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Effect of Local Cassava Fermentation Methods on Some Physiochemical and Sensory Properties of *FUFU*

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Abstract: The effects of two fermentation methods (fixed and unfixed) on the HCN content, texture, colour, flavour, water retention capacity and bulk density of *fufu,* a cassava based entree were studied using an improved cassava cultivar, TMS 0635. Results obtained showed that the HCN content of *fufu* from fixed fermentation method was significantly lower ($p<0.001$) than that from unfixed fermentation. On the other hand, bulk density and water retention capacity were significantly higher ($p<0.001$) in *fufu* processed from fixed fermentation method. Texture, colour and flavour were, however, not significantly different ($p>0.05$) in *fufu* processed from the two methods. The fixed fermentation method is, therefore, recommended for *fufu* processing with cassava cultivar TMS 0635.

Key words: Cassava fermentation, *fufu,* HCN content, organoleptic properties

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is one of the most useful tropical crops widely exploited as a cheap caloric source. However, much attention has continually been drawn to the anti-nutritional substance (cyanide) in this crop which could be lethal to man if consumed in large doses over a period of time (Hahn and Keyser, 1985; Hahn, 1989).

To make cassava suitable for human consumption, it is usually subjected to different processing methods which vary from location to location. Such methods generally aim at reducing the toxicity, improving palatability and converting the perishable fresh root into stable products. *Fufu* is a favourite cassava-based entree popular in many parts of West Africa. One major problem in processed *fufu* is the flavour of the product which may be unacceptable to many people. It varies from one processing batch to the other by the same processor (Oyewole, 1991; Oyewole and Sanni, 1995). In an attempt to improve on its flavour; some modern producers of *fufu* have adapted the "unfixed fermentation" method, which involves changing the water daily throughout the period of fermentations against the previously practiced fixed fermentation method in which the water remains unchanged throughout this period. Presently, there is limited information on the comparative effects of these two methods on the HCN content as well as some quality attributes of *fufu*. Such information could help in standardizing *fufu* production through public health policy formulation.

The present study, therefore, seeks to compare the effect of fixed and unfixed fermentation methods on some quality attributes of *fufu* using an improved cultivar of cassava, TMS 0635.

MATERIALS AND METHODS

Cassava variety used: Cassava tubers of cultivar TMS 0635 were harvested at 9 months from the farms of AKADEP (Akwa Ibom State Agricultural Development Project) Uyo, Akawa Ibom State, Nigeria.

Processing of cassava tubers into *fufu*: The method described by Oyewole and Odunfa (1989) was largely adopted. The cassava roots were sorted by visual assessment, peeled, washed, divided into two equal parts and soaked submerged in two 50-litre plastic containers for the 96 h-fermentation process under ambient condition (30±2°C). However, in one container, the fermentation water remained unchanged throughout the soaking period (fixed fermentation) whereas in the second container, there was regular changing of water daily throughout the period of fermentation (unfixed fermentation). The resulting retted roots were hand-pulverized or grated, wet-sieved and dewatered in clean jute bags (using heavy stones) to obtain the raw cassava mash. Five kilograms of the cassava mash obtained was diluted with three litres of distilled water and cooked in a standardized procedure common to all samples (using a gas cooker) to a solid and firm consistency. Samples of raw cassava mash and cooked *fufu* were collected for analysis.

Analysis of fermented cassava mash and cooked *fufu*
HCN content: Estimation of hydrocyanic acid content was done using silver nitrate volumetric analyses (AOAC, 1990; Oboh *et al*., 2002; Tanya *et al*., 1997) for both cooked *fufu* and raw cassava mash from the fixed and unfixed methods of fermentation. 10g of each sample was weighed into 300ml round bottle flask and left to soak in water for 4 h. It was then steam distilled into 20 ml of 2.5% (w/v) NaOH contained in an

Table 1: Comparison of some parameters estimated in fermented cassava mash (FCM) and cooked fufu using two processing methods in cassava cultivar TMS 0635

Parameters	Sample	Method 1	Method 2	Cal $t_{(8)}$
HCN (mg/100g)	FCM	0.926±0.032	1.22±0.019	***7.967
	Cooked *fufu*	0.726±0.0092	0.96±0.012	***15.6
Bulk Density (g/ml)	FCM	1.19±0.002	1.09±0.003	***8.72
	Cooked *fufu*	1.12±0.0001	1.04±0.0004	***9.64
Water retention capacity	Cooked *fufu*	7.00±0.0075	5.2±0.836	***16.7

Method 1 -Fermentation water remained unchanged (fixed fermentation), Method 2 -Fermentation water was changed daily (unfixed fermentation), *** -Very highly significant (p<0.001), FCM - Fermented cassava mash.

Erlenmeyer flask. The distillation continued until 250 ml of the distillate was collected. 8.0ml of 6N NaOH and 2ml of 5% (w/v) KI were added to the distillate. The distillate was then titrated with 0.02N $AgNO_3$ until there was a faint but permanent turbidity. Five replicates analyses were performed for each sample.

