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Advances in Applied Science Research, 2012, 3 (5):2687-2692

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ISSN: 0976-8610
CODEN (USA): AASRFC

Nutritional Quality and Preference of *Fufu* processed from selected Cassava Mosaic Disease (CMD) Resistant Cultivars

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ABSTRACT

Cassava Mosaic Disease (CMD) resistant cultivars were harvested fresh at 10-12 months old. Fufu flours were obtained from the cassava roots using advanced processing method. Proximate composition of fufu flours and sensory evaluation of their dough prepared from the Cassava Mosaic Disease (CMD) resistant cultivars were studied. Moisture content ranged from 7.31-8.40%, which were within the recommended standard for edible cassava flour (13% m/m Max.). Protein ranged from 0.35-2.45%, ash (0.15-1.50%), fat (0.12-0.61%), fiber (0.01-0.20%), carbohydrate (81.81-90.37%) and dry matter (81.792.69%). Low protein, ash, fiber, fat and high carbohydrate and dry matter confer with the nutritional composition of cassava root. Sensory evaluation of dough prepared from the cassava fufu flours obtained showed that colour, odour, elastic quality, hand feel/texture and over all acceptability were all acceptable to the panelists. However, fufu prepared from TMS 97/3200 and 99/3037 were most acceptable for over-all acceptability. Therefore, this work recommends the promotion and utilization of these newly improved cassava cultivars for fufu production

Key words: Cassava, *fufu* flours/dough, proximate composition and sensory evaluation.

INTRODUCTION

Cassava (*Manihot esculenta Crantz*) is an important staple food crop for millions of people in the tropics [1].Cassava plays a very important role in the food security of Africa [2] that is the largest cassava producing continent in the world. Cassava root is normally processed before consumption as a means of detoxification, preservation and modification and various fermented cassava products are available including *gari*, *fufu* and *lafun* [3]. Cassava roots contain mainly carbohydrates, of which 80% is starch, the levels of protein (1-2%) and fat (less than 1%) are not nutritionally significant [4].

In Nigeria, cassava is processed into *gari*, *fufu*, pellets for compounding animal feeds and *kpokpo gari* [5] [6] and also into instant aromatized (fermented) flour [7] .

Fufu is a wet paste made from cassava [8].

As at date, new cassava varieties are being introduced to farmers for their agronomic benefits. [9], with little considerations for the quality of the end products.

One of the constraints in the commercialization of local fermented cassava products is that the quality of the products varies from one processor to the other and even from one processing batch to the other by the processor [10]. Factors which have been found to be responsible for this include: the differences in the methods of processing from one processor to the other [11]; variations in the temperature of fermentation as influenced by the season [12], the age and the variety of the cassava root used by different processors [13].

Cassava Mosaic Disease Resistant varieties have been bred and their rapid multiplications are on-going in Nigeria [14]. There is need to have information on the CMD resistant cultivars that will give good *fufu* flour and dough based on their proximate composition and sensory qualities respectively.

MATERIALS AND METHODS

2.1 Source of materials

Ten Cassava Mosaic Disease resistant (CMD) cultivars namely TMS 30572, 92/2101, 99/3037, 96/0603, 97/4763,92/0325,M98/0068,92B/00068,92/0057 and 97/3200 were harvested at 10-12 months old. The varieties were properly identified by the cassava breeders in the Cassava Programme of National Root Crops Research Institute (NRCRI), Umudike, Abia State, Nigeria.

Their selections were based on previous data reported by Etudaiye *et al*. [16] where the dry matter contents of the *fufu* flours ranged from ranged from 87.75 to 94.48%, final viscosity, 76.00 to 295.00RVU, and set-back viscosity, 28.17 to 70.42 RVU. Dry matter is a practical approach to improving the shelf life and marketability of *fufu* flour [11][15]. [17] and [18] described these pasting parameters as: final viscosity is used to determine a particular starch-based sample quality. It gives an idea of the ability of a material to gel after cooking. Set-back viscosity is a measure of the stability of a paste after cooking. It is the cooling phase in which a re-association between the starch molecules occur to a greater or lesser degree. It therefore affects retrogression or re-ordering of the starch molecules. Set- back has been reported to correlate with the texture of *fufu* flours. It is also associated with synergism and weeping. Low set-back of *fufu* paste or dough indicates high stability.

2.2 Production of cassava fufu flours

Cassava *fufu* flours were processed from each of the Cassava Mosaic Disease (CMD) resistant variety using advanced processing methods as described by [19] and [20] (Fig 1).

