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Research article

MICROBIOLOGICAL LOADS OF ROAD SIDE DRIED CASSAVA FLOUR FROM CASSAVA BALLS AND CHUNKS

OGORI A.F and GANA J

SCHOOL OF VOCATIONAL EDUCATION FEDERAL COLLEGE OF EDUCATION KONTAGORA .PMB 39 NIGER STATE ,NIGERIA

E-mail: ogoriakamafriday@gmail.com

ABSTRACT

The quality characteristics of cassava flour from meal of retted dried balls and chunks in Makurdi metropolis were investigated. Seventy six percent (76%) respondents indicates that local stream provides the source water used for the fermentation (ball) and washing of the chunks before sun drying . The result of microbial analysis showed that bacteria count ranged between (3.2x103-7.3x10^5) cfu/ml, mould count were (9.6x 10^1 – 3.6x10^3) cfu/ml and coliform count were (0-6.5x10^4) cfu/ml far in excess of standard. Mould isolate were Aspergillus spp, Rhizopus spp. Bacteria isolate include Bacillus spp, Staphylococcus spp and Echerichia Coli. Other isolates were Enterobacters pp, Proteus spp .

Key word: cassava ball, cassava chunks,microbiological quality.road side dried cassava flour

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INTRODUCTION

Tropical tuber crops constitute one of the most important staple food commodities in the world. The major tuber crops include sweet potatoes, yam, Irish potato, cassava and cocoyam. These are usually high in moisture content which affects storage under ambient conditions.

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Cassava (*Manihot esculenta crantze)* is a crop belonging to the Euphersiocea family, classified into bitter and sweet cassava type (Purseglove 1991). About 34 million tonnels of the world cassava produce are from Nigeria (FAO, 2001), Cassava potential uses cut across human consumption, animal feed stock, industrial or medicinal products and valued market profit (Asonye 2001, Nweke *et al;* 2002).

Traditional meal of retted dried cassava ball and chunks are processed by large segment of Nigeria population by peeling washing slicing, fermenting, draining or moudling and drying. Cassava chips flour have been reported to be a better quality food and of long shelf life than potato (Bokanga, 1990).

The fleshy portion of cassava contain 62% moisture, 35% starch, 1% protein, 0.3% fat, 2% fiber and 1% ash. The fresh roots contain 35mg/100g of vitamin C, trace amount of niacin and fat soluble vitamins (Purseglove, 1991). Cassava chips has a wide application for dough and paste, for composite flour making and starch as source of fermentable sugar required in the production of alcoholic beverages (Amutha and Gunasekaean, 2001). Processed cassava flour has been reported to be good weaning food, feed ingredient and bakery substitute (Lekule and Sarwath, 1992).

The most economic method of processing cassava is by drying. The traditional drying process is carried out by the local women who normally target the period of scarcity as the purpose for preservation. The drying is carried out under unhygienic environment resulting in products of low hygienic quality (Kwaisa, 1988). The wet produce are usually spread on bamboo, tarpaulin, rocky surfaces, and concrete floors by the road side, thus exposing them to chemical, physical and microbiological hazards and losses due to packing and redrying.

In most parts of the country, drying by the road side is most economical for meal of retted dried cassava balls and dried chunks. The method however exposes the product to dust, insects, secondary fermentation, animal contamination and other environmental hazards. Wide spread of *staphylococcus* from animal and human have been observed because of close association of animal with food, poor sanitation, contaminated rocky surfaces or tarpaulin and polluted environment charged with spoilage and pathogenic flora (Norris, 1989).

The safety of meal of retted dried cassava balls and dried cassava chunks coupled with the low nutritive content of the products from them is of great concern hence food eaten has direct influence on health (WHO, 1997). It is important for food inspectors, processors and handlers to keep dried cassava balls and dried chunks and its food safe from pathogens. Several micro organisms have been known to affect the quality of food outside the natural flora, thereby constituting health hazard when contaminated food are consumed, and posing questions on food safety

measures. Meal of retted dried Cassava balls are low acid food during processing with limited and slow rate of water loss on sun drying which generally favours spoilage food intoxication, infection and quality reduction resulting from chemical interaction (Chaftel et al; 1985).

