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# CHEMICAL AND SENSORY CHARACTERISTICS OF FUFU MADE FROM MIXTURES OF CASSAVA AND AFRICAN BREADFRUIT FLOURS

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## ABSTRACT

Cassava (*Manihot esculenta, Crantz*) tubers and African breadfruit (*Treculia africana*) were processed separately into instant flours and mixed at different proportions. Five samples were developed using ratios of; 50:50, 60:40, 70:30, 80:20 and 90:10% of cassava flour to African breadfruit flour respectively. These were made into *fufu* and subjected to sensory and chemical evaluation. The results of proximate analysis showed that the protein contents of all samples were statistically different from each other ($p<0.05$) with the highest content coming from 50:50 cassava-breadfruit *fufu* (3.28g/100g). Cassava-breadfruit *fufu* 90:10% ratio had the highest energy value of 367.64Kcal/100g and was also significantly different from all the other samples. The highest content of all the minerals examined (iron, zinc, calcium, copper) were in 50:50% cassava-breadfruit fufu. While cassava breadfruit fufu 90:10 recorded the lowest mineral content. Sensory evaluation showed the taste of cassava breadfruit fufu 50:50 to be preferred to that of others ($p<0.05$) but the colour of cassava breadfruit fufu 90:10 had the highest acceptance. The addition of breadfruit increased energy, protein and iron contents of cassava fufu.

**Key words**: Breadfruit, fufu, zinc, calcium, iron.

## INTRODUCTION

Cassava (*Manihot esculenta, Crantz*) is emerging as a dominant staple of primary or secondary importance in many developing countries of the humid and sub-humid tropics in Africa and elsewhere (Okigbo, 1980). Cassava comprised about 25 per cent of all food crops consumed in Nigeria in 1968 (Oke 1968) . In 2004 studies found that the most frequently consumed staple is maize then cassava followed by rice then sorghum (Maziya-Dixon *et al.,* 2004). There are several cassava-based food preparations. For main meals, cassava can be made into gari or fufu ( fermented wet cassava or cassava flour) according to Oyewole (1991). Cassava flour is produced through the submerged fermentation of peeled cassava roots in water. After fermentation, the fermented cassava is subjected to sun-drying and milled in order to have flour (Oyewole and Odu, 1988). Cassava is a starchy staple whose roots are very rich in carbohydrates, a major source of energy. In fact, the cassava plant is the highest producer of carbohydrates among crop plants with perhaps the exception of sugarcane. Although cassava roots are rich in calories, they are grossly deficient in proteins, fat, and some of the minerals and vitamins. Consequently, cassava is of lower nutritional value than are cereals, legumes, and even some other root and tuber crops such as yams (Okigbo, 1980).

African breadfruit (*Treculia africana)* is a wild tropical evergreen tree that has immense potential as a nutritional source for man (Osabor *et al.,* 2009). *Treculia africana* is native to many parts of West and tropical Africa. The fruit tree is of the family, *Moraceae* and is one of the four members of the genera *Treculia*. It grows commonly in evergreen and deciduous forests, often by streams but may sometimes be planted. It is a rich source of protein and energy (Osabor *et al.,* 2009). Eating breadfruit improves the diet and may help lower the risk of serious health problems. African bread fruit porridge has been used to rehabilitate children with protein-energy malnutrition (Runsewe-Abiodun *et al.,* 2001). Unfortunately, a lot of breadfruit is now wasted because of neglect and because only very few people could remember how to preserve it. It is possible to preserve larger quantities of breadfruit by adapting the old fermenting and drying methods, or by using new methods such as freezing. This study was carried out to produce a nutritious *fufu* from cassava and bread fruit and thus create other uses of African breadfruit.

## MATERIALS AND METHODS

### *Production of the Fermented Cassava Flour*

Cassava fufu was produced by buying cassava tubers and cleaning. The tubers were peeled with knife and cut into cylindrical pieces. Tubers were washed with water to ferment for a period of 96 hours. The tubers were allowed to undergo natural fermentation under ambient condition. As in traditional method, no inoculum was introduced and the fermentation temperature was not controlled. At the end of the fermentation, the soft fermented tubers were hand pulverized and sieved in water using sieve to remove the coarse fibre materials. The resulting mash was allowed to settle and the top water was decanted while the sediment wet cassava mash was sundried for two days and milled (Oyewole , 1991).

