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The Effects of Drying Methods on the Proximate Composition, Functional Properties and Sensory Evaluation of Fufu Flour

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A B S T R A C T

The effects of drying methods on the proximate composition, functional properties and sensory evaluation of fufu flour were studied.. Cassava was used to produce fufu and dried using cabinet and sun drying methods. The proximate composition and functional properties of the fufu flour were investigated. The result showed that the moisture content ranged from 10.22% to 10.43%, ash ranged from 0.75% to 0.81%, fibre content ranged from 0.3% to 0 .5%, fat content ranged from 0.15% to 0.19%, protein ranged from 0.41% to 0.45%, carbohydrate ranged from 82.22% to 82. 24%. There were significant differences in the functional properties of the fufu flours. The fufu flour were also cooked into ready-to-eat fufu dough and subjected to sensory evaluation. Sensory panelist rated cooked fufu from cabinet dryer closer to market fufu. However further investigations should still be carried out on these drying methods to improve on the colour and odour of the fufu flour so that the end product would have characteristics qualities close to normal fufu relished by many fufu eaters.

Keywords: Fufu, Processing, Functional, Flour, Cassava, Drying

1. Introduction

The world production of cassava in 1990 was estimated at about 158 million tons, 46 % of which was produced in Africa (FAO, 1991). It has been estimated that about 90 % of the cassava produced in Africa is used for human food while the remainder is used largely as animal feed and very little is used in industrial processes (Cock, 1985)

Cassava is the third largest source of carbohydrates for meals in the world. Cassava is a staple crop and is particularly important in Africa and South America and production levels of cassava in Nigeria and other major cassava producing countries (Ajao and Adegun, 2009).

Cassava roots can be processed into various products, and can replace various associated raw materials whose supply are imported, or if locally produced, are unstable. These include maize in the manufacture of animal feed, molasses for production of sweeteners or alcohol, and wheat flour in various bakery products (FAO 2006). Presently, the use of cassava as a feed ingredient is more accepted by feed millers than fifteen years ago (Knoth,1993).

It is a perennial shrub that grows to approximately 3 metres tall and has the ability to grow on marginal lands in low-nutrient soils where other crops do not grow well. It is also fairly drought tolerant and the fresh root contains approximately 60% moisture (Wikipedia, 2010).

It is grown for its enlarged starch-rich tuberous roots. The amount of carbohydrates contained in dry cassava root is higher than other staple crops, such as maize or cereals but, by contrast, the protein content is very low (UNICEF, 1990) .Cassava can grow in poor conditions but yields increase when soil fertility is maintained and a good supply of water is used. Under very good conditions yields of fresh roots can reach 90 tonnes per hectare while yields from subsistence agricultural systems average 9.8 tonnes per hectare (UNICEF, 1990). The main objective of this study is to know the effect of sun drying on the proximate properties, functional properties and sensory evaluation of fufu flour and dough.

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2. Materials and Method

2.1.1 Source of Material

The raw material (Cassava) used in this work was a variety of *manihot esculent crantz* which was harvested from botanical garden od department of Science Laboratory Technology, The Federal Polytechnic, Ilaro, Ogun State, Nigeria. The cassava was about 12mohths old at the time of harvest. The outer skin was brown, cortex was creamy and the pulp was whitish in colour. The root was then transported to the Processing laboratory, Department of Food Technology, The Federal Polytechnic, Ilaro for processing

2.1.2 Processing of Wet Fufu Paste

The wet fufu paste was produced as described by Sanni et al.,(1998). This involves peeling of cassava, cutting into chooks of different sizes, steeping in water in a plastic bowl for 3days, sieving and dewatering.

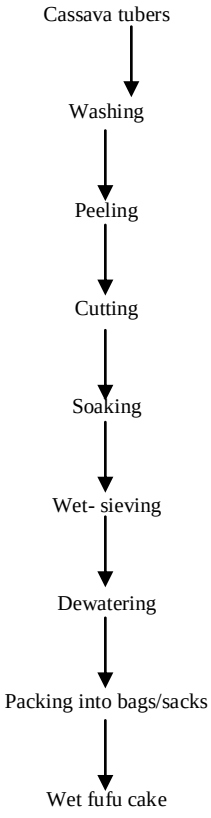

Figure 1 ***Cassava processing stages. Adapted from Okoro, (2007).***

2.1.3 Processing Cabinet Dried Fufu Flour

The pressed cake was pulverized manually before drying. The pulverized must was feed into already warmed cabinet dryer (plate 1,2 and 3) and dried at 100^{o} C for 1hour. The resulting dried fufu was then milled dry milled with a petrol engine powered attraction mill. The resulting powder is the fufu flour.