Food quality is that whole characteristics of food that make food important chemically, physically, microbiologically and economically, hence the quality of traditional processed dried cassava ball and dried chunks are of much important. The Nigeria government has approved the inclusion of 10% cassava flour in wheat flour for economic purposes. Also the oil company had indicated interest in admixture of alcohol and petroleum as substitute for crude oil, which may require varied source other than modern method of processing cassava root.

The technological application of flour from dried cassava balls and dried chunks will depend on some of their functional and microbial properties. However, limited information are available on traditional processing, preservation or safety and quality of meal of retted dried cassava balls, cassava chunks and products, hence there is need to carryout in-depth study on flour from meal of retted dried cassava balls and dried chunks that are locally dried to furnish intending users with information, encourage production and make possible technical assistance on processing and marketing as raw materials for intending factories, consumers and health inspectors. Meal of retted dried cassava ball and dried chunks are common in Benue State with less concern on its quality, therefore there is an urgent need for quick physic-chemical and microbiological analysis of this dried cassava balls and cassava chunks to evaluate it potential quality, ascertain process divisibility for both intending users at industrial and international markets. Cassava roots base technology are rising rapidly and the need to appreciate a long time usage of traditionally processed cassava roots by local consumers or villages in the middle belt region of Nigeria is important.

The research work seeks to establish relationship between traditional processed meal of retted dried cassava balls and dried chunks and its properties and dried chunks, by reasons of local processing approach many may not deviate from standard restricting guide for specific processing, production of cassava based traditional product or use as raw materials.

The study may add value to limited utilization of traditionally processed meal of retted cassava ball and dried chunks, careful target for health consumer and guide for food safety measures. The knowledge on microbiological quality of food quality eaten in a place is valuable in identifying and solving nutritional and health problems of the population. The assessment of risk associated with traditional flours were however more influenced

by public perception, however the medical profession, are still reluctant on the role of food safety in preventing infants diarrhea and the need to assure safe blend food from locally dried cassava produce are often not considered and less advocated.

MATERIAL AND METHOD

Raw Material

The under study site within the metropolis which includes Wurukum, Wadata, North Bank, High-level and Fiidi, were ten respondent processors from each site were interviewed on how the meal of retted dried cassava balls and dried cassava chunks were traditional processed, based on variety of cassava used, the fermentation equipments, the source of water, sanitary conditions and methods of backing from drying flour.

Sample of meal of retted dried cassava balls or simply cassava ball and the dried cassava chunks for the study were obtained from different locations.

Random sampling from ten points for balls and chunks within a site were done using America microbiological specification of foods (AMSF, 1980), and the three class manual method of mixing, which is adopted by Association of America Feed Control officials (AAFCO, 2000). Samples were sealed in polyethylene bags stored in cooler and then conveyed to the laboratory.

Preparation of Flour from Marrated Dried Cassava Balls

Two kilogram weight of dried cassava balls from each represented sample was thoroughly hand mixed in an aluminum bowl, about 10kg weighed of representative dry sampled cassava balls, were milled with hammer mill (type 8' labmill). The resultant flour were sieved using 100 um aperture size.

Preparation of Flour from Dried Cassava Chunks

Two kilogram weight of dried cassava chunks from each sample was thoroughly hand mixed in an aluminum bowl, about 10kg weighted of preventative dry sampled cassava chips, were milled with the hammer mill (type 8' labmill). The resultant flour was sieved using 100 um aperture size.

Referral sample or standard:. National agency for food drugs adminstration and control with standared organization of Nigeria, flour characteristics properties were used.

