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Physical Contaminants and Organoleptic Acceptability of Cassava Flour and Fufu Made from Its Ball and Chunks

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Abstract

The research work tend to bring to the public the extent in which cassava balls and chunks are contaminated after processing traditionally, its acceptable processed form as flour and fufu from cassava ball and chunks. The characteristic quality of flour from meal of retted dried balls and chunks had Seventy six percent (76%) respondents which indicate washing of the chunks before sun drying cassava. Flour obtained from cassava balls had (10-20%) physical contaminant and flour obtained from cassava chunks had (16-20%) physical contaminant. Sensory evaluation showed that fufu and flour obtained from the various cassava balls and chunks were acceptable.

Keywords: Cassava ball and chunks, Contaminants, Sensory, Flour, Fufu

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. Cassava (*Manihot esculenta)* is a crop belonging to the Euphersiocea family, classified into bitter and sweet cassava type [10]. About 34 million tones of the world cassava produce are from Nigeria. Cassava potential uses cut across human consumption, animal feed stock, industrial or medicinal products and valued market profit [6].

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 [7]. 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 [10]. 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 [5]. Processed cassava flour has been reported to be good weaning food, feed ingredient and bakery substitute [9]. 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 [8]. 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 re-drying.

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 produce to dust, insects, secondary fermentation, animal contamination and other environmental hazards. 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 [12]. 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 functionality such as contamination level and sensory acceptability of its products. 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 inspector.

Processors are concerned with ways of processing cassava into utilizable states. 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 to reveal it contamination level and product acceptability so as to ascertain it quality and process diversibility for both intending users at industry 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 are important. The technological application of meal of retted dried cassava balls and dried chunks will depend on some of their functional, microbial and nutritive properties. However, limited information are available on traditional processing, preservation or safety and quality of flour from dried cassava balls and chunks.

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

Materials and Methods

Raw Material

The under study site within the metropolis 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 packing 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 similar locations.

Random sampling from ten points within a site was done using America microbiological specification of foods [3], and the three class manual method of mixing, which is adopted by Association of America Feed Control officials [4].

Samples were sealed in polyethylene bags stored in plastic 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 of cassava balls, were milled with hammer mill (type 8' labmill). The resultant flour were sieved using 100um 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 dry sampled cassava chips, were milled with the hammer mill (type 8' labmill). The resultant flour was sieved using 100 um aperture size.

Preparation of Fufu from Cassava Ball and Chunks Flours

One kilogram of weighted flour was poured into boiling water at $80^{0}C$ and stirred continuously until gelatinization sets in, after which stirring continues to a pasty form. It is allowed to cool and rapped in apolyethenebage to cool.

Referal Standard: National agency for food drugs administration and control with standard organization of Nigeria, flour characteristics properties were used.

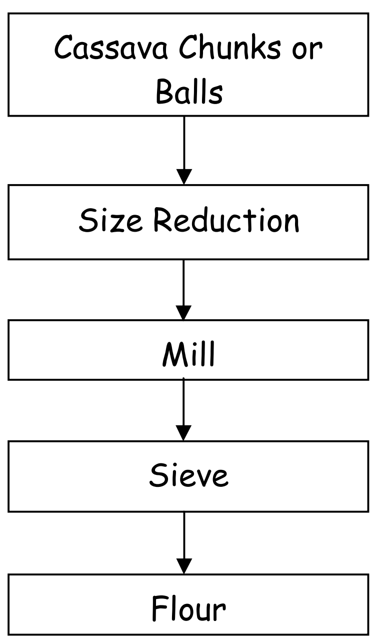

Fig. 1: Processing Cassava Ball and Chips into Flour

Physical Analysis
Physical contaminant determination was by[1].

Sensory Analysis
Sensory evaluation was by Ihekoronye and Ngoddy[13], statistical analysis was by steel and torrie [11] and Ihekoronye and Ngoddy [13], Preparation of fufu past by Apkapunam *et al.,* [2].

