

Production and Evaluation of African Breadfruit (*Treculia Africana*) Beverage

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Abstract

African breadfruit (*Treculia africana*) seeds were processed into flour which was blended with malted sorghum, skimmed milk and sugar in different ratios and was used in the production of beverage. The proximate composition, functional and sensory properties were evaluated. The moisture content increased with increase in African breadfruit substitutes in each formulation and the value ranged from 6.06% - 7.22%. The breadfruit-based beverage was very low in fat and crude fibre contents. The crude fibre content ranged from 0.40 - 1%. The protein content of the beverage was quite high and the value ranged from 20.33-26.43%. The beverage sample with a breadfruit level of 60% had better functional and sensory properties. The African breadfruit has great potential as a nutritional source, especially of protein. The use of breadfruit in the production of beverage if adopted and developed will give rise to a beverage with acceptable flavor and nutrient value and will be of great benefit for local and industrial processing. Success in this area will increase the food value of breadfruit and reduce post-harvest losses.

Keywords: Sensory Evaluation, Proper Diet, Beverage, Essential Nutrients, Proximate Properties

Introduction

Proper nutrition implies an adequate and balanced consumption of foods and utilization of all essential nutrients an individual needs (Murano, 2003). The importance and awareness of nutrition in public health issues has resulted in the increased demand for knowledge of different nutrients in foods (Chinma and Igyor, 2007). One of the most important aspects of the world food problem is non-availability in the food with respect to protein in the diet of the poor in developing countries (Chinma and Igyor, 2007). African breadfruit (*Treculia africana*) is considered a good source of dietary protein (Macrae *et al.*, 1993). African breadfruit belongs to the family of moraceae and constitutes a strategic reserve of essential food nutrients that are available at certain critical period of the year when reliable source of these nutrients are very scarce (Macrae *et al.*;

1993). It is an evergreen forest fruit tree in tropical Africa. The fruit produces a seed which is an important food item properly known as "Ukwa" by the Ibo tribe of southern Nigeria (Okafor and Okolo, 1974). The seeds of the African breadfruit are of high nutritive values and constitute a cheap source of protein and carbohydrate (Okafor and Okolo, 1974). Diverse food forms could be produced from the seeds. It is boiled and consumed as white porridge and sauce with or without fresh corn, roasted and consumed with coconut and palm kernel as snack and made into refreshing milk drink (Nwufor *et al.*, 1988). The seeds may be processed into flour apart from being cooked and eaten as a main dish (Nwufor *et al.*, 1988). The flour is used as soup condiment or thickener. The flour has high potential usage for pastries and confectionaries. In the past, the

consumption was limited to poor dwellers for whom it supplemented their diets during times of food scarcity and substituted the more expensive rice during festivals and other ceremonies (Nwabueze and Nwokenna, 2006).

Ejiofor *et al.* (1988) reported that apart from all these useful qualities of breadfruit, a non-alcoholic beverage can also be produced from the seeds. Beverages both reconstituted and non-reconstituted have assumed a dominant and essential position in the dietary pattern of Nigerian consumers owing to increased urbanization and growing demand for its thirst-quenching properties, stimulating effect and the role it plays as supplement for nursing mothers (Qkwurai, 1987). The increased emphasis on the nutritive value of foods and the present high cost of cocoa based beverage in Nigeria forms the need for further studies on the production and evaluation of breadfruit based beverage.

Materials and Methods

Source of Materials and Preparation

Matured green breadfruit pods were got from Oriendu Autonomous community in Umuahia North Abia-State, Nigeria. The other materials used, which include sorghum, sugar, skimmed milk, were bought from the Umuahia main market in Abia State, Nigeria.

Matured green breadfruit pods were allowed to ferment for 3 days, the breadfruit seeds were separated from the mucilage after which the seeds were washed with clean water and sharp sand which helped in the removal of the mucilage coat on the seeds. The seeds were sun dried for two days after which they were roasted in an oven at a temperature of 120°C for 1 hour. During the roasting process, the hauls were split off from the seeds and the seeds were then winnowed to separate the hauls from the seeds. The seeds were allowed to cool to a

temperature of 27°C before they were ground with milling machine and sieved with a muslin cloth. The resultant breadfruit flour was stored in an airtight transparent plastic container prior to the beverage production.