Its production involved steeping of peeled and washed cassava roots in water for 48hr. After 48hr, the cassava roots were washed, grated with IITA MK Powered grater (3.5HP petrol engine, made by Lambourn (UK) LTD, Carolyn House, 26 Dingwall Road, Corydon, CR93EE, United Kingdom). The pulp from each grated cassava variety was re steeped in water for another 24hr to ferment. The fermented pulp was sieved with the aide of (Endescotts laboratory test sieve with aperture size of 2.00mm, London, United Kingdom) .Sieved samples were packed in bags and dewatered using a hydraulic presser (7.5HP, John Willy and Sons LTD, United Kingdom). After dewatering, the cassava cake was pulverized by hand and sun dried on a wide opaque water proof made by Jiffy bags macro packing, United Kingdom. The sun dried sample was milled using a disc attrition mill (2A premier mill with particle size of 3.0mm.Hunt and Co., United Kingdom). Further sieving was done manually with a *muslin* cloth to obtain fine *fufu* flour. The *fufu* flours obtained from Cassava Mosaic Disease (CMD) resistant varieties were properly packaged and sealed in grip-seal polythene bags (Gl-model (2.25" X 2.25"), made by Jiffy bags macro packaging Co., United Kingdom). Packaged samples were stored at room temperature (24 – 30^0C) and ready for analysis.

2.3 Proximate composition

Moisture, crude protein, ash, crude fiber, fat of the *fufu* flours were determined using Association of Official Analytical Methods [21]. Percentage carbohydrate and dry matter were estimated by difference [22].

2.4 Sensory evaluation

Fufu flours processed from CMD resistant cultivars were reconstituted into their dough and subjected to sensory evaluation. *Fufu* flours were cooked as done traditionally by turning the flours in boiled water (flour/water ratio of 1:1 v/v).The water was brought on a gas cooker (Cannon gas cooker,C60 GTC, Empire Direct, U.K) in a pot. The gas cooker was set at blue flame. The flame was put off and *fufu* flour was poured into the water with some aggressive turning with the aid of a local turning woody material. A thick past of consistent appearance was formed.

fufu dough were properly collected into a grip-seal polythene bag (GL-1 Macro Packaging Jiffy bags, U.K) to maintain a consistent temperature. The method of Iwe [23] was employed in the sensory evaluation conducted. The *fufu* samples were coded with three letter alphabets instead of their original names to avoid bias by the Panelists. Sensory evaluation of *fufu* dough prepared from the ten CMD resistant varieties was conducted suing a 40 panel members who were regular *fufu* eaters are residing around South Eastern Nigeria. The Panelists were asked to score for colours, odour, elastic quality, hand feel/ texture and overall acceptability using a 7 - point hedonic scale where 1 and 7 represent dislike extremely and like extremely respectively.

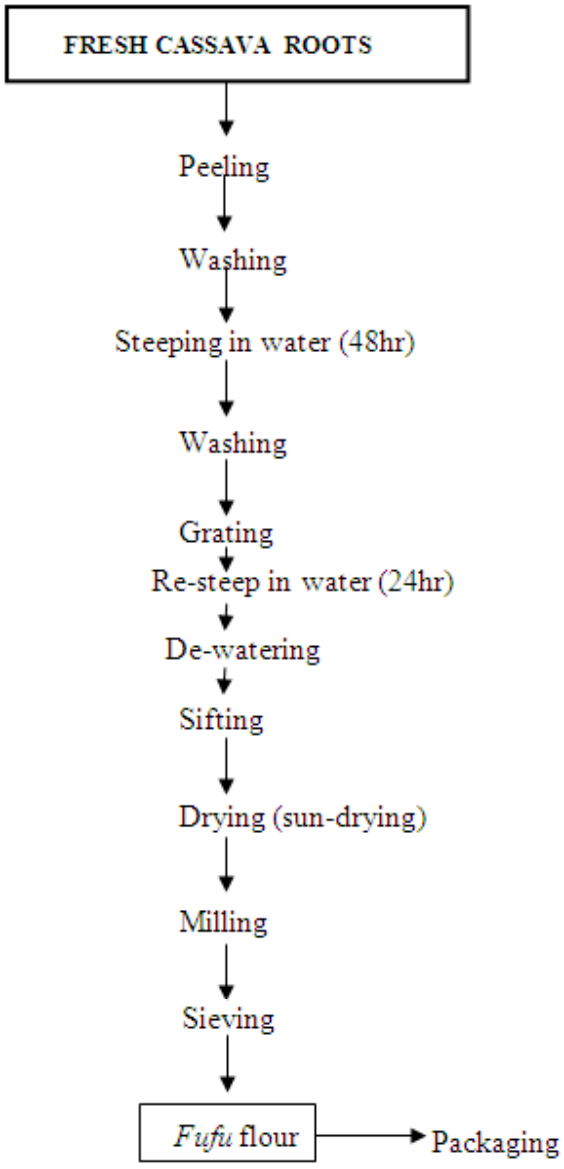

Fig 1: Flow chart for processing of cassava root into odour-less *fufu* flour

2.5 Statistical analysis

Data obtained from proximate composition of *fufu* flours and sensory evaluation of their dough processed from CMD resistant cultivars in were subjected to statistical analysis using Statistical Analytical System (SAS) [24] software package. Analysis of variance (ANOVA) was done and mean separation using Fischer LSD to determine significant differences at 0.05% probability.

