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Full Length Research Paper

Biochemical qualities of cassava fufu sold in Imo and Abia States of Nigeria

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Hawked retted cassava fufu samples, bought from different vendors in Aba, Umuahia and Owerri in two Southeastern States of Nigeria were analyzed. The biochemical, organoleptic and microbial qualities were determined from day zero and to the eighth days of hawking. The Ph increases from an average of 3.75 on the zero day to 4.20 on the eighth day. The titratable acidity decreased from 1.14% on the zero day to 0.92% on the eighth day. There were losses of organoleptic quality attributes as the day of hawking of the fufu samples increased. The colour, odour and texture of the zero day samples were more accepted and rated higher than the other days of hawking. There were increased in the microbial counts from initial average of 2.01 x 10^5 cfu /g on the zero day to an average count of 18.20x10^5 cfu/g on the eighth day. The pathogenic organisms isolated were *Aspergillums spp, Candida albicans, Staphylococcus aureus, Escherichia coli* and *Bacillus cereus*.

Keywords: Cassava Fufu, Ph, Titratable acidity, Micro organisms

INTRODUCTION

Although cassava fufu is consumed as a staple food in most southeastern state of Nigeria, it has not received any proper handling, packaging or storage.

It is traditionally sold in a wet form (moisture about 50%) which renders it highly perishable (Oguntunde and Orishagbema, 1991). Detail method of cassava fufu preparation vary from locality to locality which greatly affect the quality of the finished product (Okpokiri et al., 1985) The fufu is cooked in various villages where cassava is grown in large quantities by farmers. As cooking alone, without proper handling does not confer preservative actions on the retted cassava fufu. Although there are no reported cases of food poison as a result of consumption of cassava fufu,some cases have been reported as a result of ingestion of some other food types. Cassava and its products like other food material, have potentials for supporting the growth of microorganisms.

Microorganisms gain entry into food during storage and handling this leads to changes in texture, taste, appearance and smell, most still poisonous substances may be produced. (Muller, 1988)

This study therefore aimed at investigating the biochemical and organoleptic qualities of cassava fufu sold in the market.

MATERIALS AND METHODS

Retted cassava fufu samples were bought from Aba

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Table 1. pH of cassava fufu stored for various days under ambient temperature

Time (Days)	Sample pH CFET	CFNK	CFUM	CFKK	CFAR	LSD
0	3.85±00[a]	3.75±0.00[a]	3.80±0.00[a]	3.85±0.00[a]	3.75±0.00[a]	0
1.	3.90+0.00[a]	3.80+0.00[a]	3.90+0.00[a]	3.90+0.00[a]	3.80+0.00[a]	0
2.	4.00±0.00[a]	3.90±0.00[a]	3.99±0.00[a]	4.00±0.00[a]	3.93±0.00[a]	0
3.	4.10±0.00[a]	3.95±0.00[a]	4.00±0.00[a]	4.10±0.00[a]	3.96±0.00[a]	0
4.	4.15+0.00[a]	4.15+0.00[a]	4.15+0.00[a]	4.15+0.00[a]	4.10+0.00[a]	0
5.	4.20±0.00[a]	4.20±0.00[a]	4.15±0.00[a]	4.20±0.00[a]	4.10±0.00[a]	0
6.	4.20±0.00[a]	4.25±0.00[a]	4.20±0.00[a]	4.20±0.00[a]	4.15±0.00[a]	0
7.	4.20+0.00[a]	435+0.00[a]	4.20+0.00[a]	4.20+0.00[a]	4.18+0.00[a]	0
8.	4.25±0.00[a]	4.35±0.00[a]	4.22±0.00[a]	4.21±0.00[a]	4.19±0.00[a]	0

Values are the means of triplicate ± standard deviations. Means within the rows followed by the same letter are significantly not different from each other.
LSD = Least Significant Difference

market (Ariaria CFAR, and Ekeapara CFEK), Owerri market (Nekede CFNK and Irete CFER) and Umuahia urban market (CFUM) They were marked and given to a cassava fufu hawker in the same area who mixed them with her wares and hawked them together. Each marked wrapped sample was collected from the hawker every day for analysis. Samples were collected with sterile containers and covered immediately, and were taken to the laboratory for analysis. Samples for analysis were collected three times respectively from the hawkers.