Result Tables

Table 1: Indices of Processing Cassava into Balls and Chunks

Respondents	CBwu	CBwa	CBn/b	CBh/l	CB/fd	%	CCwu	CCwa	CCn/b	CCh/l	CCfd	%
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
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

Table 2: Physical Contaminant of Flour from Cassava Balls and Chunks

Sample	Total sample wt	Residue (g)	Hair (g)	Feather (g)	Insects (g)	Stones (g)	Sand (g)	Debris (g)	Total Contaminant	% Contaminant
RS	-	-	-	-	-	-	-	-	-	0
CBWUm	50.00	8.72	ND	1.05±0.10	ND	3±0.05a	2.13±0.30b	2.13±0.3b	8.3±0.7b	16.00
CBWAm	50.00	9.30	1±0.01b	ND	ND	1±0.06a	2.0±0.20c	4.0±0.30a	8±0.35b	16.00
CBNBm	50.00	6.56	1±0.05b	1.25±0.20a	ND	1±0.10c	4.0±0.01a	2.3±0.25b	8.9±0.50ab	18.00
CBH/L	50.00	20.41	ND	ND	ND	1±0.20c	1.02±0.05d	4.0±0.2a	5.90±0.72c	12.00
CBFDm	50.00	11.22	2±0.02a	ND	ND	0.9±0.03c	3.0±0.20b	3.0±0.0ab	10±0.42a	20.00
LSD	………	………..	0.107	1.95	……..	0.17	0.53	1.03	1.09	
CBWUm	50.00	15.38	ND	ND	2.7±0.34a	2±0.01a	5±0.10b	ND	10±0.30a	20.00
CBWAm	50.00	18.24	1±0.04a	2±0.50a	ND	1±0.30b	1±0.01d	ND	5.1±0.57ca	10.00
CBNBm	50.00	8.50	1±0.00a	1±0.40b	1±0.10a	1±0.10b	3±0.10a	ND	7±0.50b	14.00
CBH/L	50.00	13.56	ND	ND	ND	ND	1.91±0.02c	3±0.4a	5±0.40c	10.00
CBFDm	50.00	13.42	1±0.00a	1±0.10	ND	ND	1±0.33b	2±0.02b	5±0.44a	10.00
LSD	……….	………..	0.103	1.69	2.75	0.16	0.48	1.27	1.54	

Mean in the same column followed by the same superscript are not significantly different ($P \geq 0.05$).

Mean ± standard deviation from duplicate determinations

ND = Non detected

RS = Referral Standard

Table 3: The Result of the Mean Scores of Flour from Dried Cassava Balls and Chunks

Sample	Colour / Appearance	Texture	Odour	Overall Acceptability
CBWUm	3.54±0.23b	3.85±0.11a	3.55+0.2b	3.30+0.2c
CBWADm	3.45±0.23b	4.08±0.7a	2.75+0.34c	2.55+0.36e
CBN/Bm	4.25+0.1a	3.54+0.2a	2.70+0.04d	4.20+0.4a
CBH/Lm	2.70+0.02c	2.90+0.2a	3.50+0.00e	3.15+0.3d
CBFDm	3.30+0.04b	4.00+0.1a	3.90+0.03a	3.70+0.37b
LSD	0.56	1.27	0.58	1.08
CCWUm	4.90+0.24ab	3.40+0.28b	3.07+0.30b	3.10+0.0b
CCWADm	2.95+0.00c	4.68+0.31a	3.47+0.0ab	3.40+0.0a
CCN/Bm	5.20+0.26a	3.70+0.21b	3.95+0.0a	2.20+ 0.02c
CCH/Lm	3.85+0.36b	4.15+0.31b	3.80+0.0a	3.40+0.05a
CCFDm	4.10+0.12b	3.70+0.26b	0.29+0.29c	3.45+0.06a
LSD	0.80	0.92	0.76	0.12

Mean in the same column followed by the same superscript are not significantly different (P>0.05).
Values are Mean + standard deviation from duplicate determinations

Table 4: The Result on the Mean Sensory Scores of Cassava Fufu Pasts Made From Dried Cassava Ball and Chunks.

