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Organoleptic Characteristics of Cassava Flour and Fufu Obtained from Different Cassava Varieties (*Manihot spp.*) and Tuber Processing Techniques

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This research was conducted at the Agricultural Education Laboratory of the Federal College of Education (Technical) Omoku, Rivers State, Nigeria. Cassava tubers used for this research work (TMS 419, bitter carotene and TMS 30555) were obtained from the Teaching and Research Farm of Agricultural Education, FCE (T), Omoku. Three processing methods: direct, blanching and retting processing were adopted and sundried. Three treatments were used and it was a 3×3 factorial experiment fitted into a complete randomized design (CRD) and flour obtained from the various processing methods were made into fufu. Fufu obtained was served to 20 panelists whose responses were measured in a 9-point Hedonic rating scale. The analysis showed that retting method produced higher and better flour texture in TMS 419 than in bitter carotene and TMS 30555. The blanching method produced a more acceptable flour colour, but there was no significant difference in the fufu odour. The retting method was more acceptable in terms of stickiness or drawability index, degree of moulding and consumption across the three cassava varieties.

Keywords: Blanching, cassava, fufu, fermentation, hedonic retting, organoleptic

INTRODUCTION

Cassava (*Manihot* spp) is a dicotyledonous crop and a member of the family *Euphorbiaceae*. It is an important root crop that grows in tropical and sub-tropical parts of the world and is an essential food source in Nigeria and across Sub-Sahara Africa. It is known to provide over 50% of the energy for an estimated 500 million people in Africa (IITA, 1992). Currently, Nigeria is the largest producer of cassava with an annual production of 45 million tones though it is projected to produce 150 million tonnes for export purposes (Anon, 2018). The increase in the production of associated products can be linked with the continuous development of varieties of technology by the National Root Crop Research Institute and International Institute of Tropical Agriculture located at Umudike and Ibadan respectively.

The production and utilization of cassava must be given primary attention in Nigerian food policy because it is not only a chief source of dietary food energy but also a veritable source of carbohydrate for majority of the people. In Nigeria it undergoes several processes from farming to harvesting and post harvesting handling and storage. Cassava leaf is consumed as vegetable and it is a delicacy that is relished by sheep and goats, the tubers are usually processed into products such as starch, chips, ethanol, glucose, as well as into flour and paste that are frequently used for the preparation of fufu (Anon, 2017). The flour can be exported (if of good quality) to prepare cakes, bread and biscuits. Methods employed in the processing of cassava into various products differ in accordance with consumers' preference and prevailing customs, not only in Sub-Sahara Africa but also across the world. Generally, freshly harvested cassava tubers cannot store for a long period of time as it contains about 70% moisture and deteriorates very easily. Therefore, processing harvested tubers into various products is a sure way of prolonging shelf life, to enhance products transportation, marketing and reduce cyanide content. In addition to improving palatability, processing can also be used to secure improved nutritional value through increased food composites and fortification with varied protein and nutrient rich food products. Nutritionally, cassava contains potassium, iron, vitamin A, folic acid, Sodium, Vitamin C, Vitamin B6 and protein. The protein content increases three to eight times when fermented (Nwachukwu and Edwards, 1987). The sensory evaluation strategy is a standard used to assist consumers, goods manufacturers and developers in the evaluation of their goods to ensure product quality, consumer satisfaction, general acceptability and marketing success (Cocke, 1985).

Cassava tubers when processed into high quality cassava flour can be used to make bread, cakes, doughnut, chin-chin, biscuits and starch (FAO, 2017). Processing of cassava into flour is simply the conversion of the tubers into powder that is more convenient to handle, store and/or use. However, producing cassava flour for fufu preparation may require a process that is entirely different from the process employed in the production of flour for bread, starch and various other products. The procedure employed for production of high quality unfermented cassava flour for the preparation of bread and starch is based on the direct method of cassava flour processing (IITA, 1992). This involves harvesting of tubers, sorting, peeling, washing, grating, dewatering, pulverization, sun drying, milling into fine flour and packaging. Flour obtained through this method cannot be used effectively for preparation of good quality fufu. Locally, preparation of cassava tuber for fufu is achieved through tuber fermentation process that involves retting of peeled or unpeeled cassava tuber which is subsequently, sieved and dewatered to obtain a paste that is subsequently parboiled, boiled and pounded with mortar and pestle to obtain fufu (Anon, 2006; Aworh, 2008; Oyewole and Isah, 2012). Food product fermentation is common and a household technology which is known to improve nutritive value of plant based food products (Obizoba, 1998, Nnam, 2000; Obidina et al., 2008).Advantages of locally fermented food include enhanced organoleptic and preservation of properties/improvement in nutritional quality, detoxification and production of antibiotics(Oyewole and Isah, 2012). Oyewole and Isah, (2012) asserted that fermentation improves the nutritive value of food, improves its flavour, digestibility and edibility, lowers the content of anti-nutrients of cereal products and also enhance its industrial utility. Yabaya, (2008) noted that fermented foods are of great significance as they provide and preserve diverse amount of healthy foods in a great variety of flavours and texture which improves the human diet. However, the process of preparing fufu through fermentation cassava tuber is rigorous and time consuming. In view of this therefore, there is the need to develop a fufu preparation strategy that is simple, less rigorous and whose end product will be generally acceptable to the consumers.

