Determination Of Mineral And Vitamin Composition Of Sun Dried Bread Fruits Found In Rivers State, Nigeria.

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Abstract
Studies on the mineral and vitamin composition of three sun dried species of bread fruits were carried out in the Department of Plant Science and Biotechnology, Rivers State University. The mineral components investigated were calcium, phosphorus, potassium, iron, magnesium and sodium for the three species preserved for six months. A. camansi recorded highest contents of calcium (7.6±0.1) and magnesium (5.3±0.1). Although, highest values for potassium (15.1±0.00) and sodium (5.8±0.1) were recorded for A. heterophyllus species. Equal value of iron (5.0±0.00) was found in both A. camansi and A. heterophyllus. However, T. africana had highest concentration of phosphorus (3.6±0.01). Three vitamins were present in the tested species of bread fruits with H. heterophyllus recording the highest values of 42±0.00, 6.5±0.1 and 5.5±0.1 for Vitamins C, A and thiamine respectively. However, there was no vitamin C content in A. camansi and A. heterophyllus for months 5 and 6. T. africana recorded no vitamin C in months 3, 4, 5 & 6. Generally, highest performance in mineral content was observed in A. camansi while A. heterophyllus had more vitamins than the other bread fruit species.

Keywords: *Breadfruits, mineral, vitamin and shelf life.*

INTRODUCTION

Shelf life preservation involves drying of fruits, vegetables and herbs and it is a process which can be done without any special equipment or expertise. The essence of drying is to reduce the moisture contents of these materials to their safe level bearing in mind that high relative humidity and moisture encourage the deterioration of most agricultural produce leading to microbial infection (Chuku *et al.*, 2004). Chuku, (2010) reported the preservation of the fruits of Avocado pear using crude extracts of *Aloe vera*. It was observed that ripening was delayed in fruits treated with *A. vera* gel for 14 days at room temperature while the untreated fruits ripened after 5 days of storage at room temperature. Mould growth manifested as soon as the mesocarp became soft and on the 10th day of storage, the untreated fruits were completely covered with molds and the infected fruits exuded smelly fluids indicating complete deterioration of the fruits. However, the treated fruits even after they became soft resisted mold infection further buttressing the fact that *A. vera* gel inhibited mould growth on the fruits thereby bringing about prolonged shelf life of the fruits. Storage studies on groundnut and cashew nut paste (ose-oji) over a period of 3 weeks (21 days) showed an increase in the percentage of free fatty acid (FFA) in the first two weeks and a decrease in the peroxide values (PV%) of all samples. Spicing also showed an increase in the FFA% and a decrease in PV over the period of study (Ekejiofor, 2011).

Chuku and Chuku, (2015) also reported the shelf life preservation of *Dennettia tripetala* Baker F. It was observed that sundrying and smoking of the fruits of *D. tripetala* under low heat greatly stabilised the fruit quality in terms of mould growth and palatability. Smoking must have greatly reduced the moisture content of the fruits and thus concentrated the nutrients. The low moisture level of the smoked fruits also caused negative effects on the fungal isolates which could not penetrate the fruits and as such could not establish on the fruits.

Harvesting and handling procedures prior to drying are very important in achieving good quality products. According to Brenndorfer *et al.*, (1985), pre-drying procedures may include hygiene, cleaning, grading and sizing, peeling, (coring, pitting, trimming), cutting (slicing), blanching, use of additives, sulphuring, salting or sugaring. The sequence and specific procedures depends on the crop to be dried.

In the culinary sense, flour is a powder made from cereal grains, other seeds, or roots. It is the main ingredient of bread, which is a staple food for many civilizations, and other products. Wheat flour is one of the most important foods in Europe, North American, Middle East and North African cultures, and is the defining ingredient in most of their styles of breads and pastries. Higher gluten content produces lighter and softer baked products by embedding small gas bubbles. Jackfruit seed flour has high carbohydrate, especially fibre and other nutritional content (Jinshui *et al.*, 2002). The seeds are thus blended into flour and mix with other flours in baking (Verheij, 1991).

MATERIALS AND METHODS

Sample Collection and Preparation

Fruits of Artocarpus camansi were obtained from Ozuaha all in Ikwerre Local Government Area of Rivers State. *Artocarpus heterophyllus fruits* were obtained from Tere Ama in Phalga Local Government Area while *Treculia africana* were obtained from Bori in Khana Local Government Area respectively.