Sample	Colour / Appearance	Texture	Odour	Overall Acceptability
CBWUm	3.54+ 0.23b	3.85+0.11a	3.55+0.2b	3.30+0.2c
CBWADm	3.45+0.23b	4.08+0.7a	2.75+0.34c	2.55+0.36e
CBN/Bm	4.25+0.1a	3.54+0.2a	2.70+0.04d	4.20+0.4a
CBH/Lm	2.70+0.02c	2.90+0.2a	3.50+0.00e	3.15+0.3d
CBFDm	3.30+0.04b	4.00+0.1a	3.90+0.03a	3.70+0.37b
LSD	0.56	1.27	0.58	1.0
CCWUm	4.90+0.24ab	3.40+0.28b	3.07+0.30b	3.10+0.0b
CCWADm	2.95+0.00c	4.68+0.31a	3.47+0.0ab	3.40+0.0a
CCN/Bm	5.20+0.26a	3.70+0.21b	3.95+0.0a	2.20+ 0.02c
CCH/Lm	3.85+0.36b	4.15+0.31b	3.80+0.0a	3.40+0.05a
CCFDm	4.10+0.12b	3.70+0.26b	0.29+0.29c	3.45+0.06a
LSD	0.80	0.92	0.76	0.12

Mean in the same column followed by the same superscript are not significantly different (P>0.05).
Values are Mean + standard deviation from duplicate determinations

Discussion

Indices of Processing Cassava Ball and Chunks

The result on table one showed that 52% of six respondents, processor from Wurukum, North Bank and Fiidi wash tuber before drying to produce cassava balls and chunks. Only 48% of six respondent's processor from Wadata and North Bank does not wash tubers before drying of the cassava ball and chunks. From the methods of packing dried cassava balls and chunk from the drying floors, 98% of ten 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 respondents processor from Wurukum understudy site. 100% of ten respondent processors from the five local markets under the study sites used hands to collect cassava chunks from the drying floors. There was no respondent 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. The high percentages use of hands in collection of these dried cassava balls and chunks during the drying process are good conditions for handling sand and stone contaminants in the produce.

Physical Contaminants of Flour from Dried Cassava Balls and Chunks

The physical contaminant on table two above were presence of hair fragment, sand, stone, insect fragment, feather and debris. The value of the hair contaminant from Wadata and North Bank market samples were 1g respectively and 2g from Fiidi market sample which was significantly different ($p>0.05$).The feather contaminants from Wururkum and North Bank samples were 1g respectively. There were no significant different among feather contaminant. There was no insect contaminant in all the cassava ball samples collected from the five sites. The stone contaminant from Wururkum was 3g and Fiidi was 2g which were higher than stone weight contaminants from Wadata, North Bank and High level samples. Stone contaminant from Wurukum sample was significantly higher than Fiidi cassava ball sample. Sand contaminant from North Bank cassava ball sample was significant ($P>0.05$) compared to 3.0g from Fiidi, 2.13g from Wurukum and 2.0g from Wadata samples respectively. Debris contaminant which include (foreign matter and weevil) were significantly high in Wurukum and high level samples at ($P> 0.05$) compared to 3.0g from Fiidi, 2.25g from North Bank and 2.13g from Wurukum sample ball respectively. Physical contaminants of cassava ball sample ranged between (12-20%). Fiidi had 20% followed by 18% from North Bank, 16% from Wurukum and Wadata respectively and 12% from high level samples. Cassava chunks hair contaminant from Wadata, North Bank and Fiidi were 1g. There were no significantly different at (P>0.05) in cassava chunks samples for hair contaminant. The feather contaminant from Wadata was 2g; North Bank and high level were 1g respectively. There were no significant different among feather contaminants value at (P>0.05).

The insect contaminant from Wurukum was 2.7g and North Bank was 1g. There were no significant differences in insect contaminant. The stone contaminant from Wurukum was 2g. Wadata and North Bank were 1g respectively. The sand contaminant from Wurukum was 2g. Wadata and North Bank were 1g respectively. The sand contaminant from Wurukum was significantly higher compared to the rest five samples of cassava chunks. Debries contaminant from high level and Fiidi samples had no significant different at (P>0.05).The percentage physical contaminants ranged between (10 – 20%). Wurukum was 20%, North Bank 14% and 10% value from Wadata, high level and Fiidi cassava samples respectively.