Sensory analysis: A semi-trained panel of fifteen undergraduate students of the University of Calabar, who are familiar with cassava *fufu* were used to examine the texture, colour and flavour of cooked *fufu* from the unfixed and fixed fermentation methods. The test was based on a hedonic scale of 1-9 with 1 being the least desirable and 9 being the most desirable (Tanya *et al*., 1997, 2006).

Bulk density: Cassava mash or *fufu* was placed in a 25-ml graduated cylinder and packed by gently tapping the cylinder on the bench top for 30 times from a height of 5 cm. This was done five times each for both raw and cooked *fufu* from the 2 fermentation methods. The bulk density was determined as (Babajide *et al*., 2008; Nzigamasabo and Hui, 2006; Akubor *et al*., 2000; Wang and Kinsella, 1976):

$$\frac{\text{Weight of fufu samples (in g)}}{\text{Volume of same sample (in mls)}}$$

Water retention capacity: Four grams of the cooked *fufu* sample and 20 ml of distilled water were put into a 50 ml centrifuge tube. The mixture was stirred occasionally with a glass rod for 30 min after which it was centrifuged at 15000 rpm for 15 min. The amount of water retained by the *fufu* sample was taken as the difference between the initial water added and that decanted after centrifugation (Benchat, 1977).

Data analysis: Data obtained were subjected to students't-test analyses in all cases.

RESULTS AND DISCUSSION

The cyanide contents of both fermented cassava mash and cooked *fufu* were significantly lowered (p<0.001) when the fermentation water remained unchanged throughout the fermentation period, compared to when the fermentation water was changed daily (Table 1). In other words, leaving the fermentation water unchanged throughout the fermentation period gave better results in terms of the HCN content.

An average of 0.926 mg of residual cyanide was obtained per 100 g of fermented cassava mash processed through fixed fermentation. This translates to 9.26 mg/kg which is below the lethal dose of 40-60 mg/kg as reported by Bokanga (1994). This value is significantly lower (p<0.001) than the 1.22 obtained from unfixed fermentation. The difference may be attributable to the increased concentration of micro organisms in the fixed fermentation which hastens the breakdown of cyanogenic glycoside as suggested by Oyewole and Odunfa (1990).

The HCN content of cooked *fufu* was further reduced to 0.726 mg/100 g and 0.96 mg/100 g in methods 1 and 2 respectively. This is evidence that in addition to the fermentation process, cooking further helps in the removal of the toxic compound (Cooke and Maduagwu, 1978).

The slight increase in bulk density of *fufu* from fixed fermentation process over that from unfixed fermentation is an indication that *fufu* from the former may contain more fibre contents than that from the latter. This possibly resulted from increased particle breakdown of the fibrous materials during fermentation, enabling the fibre to pass along with the pulp during sieving. Mathew *et al*. (1995) and Nzigamasabo and Hui (2006) reported that fermenting micro organisms elaborate pectinolytic and cellulotic enzymes, which facilitate the lysis of the cell membranes. The insoluble fibre is thus disintegrated during the lytic process and automatically passes along the pulp.

The water retention capacity of a starch granule gives the degree of exposure of the internal structure of the starch granules to water (Raules *et al*., 1993). It is an important processing parameter and has implication for viscosity, bulking and consistency of products as well as baking applications (Kulkarni *et al*., 1991; Niba *et al*., 2001). In this study, the water retention capacity was affected by the method of fermentation. Fixed fermentation exhibited higher water retention capacity than unfixed fermentation (Table 1). This suggests that the internal structure of the starch granules may have been exposed to a greater extent during the fixed fermentation process, perhaps as a result of the increased activity of the micro Organisms.

Table 2: Subjective ratings* on texture, colour and flavour of cooked *fufu* from fixed and unfixed fermentation methods

Fermentation method	Texture	Colour	Flavour
Fixed	4.6±0.87	4.9±0.809	5.4±1.6
Unfixed	3.9±0.924	4.8±0.8	4.6±2.43
Cal $t_{(8)}$	N.S	N.S	N.S
	0.55	0.088	0.685

NS = Not significant, * = Values given are means and standard errors from 15 scores given by a panel of 15 assessors on a hedonic scale where 1 = least desirable and 9 = most desirable.

Also, since water retention capacity is related to bulking, this possibly explains, in addition to other factors considered earlier, why the fixed fermentation method recorded high bulking density than the unfixed method (Tanya *et al*., 2006).

The results of the sensory evaluation carried out on the cooked *fufu* product are given in Table 2. The preference of the panellists for the characteristic texture, flavour and colour of *fufu* fermented without changing of water is evident in Table 2, even though these values were not significantly different (p>0.05) from those obtained with regular changing of water.

In summary, results obtained in this study show that the 2 fermentation methods used here do not really affect the texture, flavour and colour of *fufu* but they do affect the HCN content, bulk density and water retention capacity. Fixed fermentation method, where water is unchanged throughout the fermentation period, is therefore recommended for the production of good quality *fufu* when using the cassava cultivar TMS 0635.

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