Freshly harvested matured unripe fruits were washed with clean water and transported immediately to the laboratory for proximate, mineral, vitamin and phyto-chemical content analysis.

Processing and preservation of Flours

Extracted breadfruit seeds were boiled, dehusked and blended. The blended sample was sundried. The sundried flours were preserved in air tight containers and stored for six months. Samples were taken monthly to assess the mineral and vitamin compositions.

Fermentation of fruits for 5 days

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Seed extract from 20 ripe fruits

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Washing of seed (2kg)

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Sun drying for 24hrs

↓

Dehusking

↓

Milling (blender milling)

↓

Sun-drying

↓

Packaging in plastic plates

Figure 1: ***A. camansi, T. africana and A. heterophyllus*** **seed flour production**

Nutrient Determination

Mineral and proximate composition of *A. altilis, A. amansi, A. heterophyllus* and *Treculia africana* were determined by atomic absorption spectrometry, flame photometry and spectro-photometry according to the methods of AOAC (2010).

Data Analysis

All procedures were carried out in triplicates and data obtained were subjected to one way analysis of variance (ANOVA). The means were tested for significance at 5% level using Duncan's multiple range (DMR) test.

RESULTS AND DISCUSSION

Table I: Effects of the Mineral Composition of Sun-dried Flours of Three Species of Breadfruit Stored for six Months

Sun Dried Flour Samples of Bread Fruit	Months	Mineral Composition(mg/100g)					
		Ca	**Fe**	**Mg**	**P**	**K**	**Na**
A. camansi	Month 1	1.4±0^{b}	4.1±0^{c}	2.5±0^{c}	4.4±0.1^{c}	3.47±0.06^{b}	2.9±0^{b}
	Month 2	1.6±0^{b}	4.2±0^{c}	3.0±0^{c}	4.0±0.1^{c}	3.6±0.1^{b}	3.0±0^{b}
	Month 3	7.4±0.1^{a}	5±0^{a}	4.5±0^{b}	3.6±0^{c}	12.8±0^{a}	3.3±0^{a}
	Month 4	7.5±0.1	4.5±0^{b}	4.7±0^{b}	4.5±0^{c}	12.6±0^{a}	3.3±0^{b}
	Month 5	7.6±0.1	4.5±0^{b}	5.0±0.1^{a}	30.2±0^{b}	12.65±0^{a}	3.4±0.1^{a}
	Month 6	7.6±0.1^{a}	4±0^{c}	5.3±0.1^{a}	37±0^{a}	12.7±0.1^{a}	3.4±0.1^{a}
A. heterophyllus	Month 1	1.5±0^{b}	5±0^{a}	2.3±0^{b}	5.5±0^{b}	4.2±0^{c}	4.4±0.1^{b}
	Month 2	1.5±0^{b}	5±0^{a}	2.3±0^{b}	5.5±0^{b}	6.2±0$^{4.}$	4.4±0^{b}
	Month 3	1.5±0^{b}	5±0^{a}	2.3±0.1^{b}	5.5±0.1^{b}	14.2±0.1^{b}	5.8±0.1^{a}
	Month 4	1.6±0^{b}	5±0^{a}	2.4±0^{c}	5.6±0^{b}	14.2±0^{b}	5.8±0.1^{a}
	Montn 5	1.8±0^{a}	4±0^{b}	3.5±0^{b}	7.0±0^{a}	14.6±0^{b}	5.8±0.1^{a}
	Month 6	1.8±0.1^{a}	4±0^{b}	3.9±0^{a}	7.2±0^{a}	15.1±0^{a}	5.8±0.1^{a}
T. Africana	Month 1	1±0^{b}	4.53±0.06^{a}	3.2±0^{b}	5±0^{b}	3.2±0^{c}	3±0^{b}
	Month 2	1±0^{b}	4.53±0.06^{a}	3.2±0^{b}	5±0^{b}	3.2±0^{c}	3.4±0^{a}
	Month 3	1±0^{b}	4.5±0^{a}	3.2±0.1^{b}	5.1±0^{b}	3.3±0^{b}	3.4±0^{a}
	Month 4	1±0^{b}	4.2±0^{a}	3.4±0^{b}	5.1±0^{b}	3.4±0^{c}	3.4±0^{a}
	Month 5	2±0^{a}	3.8±0.1^{b}	4±0^{a}	60±0^{a}	10.2±0^{b}	3.34±0^{a}
	Month 6	2±0^{a}	3.8±0.1^{b}	4±0^{a}	60±0^{a}	13.2±0^{a}	3.5±0.1^{a}

