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RESEARCH ARTICLE

An Assessment of Retting Techniques of Cassava Tubers for Fufu Production

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ABSTRACT

Fufu, a traditional Nigerian fermented cassava food product is only produced by retting. This study assessed four different techniques of retting cassava tubers to produce fufu. The cyanide content, titratable acidity and microbial population involved in the system were monitored. Four different forms of cassava tubers namely unpeeled whole tubers (UPWT), peeled whole tubers (PWT), peeled sliced tubers (PST) and peeled grated tubers (PGT) were retted. Retting was complete in 2 days for the PGT, 3 days for the PST and 5 days for the PWT and UPWT samples. Cyanide content of the retting water increased with increase in days while that of the retting tubers decreased. PGT fufu sample had the lowest cyanide content of 0.01mg/g followed by PST fufu with the value of 0.03mg/g. The UPWT sample had the highest quantity of cyanide (0.28mg/g) in the retting tubers indicating that the resulting fufu harboured some unreleased cyanide which can be dangerous to the consumers. Nine organisms (*Bacillus sp, Staphylococcus aureus, Enterobacter sp, Pseudomonas sp, Escherichia coli, Lactobacillus sp, Candida sp, Saccharomyces sp and Aspergillus sp*) were isolated from the retting water with least count been encountered in the PGT samples. Therefore retting the PGT samples can give wet fufu mash with very low cyanide, few microbial loads, in a shorter time.

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INTRODUCTION

Cassava, *Manihot esculenta* Crantz, is a perennial woody shrub with an edible starchy root. It grows in the tropical and sub tropical areas of the world. It is a staple food crop consumed in many parts of the Western and Central Africa and throughout the humid tropics. Nigeria is the World's largest producer of cassava (Sobowale *et al*., 2007).

Cassava tubers are poor in protein (1.2%) and rich in poisonous cyanogenic glycosides and free cyanides (>10mg/100g fresh weight) in some varieties (Nwabueze and Odunsi, 2006; Umeh and Odibo, 2013). The only way to process the tubers for human consumption is by fermentation. This helps to reduce drastically the cyanogenic glycosides in the tubers. It can be processed into many food products like *lafun, chikwangue, garri, fufu, tapioca*, etc (Okafor *et al*., 1998) using different techniques.

Fufu is a fermented cassava food product consumed mainly by the eastern parts of Nigeria. It comes as a wet mash or dry powder which can be cooked and pounded or stirred in hot boiling water to form dough (Okoro, 2007; Umeh and Odibo, 2013). It ranked next to garri (another fermented cassava product) as an indigenous food of most Nigerians in the south east. It is a local food consumed by the poor and the rich, though the poor and the middle class value it more.

Traditional method of processing wet fufu mash involves harvesting, washing, cutting into cylindrical patterns without peeling and steeping for 4-5 days. Improved techniques involved all the processes of the traditional method but with the tubers peeled (Obadina *et al*., 2006).

This study aimed at assessing four different techniques of retting cassava tubers to produce fufu. The cyanide content and titratable acidity of the retting water and tubers were checked. Also, the microbial population involved in the retting system was monitored.

MATERIALS AND METHODS

Cassava roots

A variety of cassava, TMS 30555, locally known as 'Onuanwuru' was cultivated at the Nnamdi Azikiwe University, Awka premises. The cassava plant was allowed to mature and used at the age of 12-18 months.

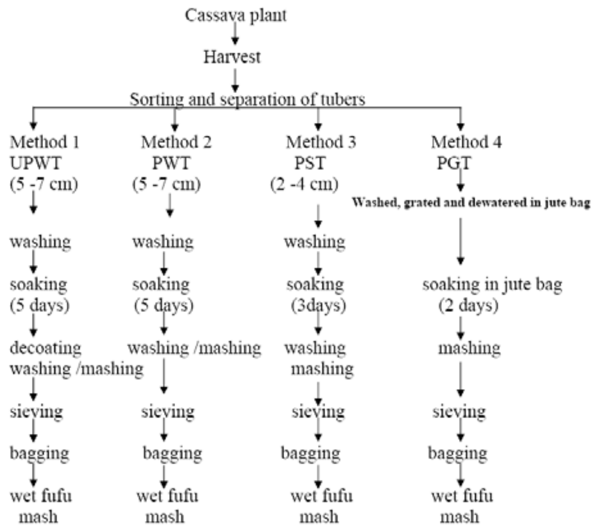

Fig 1: Different techniques involved in wet fufu mash production
Key: Method 1-Unpeeled whole tubers, (UPWT)
Method 2-peeled whole tubers (PWT)
Method 3-peeled sliced tubers (PST)
Method 4-Peeled grated tubers (PGT)