RESULTS AND DISCUSSION

3.1 Proximate composition

Table i shows the results of proximate composition of *fufu* flours processed from CMD resistant cultivars. Moisture content was lowest in *fufu* flour processed from cassava cultivar TMS30572, though, not significantly different (P>0.05) from *fufu* flour processed from cassava cultivar 98/2101. Moisture content of the *fufu* flours were generally low which was an indication of stable shelf life of the fufu flours when properly processed, packaged and stored. Values of moisture contents were within the recommended standard of 13% (m/m) Max for edible cassava flour [25]. Low protein, ash and fats and high carbohydrate contents of the *fufu* flours confirm with the nutritional component of cassava roots where carbohydrate is mainly the nutritional component of which 80% is starch [26] [27]. Fiber contents were generally low and this may be attributed to sieving method where muslin cloth was used as a sieving material. However, there were appreciable increase in protein content of the *fufu* flours obtained from cassava cultivars TMS30572 (2.455%), 96/0603 (2.10%) and 92/0325 (2.10%).This may be attributed to possible secretion of some extra cellular enzymes (proteins) such as amylases, linamarases and cellulases into the cassava mash by fermenting organisms in an attempt to make use of the cassava starch as a source of carbon [28]. The low protein of *fufu* flours is not a serious issue as *fufu* is usually consumed accompanied with different protein sources both of animal and vegetable origin. African countries are faced with not just with problems of food security but that of nutritional insecurity which manifests it-self inform of micronutrient deficiencies in the diet and they recognized cassava suitable crop for micronutrient intervention in Africa [29]. High dry matter of *fufu* flour is an indication of desirable quality attributes in the CMD-resistant varieties. Such attributes like good yields, diseases and pest tolerant, high root yields (fresh and dry), meet end-users characteristics [30] [31]. Dry matter was significantly highest in (P≤0.05) in cassava cultivar TMS30572. Dry matter is a practical approach to improving the shelf life and marketability of *fufu* flour [32], [33].

Table i: Proximate composition of *fufu* flours processed from CMD resistant cultivars

Cassava cultivars	Moisture (%)	Protein (%)	Ash (%)	Fat (%)	Fiber (%)	Carbohydrate (%)	Dry matter(%)
TMS30572	7.31b	2.45a	0.35bcd	0.28c	0.14b	89.46c	92.69a
98/2101	7.55b	1.40c	0.45bc	0.30c	0.14b	88.24e	92.45b
99/3037	8.16a	1.05d	0.25cd	0.12d	0.01c	90.37a	91.84c
96/0603	8.20a	2.10b	0.45bc	0.39b	0.02c	81.81d	91.80c
97/4763	8.21a	1.05d	0.45bc	0.65a	0.02c	89.62c	91.74dc
92/0325	8.26a	2.10b	0.45bc	0.13d	0.01c	89.80b	91.72cd
M98/0068	8.28a	1.05d	0.45bc	0.42b	0.11b	89.80b	91.69cd
92B/00068	8.31a	1.40c	1.50a	0.61a	0.20a	90.21a	91.60d
97/3200	8.40a	1.40c	0.60b	0.26c	0.05c	88.93d	9159d
92/0057	8.40a	0.35e	0.15d	0.39b	0.13b	87.09f	81.79e
LSD (0.05%)	0.24	0.21	0.27	0.07	0.06	0.17	0.17

Means down the columns with the same subscript are not significantly different (P>0.05).