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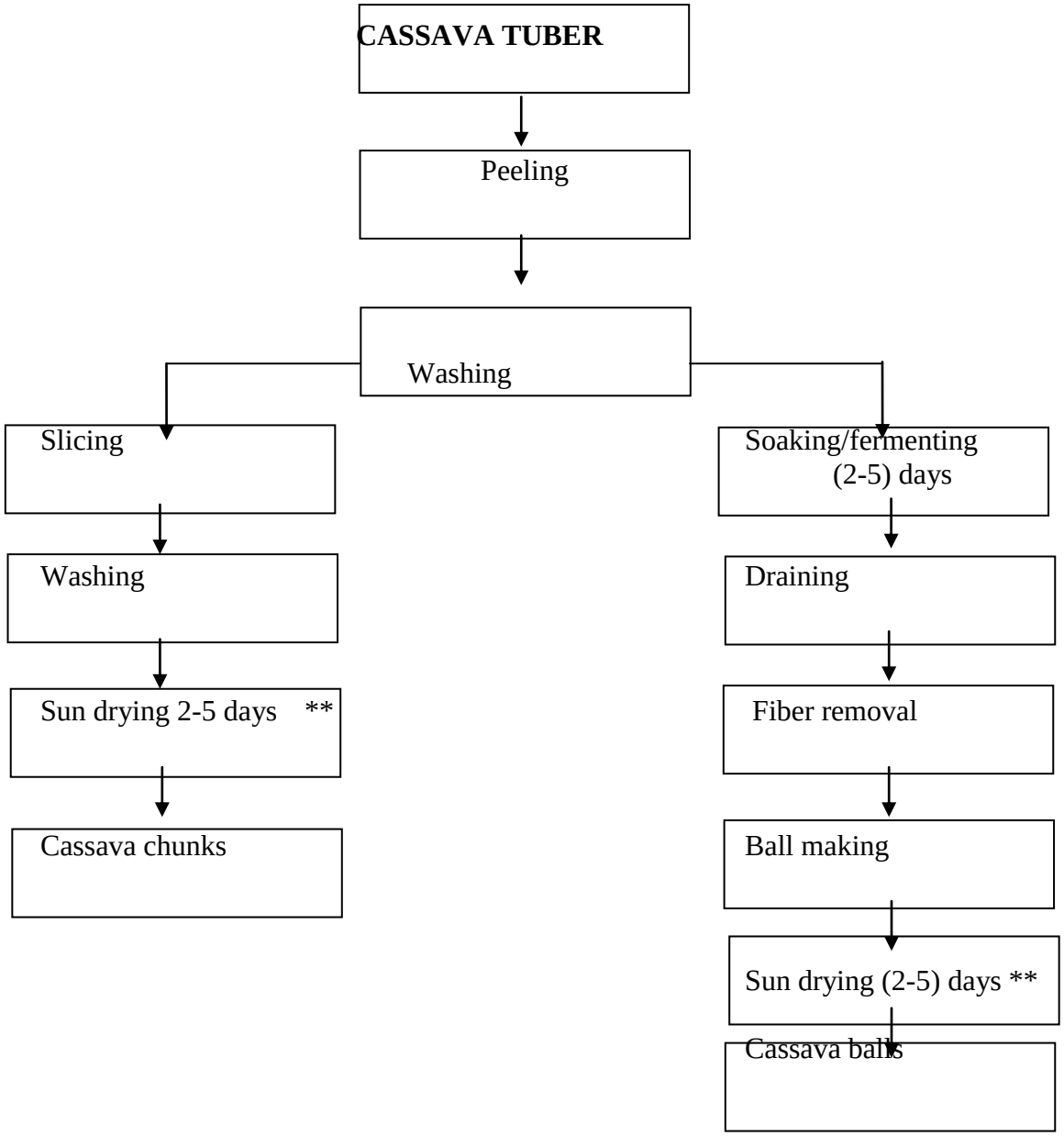
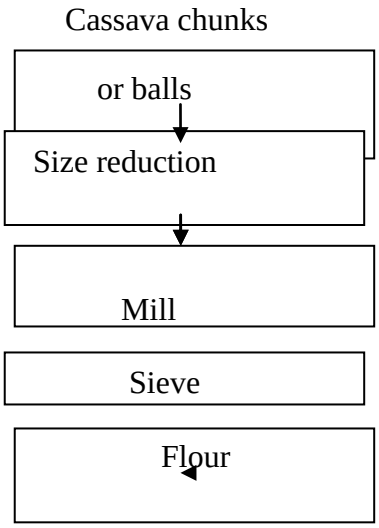


Fig 1: Traditional processing of cassava chunks and ball.