Laboratory processing and retting of the tubers

The method of wet fufu mash production by Obadina *et al.* (2006) was modified to ret the tubers in the laboratory. Figure 1 below shows the different techniques and steps used to produce wet fufu mash in this study.

Four different retting methods were used to process cassava tubers to wet fufu mash. The methods are: retting the unpeeled whole tubers (UPWT), peeled whole tubers (PWT), peeled sliced tubers (PST) and peeled grated tubers (PGT) as shown in fig 1. In all the methods 20kg of cassava tubers were retted using 5 liters of water contained in plastic buckets with lid. The cassava tubers were harvested and washed. In the first method, the head and tail portions were cut off, leaving the tubers unpeeled and whole (UPWT), and measuring about 5-7 cm long. In the peeled whole tubers (PWT), the tubers after harvest were peeled and washed, the head and tail portions were cut off, measuring also about 5-7 cm long. These were retted for five days. The third method was done by harvesting the tubers, peeling them and slicing/cutting them into smaller cylindrical portions measuring about 2-4 cm long (PST). These were retted for three days and retting was completed. In the fourth method the tubers after harvest were peeled, washed and grated using a manual Corona grinding machine. The mash was bagged in a jute bag and allowed to de-water to remove excess water then soaking the bagged mash in water for 48 hours.

During fermentation, the retting water and tubers were collected daily and analyzed for retting ability, cyanide content, titratable acidity and the microbial flora.

Microbiological analysis

The pour plate method as described by Collee and Miles (1989) was used to determine the microbial counts in the retting water using appropriate media. Identification of the bacterial and fungal isolates was carried out using the methods of Krieg and Holt (1984) and Pitt and Hocking (1997) respectively.

Determination of the retting ability

The retting ability of the tubers was determined manually by feeling the degree of softness of the tubers with hand covered with a sterile disposable hand glove.

Titratable acidity and cyanide content

The titratable acidity was determined using the method of AOAC (1990) while the total cyanide content of the samples was determined using the method of Okafor *et al*. (1998) and used by Umeh and Odibo, (2013).

RESULTS

The retting ability of the tubers is as shown in Table 1. Daily changes in the microbial counts, cyanide content and titratable acidity of the retting water are shown in Table 2. Daily changes in the cyanide content and titratable acidity of the retting tubers were presented in Table 3 while the morphological and biochemical characteristics of the microbial isolates in the retting water are as shown in Tables 4, 5 and 6.

Table 1: Daily retting ability of the tubers

Samples	Days	Retting ability
UPWT	1	-
	2	-
	3	+
	4	+ +
	5	+ + +
PWT	1	-
	2	-
	3	+
	4	+ +
	5	+ + +
PST	1	-
	2	+
	3	+ + +
PGT	1	+
	2	+ + +

Key: - Very hard; + Semi soft; + + Soft; + + + Very soft

DISCUSSION

Fermentation of cassava roots allows softening of the roots for further processing and the reduction of the potentially toxic cyanogenic glycosides present in the roots (Oyewole, 1990). It helps in the detoxification of the tubers making them consumable. Some of the food products of cassava fermentation took a lot of time to detoxify while some still harbour some unreleased cyanide. Wet fufu mash production takes up to four or five days to detoxify. In this study, wet fufu mash was produced in two days and the cyanide content of the food product was very low. Cyanide content and titratable acidity of the retting water and tubers were monitored daily and both increased daily. The cyanide content of the retting water in the UPWT was the highest (0.86mg/ml) while that of the PGT was lowest (0.46mg/ml). The titratable acidity of the retting water of the PWT was highest (0.61mg/ml) while that of the PGT was lowest (0.01mg/ml) after complete retting. Table 3 shows the daily changes in the cyanide content and titratable acidity of the retting tubers. The parameters decreased as retting