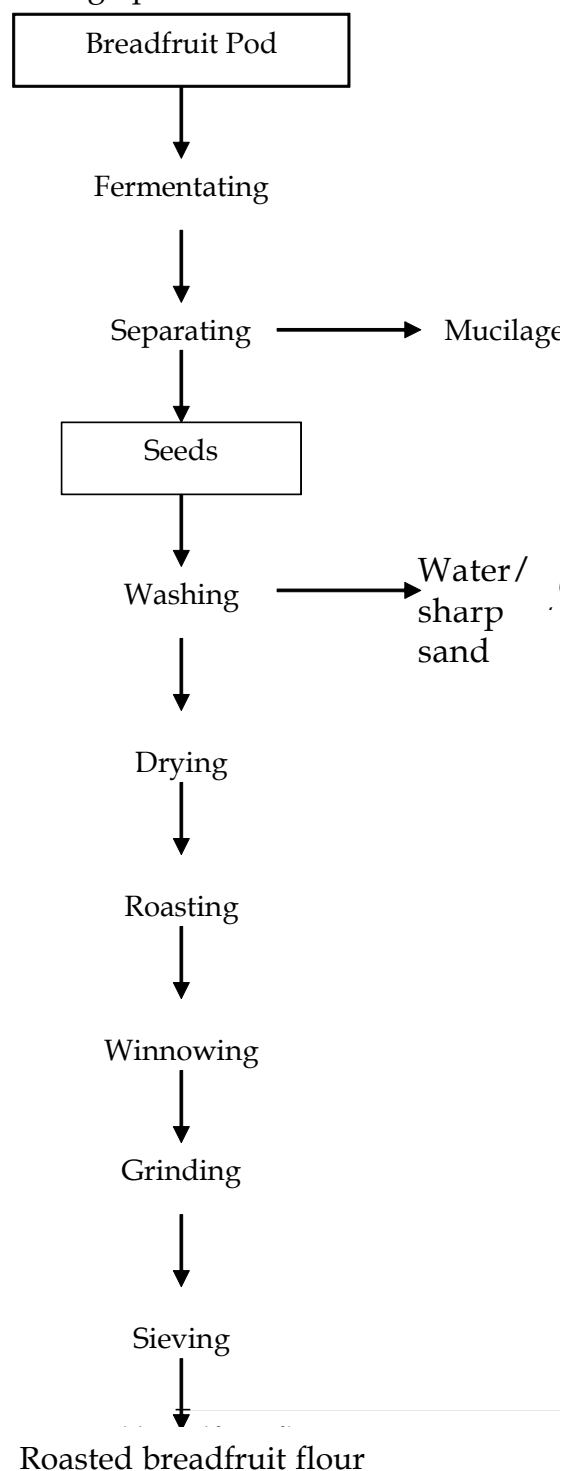


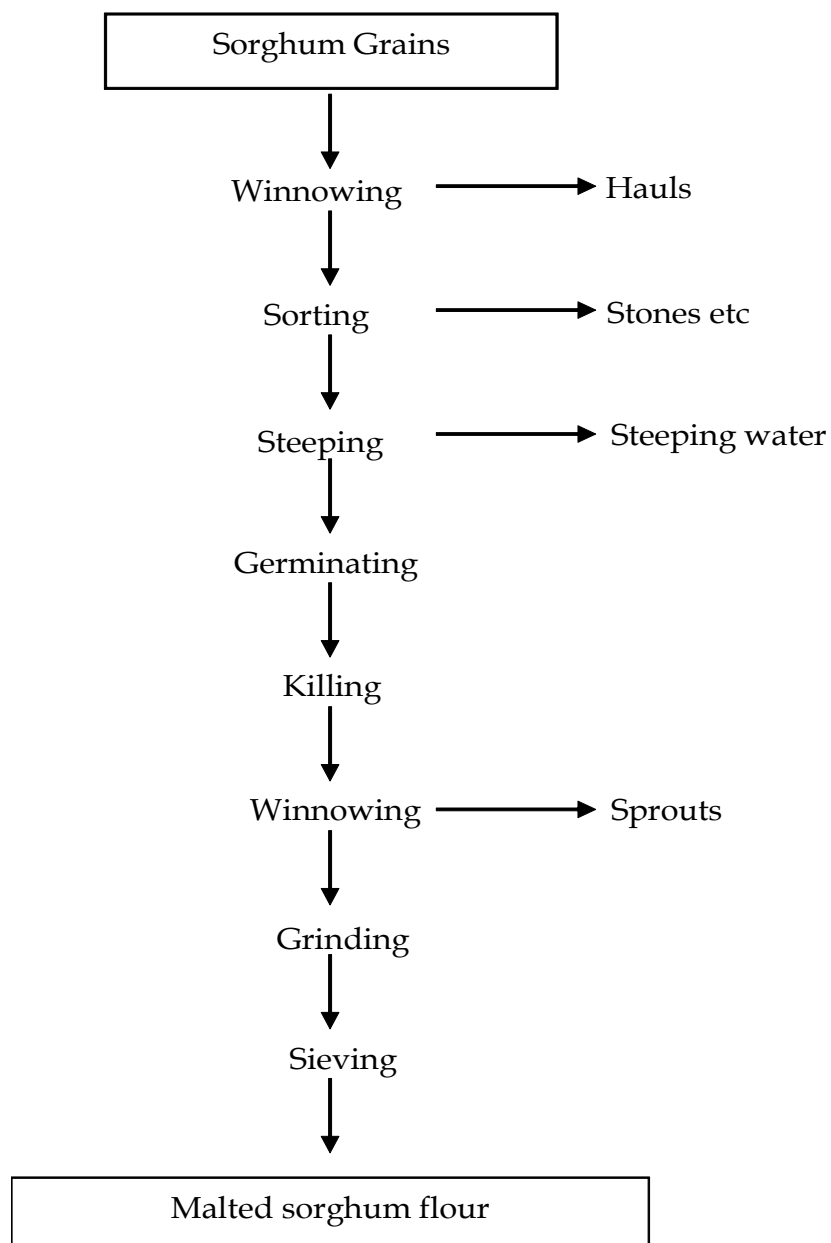
Fig. 1: Flow Chart for the processing of Breadfruit seed into flour

Production of Malted Sorghum

Malted sorghum was produced by a method described by Hough *et al.* (1982).

The sorghum used for this work was decorticated manually and winnowed to remove the haul and was also sorted manually to remove unviable seeds, stones and other contaminants. The grains were then steeped in clean water with periodic agitation at a temperature of 26°C for 18 hours to reach a moisture content of 35.5%. The swollen grains were drained

of water and spread on a jute bag that had already been sterilized with hot water and bleach. The grains were periodically turned to provide adequate aeration and were kept at a temperature of 25°C for 48 hours to germinate. When the sprouts had emerged, germination was terminated by kilning in an oven at a temperature of 80°C for 12 hours. The malted sorghum were allowed to cool and then the sprouts were removed by winnowing. Malted sorghum were then milled with the aid of a milling machine and sieved with muslin cloth.



Beverage Production

Table 1: Recipe for the Production of Breadfruit based Beverage

Ingredients	Quantity
Roasted bread fruit flour	270g
Malted sorghum	20g
Granulated Sugar	20g
Skimmed milk powder	90g

The prepared breadfruit flour, malted sorghum, skimmed milk and granulated sugar were used to produce a breadfruit-based beverage in the ratio of