(Akpapunam et al; 2000)

= **critical point

Fig 2: Milling steps of the ball and or chunks into flour



Apparatus and Equipment Used

The following apparatus and equipment were used during the course of the research work. Weighing balance (Ohaus), filter paper, attrition mill, hot air oven (Genlab). Spectrophotometer (SP-20 bush). Refrigerator (Thermo cool). Digital Viscometer (UK), Autoclave, optical microscope, microscopic slide and slide over. Incubator (Benlab), water bath (Gallan kamp). Desiccators, tripod stand, wire quaze, Bunsen burner, thermometer (0-100oc). Measuring cylinder, Assorted glass ware, pipette, Durham tubers, Petri dish, filter paper, plain sheet, hand lens Aluminum foil, cotton wool, whatman number 1 paper, inoculating loop, needle and hypodermic syringes.

MICROBIOLOGICAL ANALYSIS

Total mould count was by Harrigan and MaCance(1976) ,Diliello(1989).Coliform enumeration was by Adegoke(2000). Isolation and cultivation of moulds was by Harrigan and MaCance(1976).cultural and morphorlogical identification of mould isolate was by Harrigan and Macance(1976),Dilello(1982)and collins (1989).The isolation and cultivation of colonies enumerated was by collins (1989).

Gram stain,catalase test, was by Harrigan and MaCance(1976),motility test was by collins(1989), Indole ,methyl red –vogue prokscave and Hush and liefson tests were by Harrigan and MaCance(1976) was by Harrigan and MaCance

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RESULT TABLES

Table 1: Indices of Processing Cassava into balls and chunks

	Respondent											
	CBwu	CBwa	CBn/b	CBh/l	CBfd	percentage	CCwu	CCwa	CCn/b	CCh/l	CCfd	percentage
VARIETY OF CASSAVA												
Bitter	NR	NR	NR	NR	NR	…….	NR	NR	NR	NR	NR	…….
Sweet	10	10	10	10	10	100%	10	10	10	10	10	100%
EQUIPMENT FOR												
FERMENTATION												
Mental drum	NR	NR	NR	NR	4	16%						
Plastic container	10	10	10	10	10	80%						
SOURCE OF WATER												
Pond	NR	NR	NR	NR	NR	…….	NR	NR	NR	NR	NR	…….
Stream	8	4	8	10	6	76%	8	4	8	10	8	76%
Well water	2	NR	NR	NR	NR	24%	2	6	2	NR	2	24%
SANITARY CONDITION												
Washing	6	4	4	6	6	52%	6	4	4	6	6	52%
No-washing	4	6	6	4	4	48%	4	6	6	4	4	48%
METHOD OF PACKING												
Hand	8	10	10	10	10	98%	10	10	10	10	10	100%
Leg	NR	NR	NR	NR	NR	…….	NR	NR	NR	NR	NR	……
Broom	2	NR	NR	NR	NR	4%	NR	NR	NR	NR	NR	…….

CB/CCwu = cassava balls/chunks from Wurukum local market

CB/CCwa = cassava ball s/chunks from wadata local market

CB/CCN/b = cassava balls/chunks from North Bank local market

CB/CCH/l = cassava balls/chunks from High level local market

CB/CCfd = cassava balls/chips from fiidi high level market

NR = No respondent

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Table 2: Total microbial count, mould count and coliform counts of flour from dried cassava balls and chunks

Sample	Bacterial count (cfu/ml)	Mould count (cfu/ml)	Coliform count (cfu/ml)
RS	$1x10^{3}$	1×10^{3}	$<1x10^{3}$
CB Wum	1.3×10^{3b}	2.3×10^{4ab}	2.2×10^{4a}
CB WADm	1.3×10^{4b}	3.0×10^{4a}	1.0×10^{4a}
CB N/Bm	2.2×10^{4b}	1.7×10^{4b}	8.5×10^{3a}
LSD	585	901	319
CC Wum	30×10^{4c}	3.6×10^{3a}	2.4×10^{4b}
CC WADm	1.06×10^{5c}	1.0×10^{3d}	NC
CC N/Bm	7.3×10^{5b}	9.6×10^{1e}	5.5×10^{4a}
CC H/Lm	3.2×10^{4c}	1.2×10^{3c}	1.1×10^{4d}
CC FDm	1.23×10^{5a}	2.1×10^{3b}	6.5×10^{4a}
LSD	204	812	176