2.1.4 Processing of Sun- Dried Fufu Flour

The pressed cake was pulverized manually before drying. The pulverized mash was spread on a tray and put inside the sun to dry which was done in two days. The sun dried powdered fufu was milled in an attrition mill in a dry form.

3. Analysis

3.1 Proximate Analysis

3.1.1 Determination of Moisture

The method used A.O.A.C, (2005). A dry clean crucible was placed in an oven for about 30minutes at 80°c, cooled in a desiccators and weighted (W_1), about 5g of the sample was weighted into the crucible and the weight of the crucible and the sample was recorded (W_2). The crucible and the weighted samples were then placed in the oven at intervals, cooled in the desiccator and weighted. The weight was then recorded as the weight of the crucible plus content after drying (W_3).

$$\% \text{ moisture} = \frac{\text{loss on weight after drying}}{\text{Weight of sample}} \times \frac{100}{1}$$

$$= \frac{W2-W3\ X\ 100}{W2-W1}$$

3.1.2 Determination of Ash Content

The method used was described by A.O.A.C, (2005). 5g of the sample was weighted into a previously ignited, cooled and weighted crucible. Heating over bursen burner gently until the sample charred and the crucible and content transferred to a muffle furnace or light grew as result. It was then cooled in a desiccator and re-weighted

$$\% \text{ Ash} = = \frac{weig\ ht\ of\ \ Ash}{weig\ ht\ of\ original\ \ sample} X \frac{100}{1}$$

Where w_1, = weight of empty crucible

W_2, = weight of crucible + sample before drying

$W_{3,=}$ weight of crucible + Ash

3.1.3 Determination of Fat Content

The A.O.A.C, (2005) method was used. 5g of the sample was measured (Ws) and then put in a tumble of known weight. The cleaned, dried, accurately weighted flask filled with solvent (hexane) to be used to about 2/3 fill. The weighed sample was dropped into the tumble in the sox let extractor and was plugged tightly with cotton wool. The siphon was made to go through one excursion through the sample. The flex condenser was fixed into the sox let chamber and the heating mechanism set up. The heating was done on a manthe and the extraction was completed after about 6hours. The condenser and the thimble were removed after cooling in desiccators (WDS)

$$\% \text{ fat} = \frac{\text{weight of sample} - \text{weight of Deffated sample}}{\text{weight of sample .}} X \frac{100}{1}$$

3.1.4 Determination of Protein Content

The crude protein was determined bymethod where nitrogen in the crude protein of the samples was determined by kjeldahl nitrogen method where % crude protein of the sample was determined by kjeldahl method where nitrogen in the crude protein of the sample was determined by Kjeldahl nitrogen method where percentage crude protein total nitrogen X6.25 as described in (A.O.A.C, 1990). 2g of the sample weighed into 150ml digested flask with 5 table of kjeldahl copper catalyst 20ml of concentrated sulphuric and was added and the solution was digested until the colour changes to light green.
The solution was then cooled for 45minutes, transferred into 100ml volumetric flask and made up to mark with distilled water.The markham type semi-micro kjeldahl distillation apparatus was set up 20ml of boric acid pipettes and poured into a small conical flask with 5drops of mixed indicator which gave pink colour. 10ml of the digest with 20ml of 2% sodium hydroxide was introduced into the distillation units. As the distillation proceeds, the distillate was collected in boric acid for 10minutes until the pink colour changed to green. After the distillation of the content, the conical flask was litrated with 0.05N Hydrochloric acid back to the pink colour. Blank experiments were carried out.