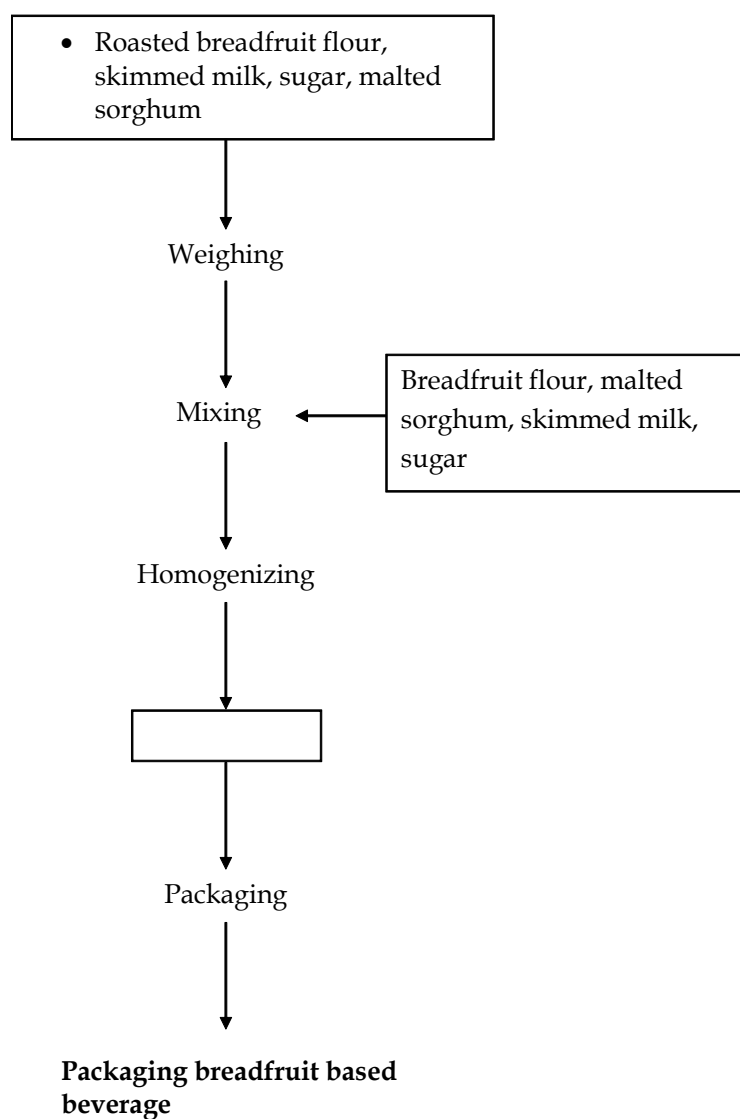
60:5:30:5 for Sample B

65:5:25:5 for Sample C

70:5:20:5 for Sample D

75:5:15:5 for Sample E

The roasted breadfruit flour and granulated sugar were put together in an electric blender and was blended thoroughly. The malted sorghum and skimmed milk were also added and mixing continued until a homogenous mixture was obtained for sample B, C, D and E respectively and was properly packaged.



Proximate Analysis: The moisture, crude fibre and carbohydrate content were determined by the method described by James (1995) while crude protein and fat content were determined by the method of Pearson (1976) respectively. Ash content was analyzed using the furnace incineration gravimetric method described by AOAC (1990).

Functional Properties: Bulk density, water absorption capacity, swelling index, oil absorption capacity, emulsion capacity, foam capacity and wettability were determined. Bulk density was assayed by the method of Okaka & Potter (1997) while absorption capacity, oil absorption capacity were determined by the method of Abbey & Ibeh (1989) respectively. Swelling index was determined by the

method of Ukpabi & Ndimele (1990) while emulsion capacity and wettability were determined by the method described by Okerie & Bello (1998) respectively. Foam capacity was assayed by the method of Narayana & Narasinya-Rao (1982).

Sensory Evaluation of Breadfruit Beverage

The sensory evaluation of each breadfruit beverage was conducted using a 20-man untrained panelist. Preference analysis using a 9-point Hedonic (Ihekoronye and Ngoddy, 1985) was used. Each beverage was coded with I being like extremely and 9 being dislike extremely. Cocoa based beverage (ovaltine) served as the control. The data obtained was analyzed using the analysis of variable (ANOVA).