Means in the same column followed by the same superscript are not significantly different ($P \leq 0.05$) Values are mean $\pm$ standard deviation from duplicate determinations;

RS = Referral Standard.
CB/CCwu = cassava balls/chunks from Wurukum local market
CB/CCwa = cassava ball s/chunks from wadata local market
CB/CCN/b = cassava balls/chunks from North Bank local market
CB/CCH/l = cassava balls/chunks from High level local market
CB/CCH/l = cassava balls/chunks from Fiidi local market

Table 3: Cultural and morphological identification of mould isolates of flour from dried cassava ball and chunks.

Sample	Isolate	colour	mycellium	conidiophore	columella	spore	rhizoid	stolen	Remark
RS									Absent
CBWUm	x_1	creamy	velvet	non-septate	vesicle	different	absent	absent	Asperg.spp coloured
CBWAm	x_2	greenish	velvet	non-septate	hemisphere	different	absent	absent	Aspergflavus
CB N/Bm	ND	ND	ND	ND	ND	ND	ND	ND	------

CB H/Lm	x_4	creamy White	flufy white	non-septate	round vesicle	green	present	prsent	Rhizopus spp
CB FDm	x_6	creamy cloured	flufywhite	non-septate	round	variable	present	present	Rhizopus spp
CCWUm	q_1	creamy	loosewall	non-septate	velvet	green	absent	absent	Asperg.flavus
CCWAm	q_2	light	looswall	nonseptate	hemisphere	brown	absent	absent	Aspergillus spp
CC N/Bm	q_3	ND	ND	ND	ND	ND	ND	ND	ND
CC H/L,	q_4	creamy White	flufywhite	non-septate	round vesicle	green	present	present	Rhizopus spp
CC FDm	q_6	green dark	flufywhite	non-septate	vesicle	green	present	presnt	Aspergillus spp

NO	=	No Organism
X, q	=	Isolates
RS	=	Referral Standard.
CB/CCwu	=	cassava balls/chunks from Wurukum local market
CB/CCwa	=	cassava ball s/chunks from Wadata local market
CB/CCN/b	=	cassava balls/chunks from North Bank local market
CB/CCH/l	=	cassava balls/chunks from High level local market
CB/CCH/l	=	cassava balls/chunks from Fiidi local market

Table 4: Identification of Bacteria Isolates of flour from dried cassava ball and chunks

Sample	Isolate	colour	shape	elevation	margine	gram rxn	catalse	motility	indole	citrate	mrv	Remark
RS												Absent
CBWUmN$_1$		pinkish	circular	flate	undulation	-shortrod *	+	-	-	+		Ech coli
CBWAmN$_2$		milky	circular	diffuse	entire	+shotrod	+	+	-	+	-	Bcillus spp
	N$_{2,2}$	yellow	circular	raised	entire	+shortrod	+	+	-	+	-	Staph Spp

CB N/BmN_3	pinkish	circular	raised	entire	+short rod	-	-	-	+ + Entebr spp
CB H/LmN_4	yellow	circular	raised	entire	-shortrod	*	+	-	- + Echer Coli
CB/FDmN_5	milky	irregular	diffuse	irregular	–shortrod	*	-	-	+ - Prot spp
CCWUmy_1	milky	circular	flate	entire	–cocci	*	-	-	+ - Entero spp
$Y_{1,2}$	yellow	irregular	flate	irregular	+longrod	+	-	-	+ + Bac spp
CCWAmy_2	yellow	crcular	raised	entire	+shortrod	+	-	-	+ + Echer coli
$Y_{1,2}$	milky	circular	flate	irregular	-coccci	*	+	-	- + Baci spp
CC N/Bmy_3	milky	irregular	diffuse	irregular	+shortrod	+	-	-	+ + Baci spp
CC H/L,y_4	yellow	circular	raised	entire	+shortrod	+	-	-	+ + Baci spp
CC FDmy_5	mlky	circular	flate	irregular	+shortrod	-	-	-	+ + Entrobater
$Y_{5,5}$	milky	circular	flate	entire	–cocci	*	-	-	+ - Proteu spp