Table 2: Daily changes in the microbial counts, cyanide content and titratable acidity of the retting water

Samples	Days	Microbial counts ($x10^6$) cfu/ml	Cyanide content (mg/g)	Titratable acidity (mg of lactic acid)
UPWT	1	4.00	0.34	0.02
	2	4.45	0.40	0.26
	3	5.20	0.58	0.40
	4	5.60	0.65	0.54
	5	6.05	0.86	0.58
PWT	1	3.65	0.45	0.16
	2	4.20	0.50	0.38
	3	5.00	0.56	0.50
	4	5.30	0.60	0.58
	5	5.60	0.64	0.61
PST	1	3.25	0.48	0.22
	2	3.60	0.52	0.46
	3	4.00	0.61	0.60
PGT	1	2.85	0.44	0.15
	2	2.05	0.46	0.01

Table 3: Daily changes in cyanide content and titratable acidity of the retting tubers

Samples	Days	Cyanide content (mg/g)	Titratable acidity (mg of lactic acid)
UPWT	1	0.84	2.41
	2	0.81	0.96
	3	0.53	0.56
	4	0.44	0.46
	5	0.28	0.25
PWT	1	0.62	1.56
	2	0.45	1.22
	3	0.22	0.58
	4	0.14	0.47
	5	0.06	0.22
PST	1	0.66	1.00
	2	0.38	1.51
	3	0.03	0.22
PGT	1	0.27	0.24
	2	0.01	nd

Key: nd = not determinable

was achieved. The cyanide content and titratable acidity of the tubers were also highest in the fufu of UPWT and PWT (0.28mg/g and 0.25mg/g) and lowest in the PST (0.01mg/g) and PGT (not determinable). This implies that the fufu produced from the UPWT and PWT still harbour some quantity of cyanide which can be dangerous to consumers. The PGT produced fufu had approximately no cyanide and therefore, it is necessary to grate the tubers prior to retting. Grating the tubers (PGT) before retting accelerated cyanide increase of the retting water coupled with increase in the titratable acidity and improved retting. Retting was complete after two days in the PGT, three days for the PST and five days for UPWT and PWT.

Grating the tubers before retting produced a retting water and fufu mash with low microbial load, cyanide content and short retting time. It caused loss in structural integrity of the tubers and cell wall degradation, which perhaps enhances contact with endogenous enzymes. Therefore increased surface area of the tubers as a result of grating increased contact between microbial enzymes and linamarin (Achi and Akomas, 2006) thereby reduces the effect of innocuous microorganisms.

The population and composition of microorganisms as well as the rate of cyanide reduction at various stages of this work is similar to that observed by Achi and Akomas, (2006). The microbial counts in the retting water increased daily (Table 2). The increase in counts may be as a result of the favorable conditions, which enabled the microorganisms to multiply. The multiplication of the coliforms, especially in the early days (1-2 days) of fermentation is a characteristic of mixed acid fermentation, the retting water tending to acidic and the roots tending to alkalinity. The fungal counts and lactic acid bacterial counts were not determinable in the first day of retting but increased in the later days. The microbial loads of the UPWT were the highest. This may be due to the peels that were not

Table 4: Morphological and biochemical characteristics of the bacterial isolates

Colony morphology	Gram stain	Spore	Motility	Urase	Catalase	Citrate	MR	V.P	Indole	H_2S	Gelatine	KCN	Coagulase	Glucose	Lactose	Maltose	Sucrose	Minitol	Prob org
Cream, rough, opaqu, & circular	+ ve long, rods in chains	+	+	-	+	+	+	-	-	-	-	-	-	A G	-	-	-	-	*Bacillus sp*
Cream white non viscous flat	- ve short rods	-	-	-	-	-	-	-	+	-	-	-	-	A	A	-	A	A	*Eschrichia coli*
Smooth mucoid and circular	- ve short rods small capsule-s (+)	-	+	-	+	+	-	+	-	-	-	+	-	A	A	-	A	-	*Enterobacter sp*
Cream smooth raised circular	+ ve cocci in clusters	-	-	-	+	+	-	-	-	-	-	-	+	A	-	-	-	-	*Staphylococcus aureus*
Blue to dirty green low convex colonies	+ ve rods	-	+	-	+	+	-	-	-	-	-	+	-	AG	-	-	-	-	*Pseudomonas sp*
Gray to white on TJA	+ve long rods in chains and singly	+	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	*Lactobacillus sp*