Result and Discussion

Table 2: Proximate composition of the beverage sample

Sample	Parameters					
	Moisture Content (%)	Crude fibre (%)	Cude protein (%)	Ash (%)	Fat (%)	Carbohydrate
450	2.02±1.83 ^d	0.00±0.34 ^c	9.50±5.87 ^c	0.77±0.28 ^a	4.44±3.44 ^c	75.76±8.15 ^a
452	6.06±1.83 ^c	0.40±0.34 ^d	26.43±5.87 ^a	1.30±0.28 ^a	11.04±3.44 ^d	54.77±8.15 ^b
464	6.06±1.83 ^c	0.60±0.34 ^c	23.92±5.87 ^b	1.40±0.28 ^a	12.38±3.44 ^c	55.64±8.15 ^b
465	6.62±1.83 ^b	0.78±0.34 ^b	22.53±5.87 ^c	1.0±0.28 ^a	13.15±3.44 ^b	55.42±8.15 ^b
475	7.22±1.83 ^a	1.00±0.34 ^a	20.33±5.87 ^d	1.56±0.28 ^a	14.06±3.44 ^a	5.83±8.15 ^b
LSD	0.42	0.10	0.59	1.47	0.37	3.40

Values are means of triplicate determination. Mean values with the same superscript on the same column are not significantly different $P<0.05$.

Key:

450 = Cocoa based beverage (Ovaltine)

452 = 60:5:30:5: of breadfruit: malted: sorghum: skimmed milk: sugar

464 = 65:5:25:5 of breadfruit: malted sorghum: skimmed milk: sugar

465 = 70:5:20:5 of breadfruit: malted sorghum: skimmed milk: sugar

475 = 75:5:15:5 of breadfruit: malted sorghum: skimmed milk: sugar.

Table 2 shows that there was a significant difference ($p<0.05$) in the proximate composition of the beverage samples except the ash content when compared with the control, cocoa based beverage (ovaltine). The moisture content of the beverage samples ranged from 2.02±1.83% in the control sample to 7.22±1.83% in the sample substituted with 75% breadfruit (i.e. sample 475). The result indicated that there was no significant difference ($P>0.05$) in the moisture content of sample substituted with 60% and 65% breadfruit.

The high moisture content in sample substituted with 75% of breadfruit could be attributed to moisture absorbed during the process of formulation. According to Edet (1988), the keeping quality of African breadfruit is enhanced or limited by the processing method. The crude fibre content of the beverage samples was very low. The control, sample (450) had the least crude content (0.00%) while sample substituted with 75U/ breadfruit (475) had the highest (1%).

The variation in the crude fibre content could be attributed to the difference in the proportion of breadfruit during the process of formulation. However the mean values of the breadfruit beverage samples do not agree with the value reported by Edet (1988). Processing of breadfruit seeds into flour could account for the very low crude fibre content of the beverage sample.

The beverage samples were not significantly different ($p > 0.05$) in their ash content. The sample substituted with 75% and 65% breadfruit had the value of $1.56 \pm 0.28\%$ and $1.50 \pm 0.28\%$ ash contents respectively when compared to other samples. The ash content of the beverage samples is in appreciable amount and agrees with what Akubor (2000) reposted,

that African breadfruit seeds are a good source of minerals compared to other fruits. The data for fat content of the beverage samples as presented in table 4.1 showed that there was significant difference ($p < 0.05$) among the samples while the values ranged from 444 ± 3.44 for sample 450(control) to $14.06 \pm 3.44\%$ for sample substituted with 75% breadfruit. This variation could be as a result of the quantity of breadfruit flour used in the formulation. The values for crude protein as shown in table 4.1 showed there was significant difference ($p < 0.05$) among the samples while their values ranged from 9.50 ± 5.87 for the control sample (450) to $26.43 \pm 5.87\%$ for sample substituted with 75% breadfruit. The variation in the crude protein content of the breadfruit beverages is because of the varying quantity of skimmed milk added.

The carbohydrate content of the beverage samples ranged from $5.477 \pm 8.15\%$ in sample substituted with 60% breadfruit to $75.76 \pm 8.15\%$ in control sample (450). There was significant difference ($p < 0.05$) between the control sample (450) and the breadfruit substituted beverages, thus the higher the protein, fat and ash content, the lesser the carbohydrate according to Messian (1992).

