of sorghum in metal silos for one year.

However, reduction of 1.4% was observed in ash content when the samples were stored further till 4 years. Reduction could also have been observed in storage of breadfruit flour, if it had been stored for more than one year due to hermetic storage environment. The values of ash obtained in dehydrated flour and those stored were found to be higher than 1.61% obtained for the seed of African breadfruit reported by Oyenuga (1968). Whereas the values obtained in this study for dehydrated flour was lower than 3.2 ± 0.04% which was reported by (Loos et al., 1981). There was fluctuation in ether extract during the course of storage with the highest recorded for dehydrated sample, while the least value was obtained for sample stored for 8 months. It was observed that the value of 4.15%, got for dehydrated breadfruit was higher

Table 1. Proximate composition of breadfruit flour in storage.

Parameter	Mean values (Before storage)	Mean values (8-month storage)	Mean values (12-month storage)
Crude protein (%)	8.42 ± 0.13	7.22 ± 0.09	4.11 ± 0. 06
Crude fibre (%)	1.91 ± 0.21	2.92 ± 0.15	0.91 ± 0.05
Ash (%)	2.50 ± 0.02	4.50 ± 0.08	4.71 ± 0.09
Ether extract (%)	4.15 ± 0.02	1.29 ± 0.07	1.74 ± 0. 06
N.F.E.(%)	83.01 ± 0.31	84.03 ± 0.02	86.53 ± 0.21
M.C. (%)	6.25 ± 0.08	5.21 ± 0.06	4.48 ± 0.07

Table 2. Mineral profile of dehydrated breadfruit stored for 8 months.

Mineral	Values (ppm) µg/g
Ca	232.0 ± 6.50
Mg	163.8 ± 4.43
Mn	8.3 ± 0.17
Zn	61.5 ± 1.41
Fe	59.6 ± 1.37
P	274.0 ± 7.41
Cu	54.6 ±1.04

than what was obtained (3.6 ± 0.06%) by Loos et al. (1981). This could probably be due to the concentration of fats in dehydrated breadfruit when compared to that of fresh samples. An increase of 3.52% was observed in the composition of nitrogen free extract (NFE) in this study during the course of storage.

This observation is not in accord with the results of NFE obtained by Opadokun and Sowunmi (1985) who noted reduction of 0.1% during the course of one year storage of sorghum stored in metal silos. The mineral characterization of breadfruit stored for 8 months showed that it has a high content of calcium, magnesium and phosphorus which would aid bone and teeth formation in children. The levels of some minerals present in breadfruit are similar to that of sweet potato that had 250 and 280 ppm for calcium and phosphorus respectively as reported by Oyenuga (1968). The breadfruit flour production line in Nigeria mainly, consists of harvesting, transportation, processing methods: washing, peeling and chipping, dehydration and milling; packaging and storage (Table 2).

Hazard analysis and critical control points

HACCP approach was applied to control and reduce the hazards to acceptable levels thereby producing safe breadfruit flour for human consumption as follows: wholesome breadfruit was harvested in the evening and transferred from Ile-Ife (Osun State) to Ibadan (Oyo State) using Nigerian Stored Products Research Institute (NSPRI's) ventilated plastic crates (CCP_1 was uncontaminated breadfruit). Harvested breadfruit samples were washed with potable water thereby eliminating microbial hazards and extraneous materials (CCP_2). Peeling and chipping of breadfruit were carried out with stainless knives which eliminated contamination (CCP_3). Loading of breadfruit chips into multipurpose dryer (MPD). Here, good handling practices were employed in order to eliminate body contamination and pathogens (CCP_4). The milling of dehydrated breadfruit was carried out using stainless steel hammer mill and stainless sieves (CCP_5) which was sterilized.

The breadfruit flour samples were packaged in food grade polythene which conformed to standard specification with gauge of 0.04 mm. This would eliminate leakage and microbial contamination (CCP_6). The packaged breadfruit flour was stored under hermetic conditions until sold. This would eliminate moisture migration, caking, mouldiness and mycotoxin contamination during the course of storage (CCP_7). The breadfruit flour sold to the market were monitored until sold completely. The vehicle used for transportation was thoroughly cleaned to avoid contamination.

CONCLUSION AND RECOMMENDATION

Dehydrated breadfruit flour is highly nutritious and can be stored for at least 8 months in transparent polythene bags without adverse effects in terms of qualities for both local consumption and export. Therefore, there are needs for its popularization and commercial awareness, and more support with production and processing techniques could help put this time-honoured staple crop back on the menu and encourage its export.

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