### *Preparation of African Bread fruit Flour (Treculia africana)*

The African breadfruits were peeled manually and cut into smaller sizes with a stainless steel knife. It was washed properly to remove dirt and then sun dried for 4 days. The dried fruits were then milled to obtain flour. The flour was packaged in a polyethylene bag and stored at room temperature until use.

### *Preparation of the Cassava-breadfruit Fufu*

The cassava and African breadfruit flours were mixed at different proportions (50:50, 60:40, 70:30, 80:20, and 90:10% of cassava flour to breadfruit flour respectively). A Kenwood mixer (Model FP 505, Kenwood Britain, UK) was used for mixing samples at speed of 6 for 5 minutes to achieve homogeneity. The resulting flour was then cooked to produce fufu. Cassava-bread fruit fufu was made by adding the cassava-bread fruit flour in to 1200ml boiling water and mixed thoroughly to smoothen the gruel. It was then cooked for 10 minutes on low heat to prevent lumps from forming.

### *Sensory evaluation*

Sensory evaluation was carried out within ten minutes of preparation. A ten-man trained sensory panel was raised from among the local consumers of cassava fufu. The panellists were familiar with the scoring scale and the assessment method during the preliminary training session. The products were arranged randomly and presented to the judges in the same type of plates and was coded in such a way that the panellists would not be biased by the coding system as a set of three digits of random numbers were assigned. A 9- point hedonic scale was used for the evaluation, where 1 represents "dislike extremely" and 9 represents "like extremely" (Ihekoronye and Ngoddy, 1985). The Panellists rated the *fufu* in terms of appearance, taste and colour. Responses were subjected to statistical analysis.

### *Chemical Analysis of the Cassava-bread fruit Fufu*

Representative samples of each cooked product were collected in triplicates and placed in sealed food containers then taken to the food analysis laboratory. It was homogenized using a "Kenwood Chef" (Thorn Emi Domestic Appliances, Ltd., Portsmouth, UK) electric blender after which a portion was weighed out into a previously weighed clean dry Petri dish and dried to a constant weight in an electric oven at 105$^o$C. The dried samples were allowed to cool in a dessicator and then ground into powder. Each dried sample of the products was packed in moisture resistant polyethylene bag with detailed description and kept frozen until further analysis. Standard procedures (AOAC, 1990) were used to determine the moisture content, crude protein (N x 6.25) and fat contents of the produced fufu. Total carbohydrate was estimated by difference. Energy value was calculated using the Atwater's conversion factors, protein and carbohydrate (4kcal/g) and fat (9kcal/g). Two gram sample of each previously dried, powdered food cassava products was transferred to acid washed crucibles and dry-ashed in a muffle furnace at 600$^o$C initially for 6 h and then to constant weight. The iron, zinc , copper and calcium contents of all the products were determined on aliquots of the solutions of the ash by flame atomic spectrophotometry procedures (AOAC, 1990) using Buck AAS (Model 200, Germany) atomic absorption spectrophotometer. Replicates of *fufu* products were analyzed to check on the accuracy and reproducibility of the method.

## RESULTS AND DISCUSSION

Table1 shows that each ratio of the cassava-breadfruit fufu resulted in a significant difference in energy content of the cassava-breadfruit fufu ($p<0.05$). Energy was highest in cassava-breadfruit fufu 90:10 (367.64Kcal/100g) and lowest in cassava-breadfruit fufu 50:50 (362.74Kcal/100g). The low energy content of cassava-breadfruit fufu 50:50 was very much higher than that of cassava fufu (312Kcal/100g) as recorded by Adepoju *et al.* (2010). Cassava-breadfruit fufu with the highest protein content was 50:50 (3.28g/100g) and that with the lowest was 90:10 (1.36g/100g). The protein content of the cassava-breadfruit fufu increased significantly ($p<0.05$) with increase in breadfruit but cassava-breadfruit fufu 60:40 and 70:30 were not significantly difference in their protein contents. Osabor *et al.* (2009) investigated the nutrient content of African bread fruit. According to his study the protein content of African breadfruit is 12.5g/100g. African breadfruit has therefore increased the protein content of cassava fufu from 2.1g/100g protein content (Adepoju et al., 2010) to 3.28g/100g in cassava-breadfruit fufu 50:50. The mineral content of cassava–breadfruit fufu is shown in Table 2. It reveals that cassava-breadfruit fufu 50:50 had the highest content of iron (2.77mg/100g), zinc (0.76mg/100g), calcium (158.86mg/100g) and copper (0.82mg/100g) and cassava-breadfruit fufu 90:10 had the lowest mineral content of iron (1.67mg/100g), zinc (0.45