Chemical and Organoleptic Analysis

The pH and total titratable acidity were determined using AOAC (1990) method. A 20-man member panel was used for the organoleptic evaluation of colour, odour and texture based on 5-point hedonic scale (Iwe, 2002)

Microbiological Analysis

One gram from each of the fufu wraps was separately homogenized in 9 ml of sterile peptone water. The dilution was serially made until 10^{-5} level of dilution was obtained. Isolation and identification was done according to the method of Ogbulie *et al.,* (2005) and ICMMSF (1978). For bacterial isolation, nutrient agar, macConkey agar were used, while sabouraud dextrose agar was used for fungi isolation. Total viable counts of bacteria were determined by enumerating the colony forming units (cfu/g) by pour plating 1 ml of 10^{-5} diluent incubated at 37^0C for 48 hours. Total fungi counts were determined by pour plating also and incubated at 37^0C for 3 days. The experiments were carried out in triplicates. Pure cultures of bacteria and fungal isolates were obtained respectively. Discrete colonies were aseptically transferred by streaking using sterile wire loops onto sterile nutrient agar, macConkey agar slants for bacteria and sabouraud dextrose agar slants for fungi to obtain pure cultures.

Characterization and Identification of Isolates

Bacteria isolates were characterized and identified by initially examining colonies morphology on their cultural properties followed by physiological and biochemical tests. (Motility, citrate, coagulase, indole, starch fermentation, gram stain, spore stain catalase and oxidase). The fungal isolates were characterized by their cultural properties stained with cotton-blue lactophenol solution and observed under low power objective lens. Chessbrough (2002); Kovac (1956); ICMMSF (1978); Ogbulie *et al*. (2005).

Data Statistical Analysis

All plates were prepared in triplicates. The plate counts were expressed in colony forming unit (cfu/g). The pH and total titratable acidity were also done in triplicates. Data obtained were subjected to statistical analysis according to Ihekoronye (1999). Significance differences were established by Duncan multiple range test at 5% level of significance.

RESULTS AND DISCUSSION

Table 1 showed the pH values of the different samples. All the fufu sample had acidic pH and this is in line with the report of Adewole (2005) and Achi and Akoma (2006) which stated that the pH value of the cooked retted cassava fufu falls within the pH range of (3.65 – 5.12). This acidic pH may have restricted the growth of certain

Table 2. Total titratable acidity of cassava fufu stored for various days

Time (Days	Sample Total Titratable Acidity CFET	CFNK	CFUM	CFKK	CFAR	LSD
0.	1.05±0.02[c]	1.21±0.5[b]	1.14±0.01[d]	0.93±0.0[d]	1.21±0.02[a]	0.22
1.	1.01±0.4[d]	1.16±0.04[c]	1.11±0.01[b]	0.92±0.1[e]	1.15±0.02[a]	0.04
2.	0.99±0.1[b]	1.00±0.1[b]	0.99±0.04[b]	0.95±0.1[b]	1.11±0.1[a]	1.5
3.	0.99±0.1[b]	0.99±0.02[b]	0.99±0.01[c]	0.94±0.01[c]	1.10±0.01[a]	0.07
4.	0.96±0.01[a]	0.99±0.01[a]	0.98±0.1[a]	0.93±0.01[b]	0.99±0.06[a]	0.22
5.	0.96±0.01[a]	0.98±0.01[a]	0.97±0.01[a]	0.93±0.01[b]	0.99±0.01[a]	0.22
6.	0.95±0.01[a]	0.98±0.01[a]	0.97±0.01[a]	0.92±0.01[a]	0.98±0.00[a]	2.6
7.	0.95±0.01[a]	0.98±0.01[a]	0.96±0.01[a]	0.92±0.01[a]	0.97±0.01[a]	2.6
8.	0.95±0.1[a]	0.97±0.1[a]	0.96±0.01[a]	0.92±0.01[a]	0.97±0.01[a]	2.6

Values are the means of triplicate determination ± standard deviations. Means within the rows followed by the same letter are significantly not different from each other.