The hair as contaminants from Wadata and North Bank, feather contaminant from Wurukum and North Bank, stone contaminant in cassava ball and chunk agreed with Gboko, and Otukpo hair, feather, stone and percentage contaminant levels [2]. The increased level of contaminant from North Bank and Fiidi cassava balls maybe due to wet drying practices packing and re-drying. The low values in contaminants levels may be due to solid nature and sizing of the cassava chunks before drying.

The Mean Sensory Scores of Cassava Fufu Pasts Made from dried Cassava ball and Chunks

From table three, Panelist scored fufu past made from North Bank cassava ball flour significantly higher for colour and odour however they were below referral standard. High level balls flour was scored least. Panelists were of the view that there were significant differences in the texture and overall acceptability of samples from Fiidi over the rest market cassava ball flour. Panelist scored fufu past made from Wadata cassava chunks flours highest for colour and odour. Wurukum flour sample was scored least. There was no significant difference in texture of fufu paste made from cassava chunks flour samples. Panelists were of different opinion on overall acceptability from fufu pasts made from cassava chunks flour. The fufu colour from North Bank and Wadata samples were preferred by panelist to other fufu samples made from cassava balls flour. This may be due to fermentation relative humidity and fair constant temperature always experience around North Bank Area.

There were significant differences in texture of fufu made from cassava ball flour. This may be due to stirring during preparation. These were however in contrast with fufu made from cassava chunks. The odour of the cassava ball from North Bank samples were preferred by panelist over the rest samples. This may be due to fairly constant high temperature that may not have allowed long range secondary fermentation to have taken place hence reducing flour odour. Wadata fufu past sample from cassava chunks was also preferred. The overall acceptability which is a combination of colour aroma and taste followed different trend. Although all the markets sample flour were acceptable, panelist preferred Fiidi fufu sample from cassava ball and Wurukum fufu sample from cassava chunks.

The Mean Scores of Flour from Dried Cassava Balls and Chunks

From table four above, Panelist scored flour from North Bank cassava ball flour high for colour, texture and overall acceptability. There were no significant difference among values in texture for samples from Fiidi, Wurukum and High level cassava ball flours in that order but had improved odour over the other cassava ball flour samples.

The cassava chips flour from North Bank samples were scored highest for colour and odour. There were no significant differences in texture in cassava chunks flour from High level and Fiidi cassava chunks flour samples. Wadata, Fiidi and North Bank chunks flours were scored least for colour, odour and overall acceptability in that order but significantly below standard.

The colour from the North Bank sample flour was preferred to other flour samples. This may be due to good milling resulting from retted ball and chemical modification by temperature. Similar trend were followed by cassava chunks flour. There were no significantly difference in cassava chunks and ball textures. This may be due to similar sieve used. The odours of the cassava ball flour Fiidi sample were preferred. This is in contrast to cassava chunks flour. Cassava chunks flour from North Bank samples were score high. This may be due to constant humidity and temperature in Fiidi and North Bank samples within that area. The overall acceptability followed dissimilar trend for both cassava balls and chunks. Although all the samples flour represented were acceptable. Panelist preferred North Bank cassava ball flour to other similar samples. Cassava chunks flour from high level and Wurukum were scored high by panelist. This may be due to constant temperature which might have reduced secondary fermentation and other chemical activities of the balls and chunks.

Conclusion

The processors from under study sites used stream water for washing of the produce which is native to coliform proliferation. The methods of packing from drying floors are hygienic. Percentage contaminants levels were far in excess of the maximum recommended level of zero percent for acceptable cassava flour. Fufu paste and flour from dried cassava ball and chunks were organoleptically acceptable.

Recommendations

1. Proper hygiene and sanitary practice by processors of dried balls and chunks during hand drying and packing from dried flour should be improved.
2. The uses of wire quash platform and drying using tarpaulins should be adopted instead of drying balls and chunks by the road sides.

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