Key: A - acid; AG - acid and gas; TJA - Tomato juice agar

Table 5: Some morphological and biochemical properties of the yeast isolates

Culture characte -ristics	Cell morphology	Sugar fermentation					Sugar assimilation					Probable organism
		Gluc ose	Mal tose	Galactose	Dex trose	Manitol	Glucose	Mal tose	Gala ctose	Dex trose	Manitol	
Cream white smooth & flat	Oval budding cells,pseudo -hyphae	-	-	-	+	-	-	+	-	+	-	*Candida sp*
Smooth cream white to tan, hairy	Budding cells	+	+	-	-	+	+	+	-	-	-	*Saccharo-myces sp*

Table 6: Some morphological characteristics of the mould isolate

Young culture morphology	Old culture morphology	Microscopy	Texture	Days	Probable organisms
Light whitish with discrete head	Black on aging	Septate hyphae and short conidiophores	Powdery and fluffy	3-4	*Aspergillus sp.*

removed and the microbes from the soil may stick to the peels. It was also observed that the PGT had least microbial counts.

It was also observed that the UPWT samples possessed the highest odour which may be due to the presence of large amount of microorganisms. Submerged fermentation over four days by traditional methods usually produced a mash and retting water which contain a foul odour resulting from uncontrolled fermentation and storage techniques (Okpokiri *et al*., 1992). Retting UPWT seems the simplest way to achieve cassava retting but involves a complex microbial process as seen in the study. The number and types of organisms in a fermenting system may result in variations in the quality of fufu produced (Ogumbawo *et al*., 2004). In conclusion, this study achieved production of wet fufu mash in two days using the peeled grated tubers (PGT).

REFERENCES

AOAC, 1990. Association of Analytical Chemist. Official Methods of Analysis. 15th ed. Washington DC.

Achi OK and NS Akomas, 2006. Comparative Assessment of Fermentation Techniques in the processing of fufu, a traditional fermented cassava product. Pak J Nutr, 5: 224-229.

Collee JG and RS Miles, 1989. Tests for identification of bacteria in practical Microbiology, 3rd ed, vol 2. Livingstone Edinghburgh London, pp: 141-160.

Krieg NR and JG Holt, 1984. Bergy's Manual of Systemic Bacteriology Vol 1. Willians and Wilkins Baltimore.

Nwabueze TU and FO Odunsi, 2006. Optimization of process conditions for cassava (Manihot esculenta Crantz) for lafun production. Afric J Biotechnol, 6: 603.

Obadina AO, OB Oyewole, LO Sanni, and KI Tomlins, 2006. Bio-preservative activities of Lactobacillus plantarum strains in fermenting cassava 'fufu'. Afric J Biotechnol, 5: 620-625.

Ogumbawo ST, AI Sanni, and AA Olilude, 2004. Effect of bacteriocinogenic Lactobacillus sp on shelf-life of fufu, a traditional fermented cassava product. World J Microbiol Biotechnol, 20: 57-63.

Okafor N, C Umeh and C Ibenegbu, 1998. Amelioration of garri, a cassava based fermented food by the inoculation of microorganisms secreting Amylase, Lysine and Linamarase into the cassava mash. World J Microbiol Biotechnol, 14: 835-838.

Okoro CC, 2007. Effect of process modification on the Physio-chemical and sensory quality of fufu-flour and dough. Afric J Biotechnol, 6: 1949-1953.

Oyewole OB, 1990. Optimization of cassava fermentation for fufu production: effects of single starter cultures. J Appl Bacteriol, 68: 49-54

Pitt JI and JH Hocking, 1997 Textbook on Fungi and food spoilage, Blackie Academic and Professional Press, London.

Sobowale AO, TO Olorin and OB Oyewole, 2007. Effect of Lactic acid bacteria starter culture fermentation of cassava on chemical and sensory characteristics of fufu flour. Afric J Biotechnol, 6: 1954-1958.

Umeh SO and FJC Odibo, 2013. Production of High Protein and Low Cyanide Wet Fufu Mash Using Starter cultures. Inter J Appl Sci Engr, 1: 45-48.