N, Y = Isolates
* = no reaction
RS = Referral Standard
CB/CCwu = cassava balls/chunks from Wurukum local market
CB/CCwa = cassava ball s/chunks from Wadata local market
CB/CCN/b = cassava balls/chunks from North Bank local market
CB/CCH/l = cassava balls/chunks from High level local market
CB/CCH/l = cassava balls/chunks from Fiidi local market

DISCUSSION

INDICES OF PROCESSING CASSAVA BALL AND CHUNKS.

Table one above showed the Indices of processing Cassava Ball and Chunks with ten respondents processor from each sites ,each site used sweet variety of cassava.The result indicates that 16% of flour respondent processors in North Bank and Fiidi used metal drums for the fermentation of cassava tuber for cassava ball production and 80% of ten respondent's processors each from wurukum, Wadata and High Level used plastic container for the purpose of fermentation. While only six respondent processor from North Bank and Fiidi under study site used similar fermentation equipments.

From the source of water used, 76% of the eight respondent processors from Wurukum, Wadata and High Level used stream water as a source for fermenting and washing of cassava balls and chunks before sun drying. Only 4% of the two respondent's processor from wurukum used well water.

Furthermore, the result showed that 52% of six respondent, processor from Wurukum, North Bank and Fiidi wash tuber before fermenting and drying to produce cassava balls and chunks. But ,Only 48% of six respondent's processor from Wadata and North Bank did not wash tubers before fermenting and drying of the cassava ball and chunks.

From the methods of packing dried cassava balls and chunk from the drying floors, 98% of the respondent's processor from Wadata, North Bank, High level and Fiidi understudy sites indicate the use of hand in collecting dried cassava balls and chunks from drying floor, with only eight respondent processor from Wurukum understudy site asserted simlar. 100% of ten respondent processor from the five under study sites used hands to collect cassava chunks from the drying floors.

There were no responded processor in the use of leg in collecting cassava balls and chunks from drying floor. Only 4% of two respondent's processor from Wurukum indicated the use of broom in collecting cassava balls from the drying floor.

Total microbial count, mould count and coli form count on dried cassava ball and chunks

Table two (2) above showed total microbial count on cassava ball and chunks are in disagreement with report by (Olaoye et al; 2006. Agu and Aliyoh, 2004). Balls and chunks did not agree with the U.S.A wheat flour and Germany wheat flour of bacteria load of 103 – 104 cfu/ml (Richter et al; 1993 and Spincher, 1986). This significant high bacteria load may be due to poor processing and drying methods as reflected in table one above. And the pH of the flour, this agreed with (Yeoh, 1988) reported that anti-microbial activity with reduce pH contributes to high bacteria counts.

Mould counts were low in Fiidi flour sample. This may be due to bioload proliferation. (Akindahunsin et al; 1999. Akin, 1991) report that natural flora of Rhizopus oryzae, Scerevisae break down cynogenic glucoside during cassava fermentation. The low counts observed in cassava chunks from North Bank sample flour may be due to fairly constant high temperature together with solid substrate surfaces provided by cassava chunks on drying. These high mould counts is an indication of potential spoilage agent and mycotoxins food poisoning (Reiss, 1978).

The coliform counts in both cassava ball flour and cassava chunks flour were not in agreement by report of (Spinchter, 1986). The low coliform count in cassava chunks flour from Wadata may be due to poor hygienic

processing conditions, as reflected in table one above. Six respondent's processor used well water in washing tubers before sun drying. However both high count in cassava balls and chunks flours may be due to coliform proliferation from atmosphere and stream water used (Collins et al; 1989. Okpokeri et al; 1984).

