

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

C.A. AGBON<sup>1\*</sup>, C.O. AKINYEMI<sup>1</sup>, A. ADELEKE AND E.C. OKEKE<sup>2</sup>

<sup>1</sup>Department of Nutrition and Dietetics, University of Agriculture Abeokuta, Nigeria.

<sup>2</sup>Department of Home Science, Nutrition and Dietetics, University of Nigeria Nsukka, Enugu State, Nigeria. \*Corresponding author

---

### 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 panelists 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°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°C initially for 6 h and then to constant weight. The iron, zinc, copper and cal-

cium 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**

Table 1 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 *fufu* 70:30 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*.

## REFERENCES

- Adepoju, O.T., Adekola Y.G., Mustapha, S.O., Ogunola, S.I.** 2010. Effect of processing methods on nutrient retention and contribution of Cassava (*Manihot* spp.) to nutrient intake of Nigerian consumers. *African Journal of Food, Agriculture, Nutrition and Development* Article Type: Report Geographic Code:6NIGR Date: Feb. 1, 2010 Words: 4630
- AOAC** 1990. Official methods of Analyses Association of official Analytical chemist 15<sup>th</sup> edition Washington D.C. USA. 1990.
- Chukwuma, A.C., Ukpabi, U** 1999. Production of Africa breadfruit *Treculia africana* and soybeans (*Glycine max*) seed based food formulations. In: Effects of germination and fermentation on nutrition and organoleptic quality. Plant food for Human nutrition. Dordrecht, 54: 193-206.
- Ihekoronye, A.I., Ngoddy, P.O.** 1985. Intergrated Food Science and Technology for Tropics. Macmillan, London. P386
- Maziya-Dixon, B., Akinyele, I.O., Oguntona, E.B., Nokoe, S., Sanusi, R.A., Harris, E.** 2004. *Nigerian Food Consumption and Nutrition Survey 2001-2003, Summary*. Ibadan, Nigeria: International Institute of Tropical Agriculture (IITA).
- Oke, O.L.** 1968. Cassava as Food in Nigeria. *World Review Nutrition and Dietetics* 9: 227.
- Okigbo, B.N.** 1980. *Nutritional implications of projects giving high priority to the production of staples of low nutritive quality: The Case for Cassava (Manihot esculenta, Crantz) in the Humid Tropics of West Africa. Food and Nutrition Bulletin* 2(4) October, The United Nations University Press, Tokyo, Japan.
- Osabor, V.N., Ogar, D.A., Okafor, P.C., Egbung, G.E.** 2009. Profile of the African Bread Fruit (*Treculia africana*) *Journal of nutrition*, 8(7):1005-1008.
- Oyewole, O.B.** 1991. Fermentation of cassava for 'lafun' and 'fufu' production in Nigeria. *Food Laboratory News* 7(2) :29-31.
- Oyewole, O.B., Odunfa, S.A.** 1988. Microbiological studies on cassava Fermentation for 'lafun' production. *Food Microbiology*, 5: 125 - 133.
- Runsewe-Abiodun, I., Olowu, Olanrewaju, A.O., Akesode, F.A.** 2001. Efficacy of the African Breadfruit DM (*Treculia africana*) in the Nutritional Rehabilitation of Children with Protein-energy Malnutrition. *Nigerian Journal of Paediatrics*, 28:128-134

(Manuscript received: 12th January, 2010; accepted: 14th July, 2010).