mg/100g), calcium (113.41mg/100g) and copper (0.38mg/100g). The iron and calcium contents of all the different cassava-breadfruit *fufu* were significantly different from each other ($p<0.05$). Though African breadfruit is not a good source of iron (Osabor *et al.,* 2009) it, however, increased the iron content of cassava *fufu* from 2.1mg/100g (Adepoju *et al.,* 2010) to 2.77mg/100g in cassava-breadfruit fufu 50:50. Zinc content of cassava-breadfruit fufu 80:20 was not significantly different from cassava-breadfruit fufu70:30 and cassava-breadfruit *fufu* 90:10 ($p<0.05$). Copper contents also of cassava-breadfruit fufu 50:50 and 60:40 were also not significantly different from each other ($p<0.05$). Sensory evaluation is shown in Table 3 and it shows that the taste and appearance of fufu 50:50 were preferred (8.60 and 8.00 respectively) to the other cassava-breadfruit fufu. Cassava-breadfruit Fufu 70:30, 80:20 and 90:10 did not differ significantly in their taste or appearance ($p<0.05$). Their colours were however significantly different from each other with cassava-breadfruit fufu 90:10 having the most preferred colour (8.80).

**Table 1: Proximate analysis of the cassava-bread fruit mixtures (g/100g)**

| Sample | Moisture content % | Dry matter % | Protein (g) | Fat (g) | Ash (g) | Crude fibre (g) | Total carbohydrate (g) | Energy (Kcal) |
|---|---|---|---|---|---|---|---|---|
| 50:50 | 8.77± 0.16a | 91.24± 0.16a | 3.28± 0.21a | 1.78± 0.01a | 0.82± 0.09a | 2.01± 0.02a | 83.36±0.03e | 362.74e |
| 60:40 | 8.50± 0.25b | 91.51± 0.25b | 2.58± 0.02b | 1.52± 0.04b | 0.68± 0.01b | 1.88± 0.01b | 84.86±0.25d | 363.60d |
| 70:30 | 8.50± 0.40b | 91.53± 0.40b | 2.58± 0.02b | 1.32± 0.01c | 0.60± 0.01c | 1.67± 0.02c | 85.87±0.34c | 365.80b |
| 80:20 | 8.33± 0.62c | 91.67± 0.62c | 1.60± 0.09c | 1.20± 0.01d | 0.51± 0.02d | 1.53± 0.01d | 86.87±0.56b | 364.80c |
| 90:10 | 7.66± 0.16d | 92.53± 0.16d | 1.36± 0.03d | 1.08± 0.01e | 0.45± 0.01e | 1.34± 0.00e | 88.12±0.18a | 367.64a |

Means in the same column with the same subscript are not significantly different at $p<0.05$

**Table 2: Mineral content of the cassava-bread fruit *fufu* (mg/100g)**

| Sample | Iron (mg) | Zinc (mg) | Calcium (mg) | Copper (mg) |
|---|---|---|---|---|
| 50:50 | 2.77±0.01a | 0.76±0.01a | 158.86±1.69a | 0.82±0.01a |
| 60:40 | 2.50±0.04b | 0.67±0.04b | 147.00±1.87b | 0.74±0.01a |
| 70:30 | 2.20±0.11c | 0.59±0.03c | 133.60±1.80c | 0.64±0.03b |
| 80:20 | 1.97±0.03d | 0.50±0.01cd | 121.05±0.06d | 0.56±0.03c |
| 90:10 | 1.67±0.01e | 0.45±0.01d | 113.41±3.32e | 0.38±0.05d |

Means in the same column with the same subscript are not significantly different at $p<0.05$

**Table 3: Mean Sensory Qualities of the cassava-bread fruit *fufu***

| Sample | Colour | Taste | Appearance |
|---|---|---|---|
| 50:50 | 6.70d | 8.60a | 8.70a |
| 60:40 | 6.85d | 8.05b | 8.15b |
| 70:30 | 7.85c | 7.50c | 8.00bc |
| 80:20 | 8.25b | 7.70c | 8.00bc |
| 90:10 | 8.80a | 7.55c | 7.80c |

Means in the same column with the same subscript are not significantly different at $p<0.05$

## CONCLUSION

The recorded values for the nutrient content of cassava-breadfruit *fufu* show that the addition of breadfruit increased energy, protein and iron contents of cassava fufu.

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