African Journal of Biotechnology Vol. 1 (2), pp. 57–60, December 2002
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2002 Academic Journals

Bio-deterioration of breadfruit (*Artocarpus Communis*) in storage and its effects on the nutrient composition

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Accepted 18 November 2002

The bio-deterioration of breadfruit in storage and its effects on the nutrient composition of the fruit was investigated at Ibadan, Southwestern Nigeria. Freshly dropped fruits were stored under laboratory conditions for a period of 9 days. *Aspergillus niger, Rhizopus stolonifer, Botryodiplodia theobromae, Mycovellosiella fulva, Penicillium sp.* and *Aspergillus flavus,* were found associated with deteriorating breadfruit in storage The freshly harvested breadfruit has 70.2% carbohydrate which reduced to 59.4% within 9 days of storage under room temperature. The amount of fat content, protein and the energy of the breadfruit also reduced in fruit samples stored for 9 days, while there was an increase in the moisture content, crude fibre, and ash content of the breadfruits in storage. The mineral contents also increased during the period of storage.

Key words: *Artocarpous communis*, bio-deterioration, breadfruit, storage nutrient composition, pathogens.

INTRODUCTION

Artocarpous communis (breadfruit) is a member of the Moraceae, a family of about 50 genera and over 1000 species (Tindal, 1965.) Breadfruit is a fruit tree that is propagated with the root cuttings and the average age of bearing first crop is between 4-6 years. It produces its fruit up to 2-3 times in a year and the number of fruits produced is very high (Soetjipto and Lubis**,** 1981). The fruit is aromatic, rich in latex and can weigh 1-4 kg (Yamaguchi, 1983).

The plant occurs in the wild in Iran and Micronesia, while its secondary centre of diversity is Polynesia. It is commonly cultivated in several other tropical countries like West Indies, Ghana, Sierra Leone, Nigeria and Jamaica (Dailziel, 1955). Breadfruit has been described as an important staple food of a high economic value (Soetjipto and Lubis, 1981) and it is a source of carbohydrate and forms a portion of the diet in several countries particularly in the highlands of the south pacific (Purseglove, 1968).

The breadfruit pulps are made into various dishes. It can be pounded, fried, boiled or mashed to make porridge. It can also be ground into flour and used in bread and biscuit making. Due to its high amount of carbohydrate, it can easily replace such carbohydrate-rich fruits like banana, though its hydrolyzable carbohydrates are thought to be higher (Parkison, 1984). Breadfruit is also known to be rich in fat, ash, fibre and protein (Tindal, 1965).

Despite the importance of breadfruit, its production is faced with several problems. This includes short shelf life and poor yield due to diseases (Cook, 1975). Since the shelf lives of breadfruits are short, they are often utilized in Nigeria within 5 days of harvesting. However, it can take up to 10 days after harvesting to get to the markets in some major cities, resulting in huge loses due to bio-deterioration. This study was therefore designed to investigate the etiology of bio-deterioration of breadfruit in storage and the probable effect on its nutrient status.

MATERIALS AND METHODS

Breadfruits were picked immediately after dropping from trees in a plantation at Ile-Ife, Osun State in Southwestern Nigeria. Twenty-five trees were selected

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and three fruits per tree were used for this experiment. The fruits were kept in sterile polythene bags and taken to the pathology laboratory of the Institute of Agricultural Research and training, Obafemi Awolowo University, Moor Plantation Ibadan, Nigeria. After nine days of storage in clean chamber at room temperature, the fungi that emerged from the fruits were isolated aseptically and plated on sterilized Potato Dextrose Agar in Petri dishes.

The inoculated plates were then incubated at 25 ± 1^0C for 6 days. The associated pathogens were identified using cultural and morphological features and by comparison with culture which was obtained from the seed health pathology laboratory of the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, and which had been identified by the International Mycological Institute, CABI Bioscience, Egham, UK.

Pathogenicity test

Freshly harvested (matured) breadfruit were surface sterilized by swabbing with 70% alcohol and bore into with a sterile cork-borer (4mm in diameter). A similar sterile cork-borer was used to cut pellets of agar containing 3-day old cultures of fungal mycelia of the isolates. These fungi were then used to inoculate the hole created by scooping out breadfruit tissue. The scooped out tissues were replaced to cover the bored hole in the breadfruit. Three breadfruits were inoculated with each isolate and 3 inoculating site of equal distance on each fruit were used. The inoculated fruits were then enclosed in polythene bags containing moist cotton wool to maintain high relative humidity and incubated at 25^0C in Gallenkamp incubators for seven days. Differences in the rate of infection were then recorded.

Determination of moisture content

Representatives portion of the fresh breadfruit samples taken at intervals of two-day for 9 days were weighed (in triplicates). These same samples were placed in an oven at 80^0C for 20 h, and weighed. The moisture content of the fruits was calculated according to AOAC (1984).

Nutrient content analysis

Three fruits from each tree were used for the analysis. Samples were excised from the fruits at a distance of 4cm from each other and at intervals of two days for nine days. These were weighed, cut into pieces and dried in a hot air oven at 60^0C for 3 days. After grinding into powder, the samples (in triplicates) were analyzed for ash, crude fibre, crude protein, carbohydrate, energy and the nitrogen free extract using the official method of analysis (AOAC, 1984). Chemical elements were also analyzed according to standard methods (AACC, 1983) at the analytical laboratory of the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.