Table 3. Sensory evaluation scores of colour for stored cassava fufu

Time (Days)	Sample and their Scores CFET	CFNK	CFUM	CFKK	CFAR
0.	4.8±0.49	4.6±0.49	4.5±0.30	4.4±0.49	4.40±0.40
1.	4.6±0.69	4.5±0.50	4.40±0.66	4.4±0.46	4.3±0.46
2.	3.9±0.42	3.6±0.49	3.6±0.48	3.4±0.52	3.2±0.56
3.	3.8±0.44	3.6±0.49	3.5±0.50	3.4±0.52	3.2±0.56
4.	2.6±0.50	2.5±0.50	2.5±0.50	2.4±0.50	2.2±0.50
5.	2.6±0.50	2.5±0.50	2.5±.50	2.4±0.50	2.2±0.50
6.	2.1±0.30	2.2+0.57	1.9±0.30	1.5±.50	1.3±0.50
7.	1.9±0.30	1.8±0.41	1.5±0.50	1.3±0.50	1.3±0.50
8.	1.3±0.50	1.3±0.50	1.2±0.50	1.2±0.50	1.1±0.50

Values are the means of triplicate determinations ± standard deviation.

micro-organism. As the days of hawking increases the pH increases from 3.75 to 4.20 allowing the growth of the pathogenic and spoilage organisms. Increasing pH of food during storage has been attributed to the release of ammonia by spoilage micro-organisms (Sarkar et al., 2006; Olawepo et al., 2001) The total titratable acidity decreases as the pH increases. From Table 3 it was observed that the sensory qualities decreased with increase in the number of days of hawking for all the samples. The firm texture becomes sticky, the colour changes and odour becomes more pungent On the eight day different colours were seen on the retted cassava fufu. The different colours were as a result of biochemical changes and conspicuous growth of different micro-organisms.

Table 4 showed rapid increases in the microbial count among the samples. On the initial day, CFET, CFNK, CFUM, CFKK and CFAR recorded 1.85 x 10^5 (cfu/g), 1.35x 10^5 (cfu/g), 1.08x10^6 (cfu/g), 2.70 x 10^5 (cfu/g) and 2.80 x 10^5 (cfu/g) respectively. On the eight day of hawking the microbial counts were 18.70 x 10^5 cfu/g, 18.24 x$10.^5$ (cfu/g), 16.90 x 10^5 (cfu/g), 19.08X10^5 (cfu/g) and 19.05 x10^5 (cfu/g), respectively. This indicates that the storage temperature, pH and total titratable acidity in the fufu samples, favour the growth of micro-organisms. Table 5 showed the dominant micro-organisms isolated from all the samples. The organisms were *Staphylococcus aureus, Bacillus cereus, Candida albicans, Escherichia coli, and Aspergillus* spp. Isolation of these organisms is an indication of post processing contamination as a result of poor handling and is of very paramount public health concern.

The high temperature commonly involved in the preparation of retted cassava fufu is sufficient to eliminate most of the micro-organisms but post-processing contamination may occur which affected the quality of the final product. The food may be contaminated during mixing, kneading, moulding and hawking. The presence of *Stapylococcus aureus* in the samples is due to contamination from the skin, mouth, or nose of the handlers or hawkers.