Means with different superscripts within the same row are significantly different ($P \leq 0.05$)

Legend: Ca= calcium; Fe= Iron; P= Phosphorus; K=Potassium; Na= Sodium and Mg= Magnesium

Table II: Mean Effects of the Vitamins Composition of Sun-dried Flours of Three Species of Breadfruit Stored for six Months

Sun Dried Flour Samples of Bread Fruit	Months	Vitamins(mg/100g)		
		Vitamin C	Vitamin A	Thiamin
A. camansi	Month 1	$41±0^{a}$	$2.6±0^{a}$	$0.5±0^{b}$
	Month 2	$41±0^{a}$	$2.4±0^{a}$	$0.5±0^{b}$
	Month 3	$0.05±0^{b}$	$0.15±0.01^{c}$	$0.05±0^{c}$
	Month 4	$0.05±0^{b}$	$0.02±0^{c}$	$0.04±0^{c}$
	Month 5	-	$1.6±0^{b}$	$5±0^{a}$
	Month 6	-	$1.8±0^{b}$	$5.1±0^{a}$
A. heterophyllus	Month 1	$42±0^{a}$	$2.5±0^{c}$	$0.3±0^{c}$
	Month 2	$42±0^{a}$	$2.6±0^{c}$	$0.3±0^{c}$
	Month 3	$0.4±0^{b}$	$4.5±0^{b}$	$0.8±0.1^{b}$
	Month 4	$0.4±0^{b}$	$4.7±0^{b}$	$0.7±0.1^{b}$
	Month 5	-	$6.4±0^{a}$	$5.3±0.1^{a}$
	Month 6	-	$6.5±0.1^{a}$	$5.5±0.1^{a}$
T. Africana	Month 1	$0.5±0.1^{a}$	$4.8±0.1^{b}$	$0.12±0.01^{b}$
	Month 2	$0.2±0.1^{b}$	$4.9±0.1^{a}$	$0.15±0.01^{b}$
	Month 3	-	$5.1±0^{a}$	$5.5±0.1^{a}$
	Month 4	-	$5.1±0^{a}$	$5.5±0.1^{a}$
	Month 5	-	$5.1±0^{a}$	$5.5±0.1^{a}$
	Month 6	-	$5.1±0^{a}$	$5.5±0.1^{a}$

Means with different superscripts within the same row are significantly different ($P \leq 0.05$)
Key
- = No vitamin C

The calcium content of *A. camansi* for month 1, month 3 and month 6 were 1.4±0, 7.4±0.1 and 7.6±0.1 respectively. There was significant (P≤0.05) difference. The calcium content of *A. heterophyllus* for month 1 and 3 were 1.5±0 while month 6 was 1.8±0.1. *T. africana* for months 1 and 3 were 1±0 while month 6 was 2±0. This result showed that the calcium content of sundried flours of breadfruit increased significantly (P≤0.05) at month 6. Calcium supports and strengthens the skeletal system (Greenberg, 1995; Aremu *et al* 2006).
The iron content of *A. camansi* for month 1 was 4.1±0; month 3 was 5±0 while month 6 was 4±0. The iron content of *A. heterophyllus* for months 1 and 3 were 5±0 while month 6 was 4±0. The iron content of *T. africana* for months 1 and 3 were 4.53±0.06 and 4.5±0 while month 6 was 3.8±0.1. This result revealed that the iron content of sundried breadfruit flours reduced at month 6. Iron has been known to be a major part of the blood component (Devillota *et al*., 1981; Agbagwa *et al*., 2020a).
The magnesium content of *A. camansi* for month 1, 3 and 6 were 2.5±0, 4.5±0 and 5.3±0.1 respectively. *A. heterophyllus* for months 1 and 3 were 2.3±0 and 2.3±0.1 while month 6 was 3.9±0. That of *T. africana* for months 1 and 3 was 3.2±0 and 3.2±0.1 while month 6 was 4±0. This result showed that magnesium content of the breadfruit flours increased and were not affected by processing and storage. The relevance of magnesium cannot be overlooked as it is vital for several metabolic processes (Falade *et al*., 2003).
The phosphorus content of *A. camansi* for months 1, 3 and 6 were 4.4±0.1, 3.6±0 and 37±0. That of *A. heterophyllus* was 5.5±0 and 5.5±0.1 for months 1 and 3 while month 6 was 7.2±0. That of *T. africana* was 5±0 and 5.1±0 for months 1 and 3 while month 6 recorded 60±0.

