

Assessment of Wrap Sizes as it Affects Storage of Fufu, a Traditional Cassava Based Fermented Products

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Abstract: Fufu, a traditional Cassava based fermented food product was prepared in the Laboratory and used for the study. Due to the short time storage and transportation of this particular food from one place to another on a popular demand because of its nutritional values, three wrap sizes were adopted to assess storage improvement. In this method, 50 g, 100 and 200 g of raw fufu were wrapped before cooking for the normal 1 h. The batches were stored on a wooden tray at ambient temperature in the laboratory. Quantitative determination of microbial and chemical changes occurring in the fufu samples was studied for four weeks. Microbial counts was higher in the 200 g wrap at fourth week of storage being 8.40×10^4 cfu (g^{-1}) for bacteria and 2.32×10^3 spore (g^{-1}) for fungi while it was 1.35×10^4 cfu (g^{-1}); 1.06×10^3 , 1.66×10^3 spore (g^{-1}) bacterial and fungal counts, respectively for 50 g and 100 g wraps. Also at fourth week of storage pH was 3.80, 4.06 and 6.15; TTA was 0.45, 1.85 and 2.56% (W/W lactic acid) while moisture was 45.10, 58.40 and 70.30%, respectively for 50, 100 and 200 g wraps. In the pounded fufu at fourth week storage, colour odor, aroma and texture rating were significantly higher ($p < 0.05$) for the 50 and 100 g wraps for overall acceptability while the 200 g wrap characters were very low thus unacceptable. This implies that smaller wrap sizes will store longer than big wrap sizes.

Key words: Cassava, fermentation, fufu wrap sizes, storage, sensory attributes

INTRODUCTION

Fufu is one of the food products of cassava (*Manihot esculenta* crantz) root. It is produced by fermenting peeled cassava tubers in water for 3-4 days, following sieving to obtain mash or slurry that is washed severally by changing the water. Excess water in the mash is drained in sack. The mash is then mixed with gari (another cassava root based product) in ratio of 8:2 and it is reconstituted by mixing with some quantity of clean water until a starchy paste is formed. The paste is wrapped in cellophane bag, cooked for 1 h, pound to form a dough. (pounded fufu) and eaten with any African flavoured source. This cassava fermented based product (fufu) is consumed widely in Nigeria and some other African countries because of its high energy. The people that know the value and importance of fufu as a staple food have popularized it and this has led to the increase in demand of the food. Fufu is known to contribute extensively to the caloric intake of manual workmen, street hawkers and students thus its nickname 6 to 6.

Achi and Akomas (2006) reported the isolation of *Lactobacillus* sp. *Bacillus* sp., yeast and coli form bacilli during fermentation of cassava using different processing methods. Lan Caster *et al.* (1982) reported that cassava farming populations have empirically developed several processing methods for

stabilizing cassava and reducing its toxicity. Hence fermentation enhances cassava roots and preparation to a dimensional food (Fufu) which is transported from one part of the country to another on a very high population demand because of its nutritional value, a good storage means is highly important.

However, there is no specific measure to make the wraps of fufu uniform before cooking and moreover, the cellophane bags use in the wrapping are not of the same size hence different producers. While some people preferred to use the size that can only accommodate about 100 g, others use the cellophane bag size that can accommodate about 200 g bag, the normal hour of cooking is 1h. Hence there is variation in size of fufu wraps before cooking, even for the same period of time, we therefore undertake this study to look at sizes of fufu wraps and how it affects storage.

MATERIALS AND METHODS

Retting of Cassava Roots

Thirty kilograms of peeled cassava roots was washed and soaked in 10 L of clean tap water in clay (earthen) pot and covered to ferment for 4 days. The retted cassava roots was washed and sieved in a plastic basin with water. This was allowed to stand for about 30 min that the mash can settle. The mash was washed three times at intervals of 20 min by decanting and replacement of top water to reduce microbial load and accumulated offensive odors during fermentation. Thereafter, excess water was drained by putting the mash in a sack. The mash was transferred into a clear basin and mixed with Eba (another cassava based fermented product) and some quantities of water to form a starchy paste. Different sizes (50, 100 and 200 g) of the starchy paste was wrapped in transparent cellophane bags and cooked for 1h. At this stage it can be founded and eaten with source but prepared samples were kept to monitor storage.

Storage Procedure

The prepared fufu samples of different sizes were spread out on a dry and clean tray at room temperature for four weeks. Replicate sample of the different sizes were collected from the batch for analysis every week.

Physicochemical Analysis

pH

Ten grams of the sample was mashed in 50 mL sterile distilled water. The suspension was collected in a 50 mL capacity beaker and the pH determined with Extick pH meter after standardizing with buffer 4.0 and 7.0 solutions.