Bacillus cereus an opportunistic pathogen of humans, is a frequent inhabitant of soil, leaf surfaces and wrapping materials. Its presence in the fufu is due to the materials used in wrapping and packaging.

Aspergillus spp in the food may lead to food poison-

Table 4. Microbial counts of stored cassava fufu

Time (Days	Microbial Counts x 10^5 cfu CFET	CFNK	CFUM	CFKK	CFAR	LSD
0	1.85±0.04^b	1.35±0.04^c	1.08±0.04^d	2.70±0.08^a	2.80±0.04^a	0.29
1.	2.09±0.04^a	2.25±0.04^a	1.85±0.04^d	3.05±0.04^b	3.08±0.04^b	0.13
2.	3.30±0.04^a	3.60±0.4^b	3.00±004^c	3.30±0.04^d	4.30±0.04^b	2.6
3.	5.00±0.04^a	5.50±004^c	4.60±0.04^d	6.00±0.04^b	5.70±0.04^c	0.09
4.	7.00±0.04^a	6.90±0.04^a	5.00±0.04^a	7.00±0.04^a	7.40±0.04^a	8.9
5.	8.00±0.08^a	8.20±0.04^b	7.06±0.01^a	9.00±0.04^a	9.10±0.03^a	2.9
6.	10.80±0.04^a	11.46±0.04^b	11.56±0.94^c	13.10±0.08^a	13.20±004^a	1.5
7.	14.3±0.08^a	14.31±0.12^d	13.75±0.8^e	15.30±0.1^c	16.30-±0.16^b	0.37
8.	18.3±0.04^a	18.1±0.02^b	1700±0.04^c	19.00±0.14^b	18.80±0.14^b	2.36

Values are the means the triplicate determinations ± standard deviations. Means within the rows followed by the same letter(s) are significantly not different from each other.

Table 5. Morphological and Biochemical Characteristics of bacterial and fungal isolates.

Cultural and morphological Characteristic	Gram reaction	Mortility	Catalase	Coagulase	Oxidase	Indole	Crtrate	Glucose	Sucrose	Mannitol	Lactose	Maltose	Inositol	Dacitoli	
Rose pink round smooth Edge slightly raised Colonies 2-4um rods on Macconky	-Ve rods	+	-	-	-	+	-	+	-	-	A	+	+	+	*Escherichia coli*
Creamy regular smooth raised clonies 1-2um	+ve coci	-	+	+	-	-	-	A	+	A	–	A	+	+	*Staphylococcus aureus*
Grey round and wavy edge Flat and irregular rods 2-5um	+Ve rods	-	+	-	+	-	+	A	A	A	A	A	-	-	*Bacillus cereus*
Key	+ = positive, - = negative, A = acid production														
	FOR FUNGI														
Cultural Identification Whitish irregular and slightly rounded and dry on saboured dextrose agar	Staining +Ve cocci with pseudo hyphae										Identified Isolates Candida albicans				
Black irregular dry and poundery	+Ve with hyphae										Aspergillus spp.				

ing, since many of these fungi are toxin producing organisms. Ubiquitous in the environment and originated from the market display areas. The presence of *E.coli* in the food indicates that such fufu has been contaminated with faecal materials and such food is not safe for human consumption.

The presence of high number of these organisms as the day of hawking increases indicates progressive proliferation with negative effects on nutritional quality and organoleptic properties since many key nutrients will be broken down and utilized by the spoiling agents (Bueno *et al.,* 2004).

CONCLUSION

The changes in pH and total titratable acidity favours the proliferation of micro-organisms and makes the cassava

fufu unsafe for consumption after the fourth day of production unless the cassava fufu is re-heated to kill the micro-organisms. Re-heating causes the texture to be more sticky and it is not appreciated by consumers. Adequate sanitation practice should be enforced concerning the sale of cassava fufu. Personal hygiene of hawkers and sanitation of utensils are important. Hawkers should be enlightened on hygienic practices.

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