The Functional Properties

Table 3: Functional properties of breadfruit substituted beverages

Parameters	Samples				LSD
	452	464	465	475	
Bulk density (g/cm ³)	1.98 ± 0.09^b	2.06 ± 0.09^a	1.83 ± 0.09^c	1.90 ± 0.09	0.07
Emulsion capacity(5)	91.20 ± 2.71^b	91.26 ± 2.71^{bc}	97.76 ± 2.71^a	94.50 ± 2.71^a	6.12
Wattability (scc)	56 ± 16.9^{bc}	64 ± 16.49^b	88 ± 16.49^a	96 ± 16.49^a	27.0
Foam Capacity (%)	7.91 ± 1.77^a	6.69 ± 1.77^a	4.73 ± 1.77^a	3.32 ± 1.77^b	1.90
Water absorption					
Capacity (g/ml)	4.27 ± 0.08^a	4.25 ± 0.08^a	4.37 ± 0.08^a	4.47 ± 0.08^a	0.20
Swelling index (cm ³ /g)	3.59 ± 0.43^d	4.25 ± 0.43^b	4.25 ± 0.43^b	4.77 ± 0.43^a	0.05
Oil absorption					
Capacity (g/m)	3.90 ± 0.07^c	4.05 ± 0.07^a	4.05 ± 0.07^a	4.08 ± 0.07^a	0.07

KEY

- 452 = 60:5:30:5 of breadfruit: malted sorghum: skimmed milk: sugar
 464 = 65:5:25:5 of breadfruit: malted sorghum: skimmed milk: sugar
 465 = 70:5:20:5 of breadfruit: malted sorghum: skimmed milk: sugar
 475 = 75:5:15:5 of breadfruit: malted sorghum: skimmed milk: sugar

There were significant difference ($p < 0.05$) in the bulk density of sample substituted with 60% breadfruit (452) and 65% breadfruit flour (464) also in sample substituted with 70% and 75% breadfruit flour. The bulk density of the beverages samples was found to be within the range of $1.83\text{g}/\text{m}^3$ to $2.06\text{g}/\text{cm}^3$. Bulk density is important in relation to packaging (Okezie and Bello, 1988). There were significant differences ($p < 0.05$) in the emulsion capacity of the beverage samples as shown in table 4.2. Emulsion capacity which ranged from 91.20 ± 2.71 to $97.76 \pm 2.71\%$ indicates the ability of the beverages samples; to hold water and oil in a solution. The high values in the emulsion capacity of the breadfruit substituted beverages could be attributed to their protein content.

The beverages samples were significantly different ($p < 0.05$) which ranged from 56sec to 96secs. It was observed that the higher the breadfruit content, the lower the wettability of the beverages samples. There were significant differences ($p < 0.05$) in the foaming capacity of the beverage samples. The foam capacity of the beverage samples which ranged from 3.32 ± 1.77 to

$7.91 \pm 1.77\%$ could therefore be attributed to the amount of native protein present in the samples (liu, 2000). Foaming is a functional property peculiar to proteins (Murano, 2003).

There was no significant difference ($p < 0.05$) in the water absorption capacity of the beverages samples which ranges from $4.27\text{g}/\text{mol}$ to $4.47\text{g}/\text{mol}$. Water absorption capacity is important in modifying the textural properties of food product where water activity is needed.

Swelling index ranged from $3.59\text{cm}^3/\text{g}$ for sample substituted with 60% breadfruit (452) to $4.77\text{cm}^3/\text{g}$ for sample substituted with 75% breadfruit (475). This shows the ability of the beverage samples to swell and retain gases in its structure. Chen *et al.* (2003) described swelling index as an important property of food quality and low value is an indication of good quality. This is true as the start foods swells beyond a particular degree, it loses its starch granules and this affects the texture of food and so there is a linear relationship between swelling index and solid loss.

Table 4 shows there were significant difference ($p < 0.05$) in the beverages sample which ranged from $3.90\text{g}/\text{ml}$ to $4.08\text{g}/\text{ml}$ for sample substituted with 60% to 75 breadfruit flour. Increase in oil absorption may be attributed to the presence of more hydrophobic proteins which show superior binding of lipids (Kinsella, 1976).

Oil absorption capacity is an important functional property in beverage production because it affects flavor retention and improves mouth feel (Hutton and Campbell, 1981).