$$\% \text{ N} = \frac{Litre\ \ value - blank\ \ 7.7X\ normality\ \ \ of\ \ acid}{weig\ ht\ of\ \ sample}$$

$$\% \text{ crude protein} = \% \text{ Nitrogen X ConversionFactor (C.F)}$$

3.1.5 Determination Of Crude Fibre

About 2g of the dried sample was exploited in other to remove fat. It was then boiled with about 200ml of sulphuric acid containing 1.25g of the acid per 100ml for 30minutes under specified condition. It was filtered through muslin cloth a filtered funnel was with boiling water until the washing was no

longer acid. It was then boiled for 30minutes with 200ml of sodium hydroxide solution containing 1.25g of carbonated green sodium hydroxide per 100ml and filtered through a filtering cloth. The material was dried at 100°c to a constant weight and then incinerated cooled and weighted again.

$$\% \text{ Crude fibre} = \frac{Wi - W2}{W2} X \frac{100}{1}$$

3.1.6 Determination of Carbohydrate

By difference, this involves obtaining the available carbohydrates content by calculation having estimated all the other fraction by proximate analysis is of available

CHO = 100- (% moisture + % ash + % fat + % protein) (A.O.A.C 1990)

3.2 Functional Properties

The following functional properties were studied bulk density, water absorption capacity, solubility, swelling power and dispensability

3.2.1 Bulk Density

The method used by Oladele and Aina, (2007) was utilized 50g flour sample was put into 100ml measuring cylinder, was tapped continuously until a constant volume was obtained. The bulk density (g $1cm^3$) was calculated as weight of flour (g) divided by flour volume (cm^3)

3.2.2 Water Absorption Capacity

Water absorption capacity of the flour samples were determined by Abbey and Ibey, (1988) with slight modification. One gram of flour sample was mixed with 10ml of distilled water or oil and was placed in a centrifuge tube. The suspension was agitated for one hour on a griffin flask shaker after which it was centrifuged for 15min at 2200pm. The volume of water or oil on the sediment water was measured. Water and oil absorption capacities were calculated as ml water or oil absorbed per gram of flour respectively.

3.2.3 Swelling Power

This was determined by the method described by Oladele and Aina (2007). 1g of the flour was mixed with 10ml distilled water in a centrifuge tube and heated at 80^0c for 30 minutes. This was continuously shaken during the heating period. The tube was removed from the bath, wiped dry, cooled to room temperature (28^0c) and centrifuged for 15min at 2200rpm. The supernatant was evaporated, and the dried residue weighed to determine the solubility. The swollen sample (paste) obtained from decanting supernatant was also weitghed to determine the swelling power. Swelling power was calculated as

$$\text{S.P} = \frac{Weig\,ht\ of\ the\ paste}{weig\,ht\ of\ the\ dry\ cample}$$

3.2.4 Dispersibility

This was determined by the method described by Oladele and Aina (2007). The flour samples were evenly spread on the surface of 25°c distilled water. The mixture was stirred manually for a short time and part of the mixture filter through a science. The total solids content of the collected liquid was determined. Dispensability was calculated from the mass of test potion and the values for water content and total solids

3.3 Sensory Evaluation

A taste panel evaluation of fufu produced from all the samples were conducted using a panel of 10 judges who were regular fufu eaters. Fufu was prepared by first reconstituting the powder in water and cooked on fire until a consistent paste was obtained. The judges were asked to score for odour, colour, texture, taste and over all acceptability using a 9 point hedonic scale where 1 and 9 represent dislike extremely and like extremely respectively.

4. Results

Table 1: Proximate Comparison of Fufu Flour

PARAMETERS (%)	SAMPLES		
	Fresh tuber	***Sundried***	***Cabinets dried***
Moisture (%)	59.43 ±0.03	10.23±0.03	10.22±0.01
Ash (%)	1.0 ±0.01	0.81±0.01	0.74±0.03
Fibre (%)	0.6 ±0.02	0.5±0.01	0.30±0.01
Fat (%)	0.2 ±0.03	0.19±0.03	0.17±0.03
Protein (%)	0.7±0.01	0.65±0.04	0.51±0.02
Carbohydrate (by difference %)	85.24 ±0.04	82.24±0.01	82.22±0.01

Values are means ± standard deviation of duplicate determinations| "Not significantly different (P>0.05).
Mean values followed by different superscript within the same row are significantly different (P<0.05)