Total Titratable Acidity

Twenty five milli liter sample suspension was boiled in a conical flask and allowed to cool. Three drops of phenolphthalein indicator was added and mixed thoroughly. This was titrated against (0.1 M) Na OH. The titratable acidity was expressed as lactic acid equivalents on a wet basis.

Moisture

The moisture content was determined by weighing 1 g of the sample and drying in oven regulated at 105°C until a constant weight is attained according to AOAC, (1980).

Microbiological Analysis

The microbiological quality was assessed from a prepared 10 fold serial dilution of sample by spread plating 0.5 mL each on aerobic plate count agar for total viable count. Baird parker with egg

yolk was used to isolate *Staphylococcus aureus*. After incubation for 48 h at 37°C, dark colonies with clear zone was identified as *Staphylococcus aureus*. Lactic acid bacteria were determined by plating the samples on deMan Rogosa and Sharpe (MRS) agar (Oxoid) and incubated for 48 h at 37°C. Moulds and yeast were determined by plating on malt extract agar (oxoid) and incubated at 25°C for 72 h.

Further more, microbial colonies were purified by sub culturing on freshly prepared media for identification to species level. Pure bacteria isolates were identified based on the criteria of Holt *et al.* (1994).

Yeast, were identified based on the criteria of Barnett *et al.* (1983) and Moulds identified with the descriptions of Rhode and Hartman (1980).

Sensory Quality of Pounded Fufu

At 4th week of storage, the same fufu replicate samples used for physicochemical and microbiological analysis were warmed for about 10-15 min, pounded in mortar until it attained a dough-like consistency and packed equally on serving plates for sensory quality assessment. With a 10 member panel of regular fufu consumer, colour, odor, flavour, texture and overall acceptability of the pounded fufu was evaluated. The parameters were rated on a 9 point hedonic scale. The ratings were described as dislike extremely (1), dislike very much (2), no preference (5), like extremely (6), like moderately (7), like very much (8) and like extremely (9).

However, the experiment was replicated three times and the data obtained were analyzed using the analysis of variance to determine differences and Duncan's multiply range tests to separate the means.

RESULTS

The results of the physicochemical changes in the different sizes of fufu wrap for storage assessment is shown in Table 1. It shows that pH values of the fufu wrap sizes decreases along side period of storage. The 50 g wrap had initial pH at 0 week as 4.15 and this subsequently decreased to 3.80 at 4 week of storage. The 100 g wrap in that order also decreases from 5.14-4.06 and 200 g wrap from 7.60-6.15 at 4 week of storage. TTA and moisture values in the wrap sizes however increases along side period of storage. The initial TTA for 50, 100 and 200 g wraps were 0.40, 1.20 and 1.50%, respectively and as well in that order increases to 0.45, 1.85 and 2.56% at 4 week of storage. Likewise, the moisture contents in the 50 g wrap increases from 30.10-45.10% , 100 g wrap increases from initial value of 51.20-58.40% and the 200 g wrap increases from 60.70-70.30% at four week of storage.

The bacterial and fungal loads as observed in the wrap sizes was in the order of the smaller the wrap size of the samples the higher the load; and also, the longer the storage period of the samples the higher the microbial population (Table 2). The microorganisms isolated and identified from the samples during storage are *Micrococcus Lactis*, *Lactobacillus lactis*, *Bacillus cereus* and *Staphylococcus aureus* while the fungal species includes *Saccharomyces cerevisiae*, *Neurospora crazza*, *Aspergillus flavus*, *Mucor mucedo* and *Penicillium notatum*.

Table 1: Physicochemical properties of prepared fufu during storage

Week	pH			TTA (% lactic acid)			Moisture (%)		
	50 g	100 g	200 g	50 g	100 g	200 g	50 g	100 g	200 g
0	4.15	5.14	7.60	0.40	1.20	1.56	30.10	51.20	60.70
1	3.90	4.68	7.00	0.35	1.40	1.60	30.20	54.00	65.00
2	3.84	4.32	6.90	0.38	1.56	1.80	36.40	56.14	67.50
3	3.84	4.21	6.30	0.42	1.60	2.20	40.20	56.60	68.40
4	3.80	4.06	4.15	0.45	1.85	2.56	45.10	58.40	70.30