Table 4: Sensory Scores of Breadfruit Substituted with Cocoa Based Beverages

Sample	Parameters			
	Taste	Appearance	Flavor	General Acceptability
450	2.25±0.98 ^{bc}	3.2±0.41 ^c	2.4±0.64 ^a	2.65±0.71 ^{bc}
452	2.35±0.98 ^{ab}	2.6±0.41	3.3±0.64 ^a	2.45±0.71 ^{bc}
464	3.2±0.98 ^b	2.75±0.41 ^d	3.5±0.64 ^a	3.0±0.71 ^c
465	4.05±0.98 ^a	3.45±0.41 ^b	3.8±0.64 ^a	3.95±0.71 ^{ab}
475	4.8±0.98 ^a	3.7±0.41 ^a	4.4±0.64 ^a	4.25±0.71 ^a
LSD	1.20	0.10	1.39	1.17

Mean values with different letters in the same column differ significantly ($p < 0.05$)

KEY

450 = cocoa based beverage (ovaltine)

452 = 60:5:30:5 of breadfruit: malted sorghum: skimmed milk: sugar

454 = 65:5:25:5 of breadfruit: malted sorghum: skimmed milk: sugar

465 = 70:5:20:5 of breadfruit: malted sorghum: skimmed milk: sugar

475 75:5:15:5 of breadfruit: malted sorghum: skimmed milk: sugar.

Sensory evaluation was carried out using 20 untrained panelists. Their perceptions were analyzed on a 9 point-Hedonic scale.

The result of the sensory evaluation on taste for each beverage sample as shown in table 4 differed significantly ($p < 0.05$). The most acceptable in terms of taste is the control sample (450) with a score of 2.3 which signifies a high level of acceptability followed by sample substituted with 60% breadfruit (452) which scored 2.4 and sample substituted with 65% breadfruit (464) was moderately preferred with a score of 3.2. The taste for almost all the samples were accepted except for beverage sample substituted with 70% breadfruit (465) and the sample substituted with 75% breadfruit flour which were slightly preferred.

The result from the mean of the samples showed that there was significant difference ($p < 0.05$) in the appearance of the beverage samples. Sample (452) which was substituted with 60% breadfruit had a score

of 2.6 which signifies a high level of acceptability in terms of appearance followed by sample substituted with 65% of breadfruit (464) with a score of approximately 2.8. Beverage samples 450(control), 465 with 70% breadfruit substitution and 475 with 75% breadfruit substitution having mean values of 3.2, 3.5 and 3.7 respectively were least preferred from other beverage samples, this could be attributed to the varying quantity of milk added to the beverage sample during formulation.

The results on the flavor acceptability of the breadfruit-substituted beverages had no significant difference ($p < 0.05$). However, there was a slight difference between the breadfruit beverage samples and the control sample. This could be as a result of the processing method of the beverage's raw material. Ihekoronye & Ngoddy (1985) reported that roasting affects development of off-flavor and aroma. However, there was significant difference ($p < 0.05$) in the general acceptability of the breadfruit substituted beverage samples. Sample substituted with 75% breadfruit (475) compared favorably with sample substituted with 70% breadfruit (465) while sample substituted with 60% breadfruit varied significantly with sample substituted with 75% and was the least preferred.

From table 4, sample substituted with 60% breadfruit (452) with approximately 2.5 score of preference is the most acceptable followed by samples 450 and 464. Sample substituted with 70% breadfruit (465) which scored approximately 4.0 and sample substituted with 75% breadfruit with a score of 4.25 were slightly accepted by the 20 panelists. This could be as a result of the balance between the breadfruit flour and milk which produced a fine breadfruit flavor such that an acceptable level was reached.

Conclusion and Recommendation

The African breadfruit has great potential as a nutritional source, especially of protein. We are yet to fully appreciate these potentials and the possibility of its commercial production. The use of breadfruit in the production of beverage if adopted and developed will give rise to a beverage with acceptable flavor and nutrient value and will be of great benefit for local and industrial processing. Success in this area will increase the food value of breadfruit and reduce post harvest losses.

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