Table 2: Functional Properties of Fufu Flour

	SAMPLES	
Parameters	**Sun- dried**	**Cabinet dried**
BD (g/ml)	0.5263±0.04	0.5102±0.01
WAC (g/100g)	163±0.06	152±0.03
SP(g/g)	5.80±0.04	5.71±0.0
Solubility (g)	5.07±0.04	4.82±0.01
Dispersability (%)	73±0.00	75±0.00

Values are means ± standard deviation of duplicate determinations| "Not significantly different (P>0.05).
Mean values followed by different superscript within the same row are significantly different (P<0.05)

Table 3: Sensory Evaluation of Fufu Dough

PARAMETERS (%)	SAMPLES		
	Market fufu	***Sun dried***	***Cabinet dried***
Colour	7.9^{a}	5.6^{b}	7.4^{a}
Flavour	7.5^{a}	6.3^{b}	6.8^{b}
Consistency	8.0^{a}	6.4^{b}	7.7^{a}
Taste	7.3^{a}	6.3^{b}	6.9^{a}
Overall Acceptability	8.2^{a}	6.0^{b}	7.3^{a}

Values are means ± standard deviation of duplicate determinations| "Not significantly different (P>0.05).
Mean values followed by different superscript within the same row are significantly different (P<0.05)

5. Discussion

The results of proximate analysis dried fufu flour were shown in table 1 above. The moisture content ranges 10.22 to 59.43%. The cabinet dried sample had the lowest moisture content and the sun dried sample had the highest moisture. The moisture content in this research work is similar to the reported of Dawkins and Lu, (1991).The carbohydrate content ranges 82.22 to 85.10% with the control(fresh tuber) sample having the highest carbohydrate content and cabinet dried sample having the lowest carbohydrate content. This could attribute to high content of starch present in cassava root (Abrahão et al., 2006). The cabinet dried had the lowest Ash which ranged from 0.75% to 0.81% and fibre content which ranged from 0.3% to 0.6% when compared with the fresh tuber had the highest fibre content and Ash content.

Table 2 shows the functional properties of fufu flour obtained from sun drying and from a cabinet dryer.The value of water absorption capacity ranged from 163 ± 0.04g/100g to 152 ± 0.03g/100g with sun drying having the highest an cabinet dried fufu having the lowest value. High water absorption capacity is attributed to loose structure of the starch polymers while low value indicates the compactness of the molecular structure (Adebowale et al., 2005).Fufu flour from cabinet dryer has dispersibility of 75 ± 0.00% while sun dried fufu flour has 73± 0.00%. dispersibility of flour reconstitutes on water kulkami et al., (1991). The bulk density ranged from 0.5102 + 0.0g/ml to 0.5263 ± 0.04g/ml cabinet dried fufu flour has the lowest bulk density and sun – dried fufu had the highest one. The values of least swelling power ranged between 5.71 ± 0.06 to 6.80 ± 0.04, the least swelling power which is a measure of the minimum amount of flour that is needed to form a gel in a measured volume of water.The higher the swelling power the higher the amount of flour needed to swell therefore, is should be noted that the greater the percentage of the any lose fraction of the starch, the quicker the formation of the gel.The dispensability of the samples ranged from 75 ± 0.00g/g with the cabinet dried fufu having the highest and sun dried having the lowest. There was a different due to the efficiency of the drying methods and the fact that the same milling machine was used to mill the flour after drying

Table 3 shows sensory evaluation scores for cooked paste fufu dough from cabinet and sun compared to market cooked fufu. There were significant differences ($P<0.05$) in the panelist rating of the samples for color, which may be due to the drying method. There were significant difference ($P< 0.05$) in the sensory attributes of the cooked fufu samples except odor, In terms forover all acceptability cooked fufu from cabinet dried flour was rated closer to the market fufu than sun dried flour.

6. Conclusion

Although the drying method used to preserve wet fufu have effect on physiochemical and organoleptic qualities of the resultant fufuflour and dough. Sensory evaluation showed that the market fufu prepared from wet fufu paste was most preferred and followed closely with cabinet dried fufu. So many people complained that the cooked fufu from sun-dried flour has similarities to lafun.

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