Table 2: Total aerobic Microbial count of prepared fufu during storage

Week	Bacterial count (Cfu g ⁻¹)			Fungal count (Spore g ⁻¹)		
	50 g	100 g	200 g	50 g	100 g	200g
0	0.03×10 ⁴	0.50×10 ⁴	1.78×10 ⁴	0.05×10 ³	0.61×10 ³	1.32×10 ³
1	0.65×10 ⁴	0.96×10 ⁴	2.14×10 ⁴	0.25×10 ³	0.84×10 ³	1.76×10 ³
2	0.92×10 ⁴	1.63×10 ⁴	3.68×10 ⁴	0.60×10 ³	1.03×10 ³	1.98×10 ³
3	1.11×10 ⁴	2.20×10 ⁴	6.90×10 ⁴	0.94×10 ³	1.46×10 ³	2.14×10 ³
4	1.35×10 ⁴	2.8×10 ⁴	8.40×10 ⁴	1.06×10 ³	1.66×10 ³	2.32×90 ³

Table 3: Means sensory score of pounded fufu only at week four of storage

Treatments	Colour	Odour	Aroma	Texture	Overall acceptability
50 g	8.6a	8.7a	8.5a	8.8a	8.5a
100 g	8.4a	8.3a	8.7a	8.6a	8.3a
200 g	5.5b	5.3b	4.2b	4.6b	4.6b

Mean score with the same letter are significantly different (p<0.05) n = 10; Score are 1-9 on a hedonic scale

The main sensory analysis of pounded fufu sample at four week storage showed no significant difference (p<0.05) in colour, odor, aroma and texture between the 50 and 100 g wraps size thus their acceptability at 4th weeks of storage, but was significantly different in the 200 g wrap thus having unacceptable characters in all the sensory parameters evaluated (Table 3).

DISCUSSION

Cassava root contained *cyanogenic glucocides* which are highly toxic. To reduce this toxin and to make the roots soft for processing into a dimensional fermented based food, cassava roots are retted in water to ferment for 3-4 days. Ogunbawo *et al.* (2004) emphasized that though this type of fermentation is the simplest way to achieve cassava retting, it involves a complex microbial process. However; it is this complex microbial process and the days of fermentation that results to the desired ideal fufu product.

The decrease in pH observed in the various fufu wrap sizes could be associated with the production of organic acid and other acid metabolic end product which has culminated to effect the drastic pH reduction. Also in the moisture content, an increase alongside period of storage was noticed and this could be as a result of the time to time microbial increase in population and perhaps in diversity which solubilizes the substrates by the associated microbial enzymes for the utilization of the fufu.

The growth of microorganisms in the various wrap sizes of the sample without storage control means, led to the dynamic microbial increases alongside period of storage. These microorganisms increases progressively during storage to a stage in which the organoleptic properties of the 200 g wrap was strongly affected thereby resulting to the certain characteristics not acceptable in a quality fufu product. The microbial successional growth in the prepared fufu samples even to the alteration of character in quality fufu specifies its nutritional values as a quality cassava fermented based food. The microorganisms isolated from the fufu sample could be the organisms involved in the fermentation hence the fermentation employed for the fufu product was natural fermentation where complex microbial populations are involved in the fermentation. Though this might be the situation, it can not be ignored that some of these organisms could be contaminants from humans during packaging, the cellophane bags used for wrapping, the materials used and even from the immediate environment where the prepared fufu were stored.

The microbial population recovered from the samples was in order of size of the fufu wraps. However, this emphasizes that the smaller the fufu wrap size, the more heat penetration in the starchy paste during cooking to reduce microbial load and moisture contents in the samples. This was evident

in the sample where the 200 g wrap with the highest microbial load even at 0 week of storage could not be acceptable after four weeks of storage unlike the 100 and 50 g wraps. The strong objectionable odor and aroma observed in the spoilt fufu could be due to volatile product of carbohydrate fermentation by carbohydrate saccharolytic microorganisms such as the isolated yeast species, *Bacillus* and certain moulds which are capable of fermenting CO₂, formic acid, acetic acid, aldehyde and alcohol (Njoku *et al.*, 1990).

The observed colour changes may be as a result of oxidation and interactions of metabolic products of microbes on the food (Wood, 1985). The sticky texture observed in the spoilt fufu may be as a result of the production of laven and dextran producing bacterial genera (Steinkraus *et al.* 1983).

The sensory score of the pounded fufu revealed the overall acceptability in the 50 and 100 g wraps while the 200 g wrap was unacceptable at four week of storage at ambient temperature. Though there was no significant difference in 50 and 100 g wraps at four week of storage, shelf life extension could characterize a margin between them.

CONCLUSIONS

Based majorly on sensory, microbiological and biochemical parameters determined, the 50 and 100 g wrap of prepared fufu were the most valuable for achieving a longer storage.

Since prepared fufu are transported from one part of the country to another and has been discovered that fufu is liable to chemical and microbial spoilage, thereby, resulting to unacceptability of the product, this modification of wrapping them in small size before cooking for one hour may provide benefits which can improve longer storage facility of the products for consumers to have quality and acceptable fufu irrespective of the distance in transportation and bulk production most especially when cassava is scarce.

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