This result showed that the phosphorus content of sundried flours of breadfruit increased significantly (P≤0.05) at month 6. Moreover, the phosphorus content of sundried flours is known to be higher than that of the seeds (Aremu *et al*., 2006).
The potassium content of *A. camansi* for months 1, 3 and 6 were 3.47±0.06, 12.8±0 and 12.7±0.1. *A. heterophyllus* for months 1, 3 and 6 were 4.2±0, 14.2±0.1 and 15.1±0 respectively. *T. africana* for months 1, 3 and 6 were 3.2±0, 3.3±0 and 13.2±0 respectively. The potassium content of sundried flours of breadfruit increased significantly (P≤0.05) at months 3 and 6. Potassium is essential for several metabolic processes (Appiah, 2011).
The sodium content of sundried flour of *A. camansi* for months 1, 3 and 6 were 2.9±0, 3.3±0 and 3.4±0.1 respectively. *A. heterophyllus* for month 1 was 4.4±0.1 while months 3 and 6 were 5.8±0.1. *T. africana* for month 1 was 3±0 while month 3 and 6 were 3.4±0 and 3.5±0.1 respectively. In conclusion, the mineral content of sundried breadfruit flours increased considerably when compared to month 1 (control). Aremu *et al*. (2006) reported similar findings.

The vitamin C content of *A. camansi* for month 1 was 41±0; month 3 was 0.05±0 while month 6 had no vitamin C. That of *A. heterophyllus* was 42±0 for month 1, month 3 was 0.4±0 while month 6 had no vitamin C content. *T. africana* for month 1 was 39±0; month 3 recorded 1.5±0 while month 6 had no vitamin C content. This study revealed that the month 1 of sundried flour of breadfruit seeds had high vitamin C content (41±0 for *A. camansi*, 42±0 for *A. heterophyllus* and 39±0 for *T. africana*). Month 3 had a reduction in vitamin C content while month 6 had no vitamin C content at all. This is surprising as breadfruit seeds recorded no vitamin C content whereas sundried month 1 had high vitamin C content and a similar situation was reported by Agbagwa *et al*., (2020b). Presence of vitamin C provides antioxidants which help the body to develop resistance against infectious agents and the production of collagen which provides elasticity to the skin and nourishment to the hair. (WHO, 2004).
The vitamin A content of sundried *A. camansi* for month 1 was 2.6±0 while months 3 and 6 recorded 0.15±0.01 and 1.8±0. *A. heterophyllus* for months 1, 3 and 6 were 2.5±0, 4.5±0 and 6.5±0.1 respectively. *T. africana* recorded 2.2±0 for months 1 and 3 while month 6 recorded 5±0. This result revealed that sundried flours of breadfruit stored for 6 months could still supply vitamin A which promotes good eyesight (WHO, 2004).
The thiamin content of *A. camansi* for months 1, 3 and 6 were 0.5±0, 0.05±0 and 5.1±0. *A. heterophyllus* for months 1, 3 and 6 were 0.3±0, 0.8±0.1 and 5.5±0.1 respectively. *T. africana* for months 1, 3 and 6 were 0.1±0, 0.15±0 and 5.4±0.1. This result revealed that thiamin content increased significantly (P≤0.05) at month 6. Sundried flours of breadfruit preserved for 6 months could still supply thiamin to the body. Bender, (2003) indicated the importance of thiamin during the metabolism of pyruvate.

CONCLUSION

The present study has shown that the tested sundried breadfruit species had appreciable amounts of minerals and vitamins after a period of six months storage. Therefore, breadfruit should be in cooperated into daily diets as the nutrients it contains are essential for healthy living.

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