Table ii: Sensory evaluation of *Fufu* dough prepared from CMD resistant cultivars

Cassava variety	Colour	Odour	Elastic quality	Hand-feel /texture
TMS30572	5.33^{abc}	5.67^{abc}	5.22^{ab}	5.22^{ab}
98/2101	5.78^{a}	5.67^{abc}	5.22+	5.44^{ab}
99/3037	5.78^{a}	5.89^{a}	5.44^{ab}	5.78^{a}
96/0603	5.76^{ab}	5.89^{a}	5.11^{ab}	5.44^{ab}
97/4763	5.78^{a}	5.78^{ab}	5.33^{ab}	5.44^{ab}
92/0325	4.67^{c}	5.00^{c}	4.78^{b}	4.67^{b}
M98/0068	5.67^{ab}	5.22^{abc}	5.33^{ab}	5.22^{ab}
92B/00068	4.89^{bc}	5.22^{abc}	5.22^{ab}	5.11^{ab}
97/3200	6.11^{a}	5.78^{ab}	5.67^{a}	5.78^{a}
92/0057	5.78^{ab}	5.11^{bc}	5.00^{ab}	5.22^{ab}
LSD (5%)	0.83	072	0.87	0.78

Means with the same superscript within the same column are not significantly different (P < 0.05). ∗7 point hedonic scale, where 7 = like extremely and 1 = dislike extremely

3.2 Sensory evaluation

Table ii shows the result of sensory evaluation of *fufu* dough prepared from flours obtained from ten CMD resistant cultivars in Onne. Colours, odour, elastic qualities, and hand-feel /texture were all acceptable to the panelists. Acceptability of the dough may be attributed to the processing method as described by [34]. Fermentation after

grating may have resulted to loss in structural integrity and is of great importance for cell wall degradation, which perhaps enhances contact with indigenous enzymes. Therefore, fermentation of grated cassava increased contact between microbial enzymes and Linamarin [35] [36] there by reducing the activities of fermenting micro organisms. This resulted in drastic reduction in foul odour, improved colour, good elastic quality and hand feel/ texture of the dough by the panelists.

3.3 Over all acceptability

Figure 2 shows the overall acceptance scores of *fufu* samples prepared from the CMD resistance cultivars. *Fufu* prepared from cassava cultivars 97/3200 and 99/3037 were most acceptable (5.89) while that of 92/0325 variety was least acceptable (4.89).However, scoring at 7-point hedonic scale showed that *fufu* prepared from the ten cassava cultivars were acceptable by the panelists. This may be attributed to the processing method which resulted in drastic reduction in foul odour and good colours. High dry matter of the *fufu* flours resulted in ease of reconstitution which eventually gave acceptable hand feel/texture and good elastic qualities. This is in line with the report of [37] that *lafun* consumers described good quality *lafun* as one with little or no odour, having a characteristic white colour with good texture and which does not stick to the hands of the consumers.

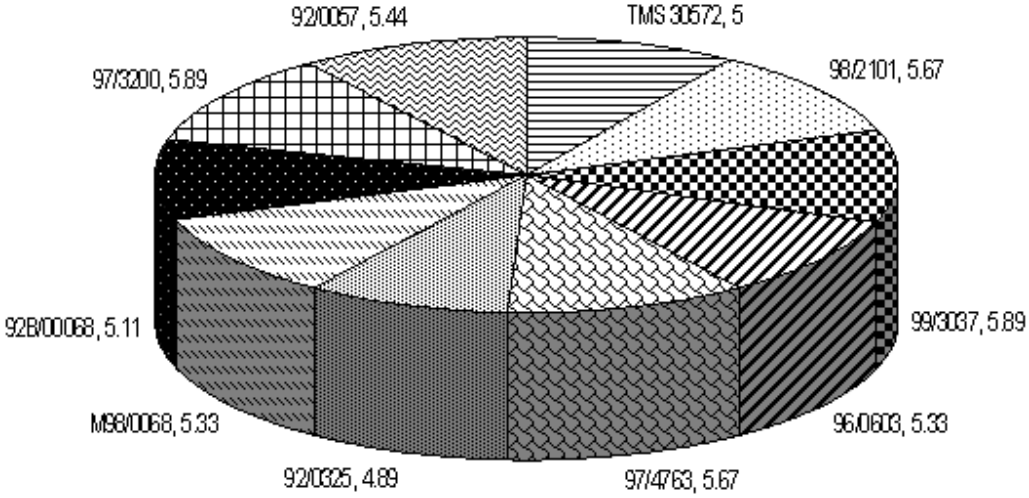

Fig 2: Scores of overall acceptability of *fufu* prepared from CMD resistant cultivars

CONCLUSION

The proximate composition of *fufu* flours processed from CMD resistant cultivars showed low moisture, high carbohydrate and high dry matter contents. These are indications of stable shelf life, cheap and available source of calories to the consumers most especially in the rural areas and ease of reconstitution during preparation into *fufu* dough. Their good sensory qualities will meet the demand of the consumers. Therefore, this work will help the farmers, consumers and industrialists to have idea on the CMD resistant cultivars with desirable qualities for *fufu* production. Processing of cassava in various food forms like *fufu* flour has the potential to help Nigeria improve its food security, diversify its manufacturing base, generate more income, raise employment and achieve trade balance.

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