RESULT

Six fungi were found associated with softening of the mesocarp (pulp) of breadfruit leading to production and emitting of offensive odour. These fungi are *Aspergillus niger, Rhizopus stolonifer, Botryodiplodia theobromae, Mycovellosiella fulva, Penicillium sp.* and, *Aspergillus flavus* (Table 1). With the exception of *M. fulva* which was slightly pathogenic, all the other fungi were able to induce extensive rotting in breadfruit within few days. On the first day of storage no fungus was isolated from the fresh fruit, while on the 3rd day, *A. niger, M. fulva and R. stolonifer* were found associated with the deteriorating fruits. Five days after storage the isolated fungi from breadfruits were *B. theobromae* can be observed in addition to the three mentioned above. On the 7th and 9th day of storage, *B. theobromae* covers over 60% of the fruit surface, and the others including *Penicillium sp*. can be observed.

Table 1. Frequency of fungi associated with deterioration of breadfruit and their pathogenic importance.

Fungi isolates	% Frequency of isolation	Pathogenicity
A. niger	95	+++
R.stolonifer	87	+++
B theobromae	100	+++
M. fulva	48	+
Penicilium sp	65	+++
A .flavus	52	++

+ Slightly pathogenic
++ Pathogenic
+++ Highly pathogenic

The freshly harvested breadfruit was found to contain carbohydrate and moisture contents of about 70.2% and

Table 2: Effect of biodeterioration of breadfruit in storage on its nutrient composition.

Nutrient Composition*	Days in storage				
	1	3	5	7	9
Carbohydrate	70.1	68.3	63.6	61.9	59.4
Moisture content	19.1	20.5	21.2	21.5	22.0
Fat	4.5	4.4	4.2	3.9	3.4
Crude protein	3.8	4.0	4.2	4.7	5.1
Ash	3.5	3.5	4.0	4.3	4.6
Crude Fibre	1.9	2.0	2.6	3.4	4.0
Energy (KCal)	310	260	210	180	180

* % Composition in 100gm of the sample.

19.10%, respectively. The carbohydrate content decreases with storage time at room temperature, while increase in moisture was observed (Table 2). The fat content was low and continuous decrease was also observed during storage. The crude fibre, crude protein, and ash content of the fruits were found to increase with storage, while the energy of 31O KCal found in the freshly harvest breadfruit gradually decreased with increase in storage time. Generally, the analysed minerals, which include potassium, iron, phosphorus, calcium and magnesium, increased with storage time (Table 3).

Table 3: Effect Of bio-deterioration of breadfruit in storage on its mineral contents.

Analyzed Minerals	Days in storage				
	1	3	5	7	9
Iron	0.029[a]	0.038	0.043	0.048	0.052
Calcuim	0.018	0.024	0.028	0.034	0.039
Phosphorus	0.043	0.073	0.114	0.115	0.115
Magnesium	0.02	0.03	0.06	0.07	0.07
Potassium	1.65	2.20	2.23	2.32	2.39

[a] % Composition in 100grm of the samples

DISCUSSION

The fungi found associated with deteriorating breadfruit in storage were *A. niger, Rhizopus sp., B. theobromae, M. fulva*, *Penicillium sp. and A. flavus.* Purseglove (1968) reported that *Rhizopus artocapi*, which is similar to one of the fungus observed in this study, as responsible for the soft rots of breadfruit in India. While the fungi found associated with the deteriorating seeds of African breadfruit (*Treculia africana*) in Nigeria are *A. niger, R stolonifer, B. theobromae* and yeast (Nwufo, and Mba, 1987).

The decrease in carbohydrate content of breadfruit stored at room temperature might be due to fermentation caused by microbes and the respiratory loss of sugars as $C0_2$. Parkison (1984) have also reported that fermented breadfruit is low in carbohydrate content. Ikediobi and Oti (1983) as well as Ravinduram and Wanasindera (1992), also attributed the steady decline in starch contents of stored *Dioscorea rotundata* tubers to the respiratory loss of sugars as carbon dioxide. There was also fat decrease in breadfruit with storage time, which is consistent with the observation that fermented breadfruit is low in fat as compared to fresh breadfruit (Nwufo and Mba, 1987; Thompson et al., 1974).

The increase in moisture content with storage time might partly be due to metabolic water. Ladele, et al. (1984) had reported that the moisture content of banana increased during storage, while the moisture content of ripe banana is higher that of the unripe fruit (Ketiku, 1973). Increase in crude fibre content was observed as from the 5th day. Awan and Ndubizu (1978) earlier observed that fibre content remained almost constant for the first week of storage. Ketiku (1973) however reported an increase in fibre contents from 0.5%-1.1% in the unripe banana to ripe pulp. Our observation of the increase in ash during storage is in agreement with the report of Ketiku (1973) who showed that ash content of banana increased from 2.0g in unripe plantain to 2.2g in the ripe fruit. Also the increase in crude protein contents of breadfruit with increase in storage time is similar to observations in other fruits (Awan and Ndubizu, 1978; Ketiku, 1973).

It is therefore advocated that breadfruit pulp be utilized within the first-four days after harvest. This will not only prevent excessive infection of the pulp by fungal pathogens but will also eliminate the possibilities of contamination with mycotoxins and other related metabolites of infecting pathogens that might be hazardous to human health.

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