Cultural/Morphological Identification of Mould/Isolate of Flour From Dried Cassava Balls and Chunks

Wurukum and High level flour samples from cassava ball indicated the presence of Apergillus Species. High level isolated strain (x_5) and Fiidi indicated the presence of Rhizopus species.Wurukum flour sample from cassava ball indicated the presence of Aspergillus flavus. Both Wadata and Fiidi flour samples had the pressure of Aspergillus species. High level flour sample was the only flour with the absence Rhizopus species and North Bank flour samples was the only flour with the absence of mould flora.

Cassava flour from dried cassava chunk indicate the presence of pathogenic flora, Proteus species in both Wurukum and Fiidi flour samples. Enterobacter spp were the dominant in isolated strain of $Y_{1,,2}$. Also, from Wurukum and Fiidi flour samples. Isolates from Wadata flour had Echerichia Coli.

proceessing and preservation locally employed had resulted to stress toxins which could resuscitated on favourable substrate conditions, as well as microbial flora adhesion and interaction (George, 1981). Cassava ball flour samples showed isolate of Aspergillus spp. Aspergillus flavus was found from Wadata and Wurukum flour samples, Aspergillus spp in high level flour sample. Rhizopus spp was the observed isolate from high level and Fiidi flour samples. The dominating presence of Aspergillus spp is an indication of indigenous natural flora during cassava fermentation (Akindahunsin et al; 1999). Cassava chunks flour from all the five site sampled showed the dominating presence of Aspegillus spp also, except in high level sample, indicating presence of Rhizopus spp. These are indigenous to cassava fermentation (Oke, 1968) and indication of public health hazard and presence of Aflatoxins .(Karen et al; 1990), Dada and Muller, 1983) stress the effect of high humidity and temperature to favor the proliferation of fungus and toxins in contaminated food stuff. The predominant presence of Asperillus spp showed that unconditioned and hygienic approach on processing had caused this high dominance of the organism.

Bacteria isolate on flours from dried Cassava Balls and Chunks.

Table four showed gram positive and negative rod isolate s with equal presence of gram positive and negative bacteria which include Escherichia coli, Proteus spp. Bacillus spp and Staphylococcus spp in cassava ball and chunks flour Proteus spp, beside posing public health hazard is an indication of member of lactose fomenter, enteric pathogen including Salmonella and Shigella spp which can result to food poison and intoxication. These agreed with (Abo aba et al; 1988 and Sokari et at; 1991) that positive rode and negative rode beside Staphylococcus spp could produce toxins, external skin infection and potent infections. Heat ranges below 50oC have been reported to deactivate micro organisms and their spore (George, 1981) which could be achieved during fufu past preparation.

The observed increase in gram positive rod in cassava chunks flour compared to negative rod of Proteus in Wurukum, Fiidi and Echerichia. Coli from Wadata samples, are due to achieved indigenous micro floral of cassava contributing in fermentation and to varied drying conditions. (George, 1981). Aflatoxines from Aspergillus flavus also inhibites the growth of Bacillus spp (Fleming et al; 1975; Lillehoj). Enterobacter and some gram negative enteropathogenes such as Staphylococcus and Echerichia. Coli had been implicated for diarrhea, external infections obvious on patience skin, urinogenital part as well as causes of dysentery. The occurrence of Bacillus spp is a clear indication of public health hazard, food spoilage vehicle and microbial pathogens in cassava chunks with Bacillus cereus and Bacillus subtilis as possible species strains.

CONCLUSION

The processors from under study sites used stream water for fermentation and washing of the produce which is native to coliform proliferation. The methods of packing from drying floors are hygienic.Microbial load from cassava balls flours were low compared to cassava chunks flour. Microbial quality characteristic test indicated the presence of Aspergillus spp, Rhizopus spp, more so Aspergillus flavus. This mould is an indication of my cotoxicity for example Aflatoxin.The presence of micro organism of public health concern, including faecal Echerichia coli, Enterobacter and Proteus spp indicated clearly that processed dried cassava balls and chunks underwent poor traditional processing with far deviation from microbial load and pathogenic requirement.Proper hygiene and sanitary practice by processors of dried balls and chunks during hand drying and packing from dried flour should be improved.

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