The cassava tuber to flour production process becomes the next best alternative. The aim of this study therefore is to develop a fufu preparation strategy or process that is less cumbersome and whose end product will be relished and cherished by the fufu consuming populace. Flour is far easier to handle, transport and preparation of flour into fufu is easier than turning locally prepared cassava paste into fufu.

METHODOLOGY

The study was carried out at the Federal College of Education (Tech), FCE (T) Omoku in Ogba/Egbema Local Government Area of Rivers State in the Niger Delta Region of Nigeria. It was a quasi-experiment that consists of both laboratory and a survey study. It was a 3×3 split plot factorial experiment with 2 treatments at 3 distinct levels. The treatments were three cassava varieties (TMS 419, TMS 30555 and Bitter carotene) and three processing methods: - direct processing, blanching and retting methods. The survey aspect of the study consist of all fufu eating populace in the area wherein the study was conducted, out of which a sample of twenty respondents were selected and their opinion sampled through the use of a 9-point Hedonic rating scale. This scale is a standard procedure used in food science for measuring food acceptability where the Judges determine the extent of like or dislike (Anon, 2017). Cassava tuber varieties used for the study were harvested fresh at the Teaching and Research Farm of the FCE (T) Omoku.

The tubers were carefully sorted, peeled, washed, sliced and weighed with the aid of a sensitive weighing balance. Slices of each variety were separately weighed and subjected to direct, blanching and retting (fermentation) methods of processing. They were later sundried and grounded into flour which were subsequently prepared into fufu using appropriate methods for turning flour into fufu. Fufu obtained were served warm to 20 panel members known to relish cassava fufu food. The responses of the panelist obtained with the aid of a questionnaire were then collected and statistically analyzed and response trend is as shown in the line graphs.

RESULTS AND DISCUSSION

Effects of various processing method on flour texture and colour are as shown in (Figures 1 and 2). Smooth, fine and better flour texture was obtained in TMS 419 cassava variety with the use of the retting methods of tuber processing (Figure 1a). Though a similar pattern of response was obtained for TMS 30555 and bitter Carotene, the result showed thatthe fine, better and smooth flour texture obtained at TMS 419 differed significantly ($P \leq 0.05$) with that obtained with the use of the retting method of cassava tuber processing, but variation in mean flour texture for TMS 30555 and Bitter Carotene did not differ significantly ($P \leq 0.05$) across the blanching and direct processing methods. With respect to flour colour, the use of blanching method of cassava tuber processing gave an acceptable and better cassava flour colour in TMS 419 and Bitter Carotene (Figures 2a and b) at $P \leq 0.05$, but in TMS 30555, direct process method had higher and better flour colour though there was no significant difference in the observed variability in colour.

Fufu quality

Mean Fufu aroma for both TMS 419 and bitter Carotene was better and more acceptable with the use of blanching method of cassava tuber processing, however the observed variation in the mean fufu aroma did not differ significantly. Similarly direct processing and retting method did not indicate any significant variation in mean fufu aroma.

Drawability index

The fufu drawability or stickiness index was higher and far better with the retting processing (RP) method across the sampled cassava varieties (TMS 419, TMS 30555 and Bitter Carotene). Blanching and direct processing did not produce any significant difference ($P \leq 0.05$) in degree of stickiness across tested cassava varieties (Figures 4a, b and c).

Again the retting (RP) method of cassava tuber processing gave fufu with a better and higher moulding capacity across the sampled cassava varieties than the rest other cassava tuber processing methods (Blanching and Direct processing). Mean variability in the moulding capacity of fufu obtained with the use of the retting method to process the tuber differed significantly ($P \leq 0.05$) (Figures 5a, b and c). Acceptable fufu colour was obtained in bitter carotene with the use of retting method of processing but variability in mean fufu colour did not differ among TMS 419 and TMS 30555 (Figures 6a, b and c) across blanching and direct methods of cassava tuber processing.

Carbohydrate is a major constituent of the cassava tuber among other food components. Hydrocyanogenic acid (HCN) is also a very important phytochemical component found in cassava tubers. However, the composition of carbohydrate and hydrocyanogenic compound in cassava tubers varies with processing techniques employed and cassava varieties utilized. Each of the above compounds exerts great influence on cassava tuber and their compositions in the final products vary depending on the processing method employed. Processing methods affects content of cyanide as well as improved storability, convenience and palatability (Hahn, 1997).

Results obtained in this study shows that in TMS 419, retting (RP) method of cassava tuber processing produced higher and better flour texture which could be attributed to the ability of the processing method to break up carbohydrate granules to smaller particles through disintegration of building molecules in the cassava. On the other hand, production of cassava flour through blanching and direct processing methods ultimately lead to production of products with coarse granules or particles as a result of incomplete breakdown of the starch molecule into simple sugars. In TMS 419, retting/fermentation method of cassava tuber processing proved a faster and quicker means of breaking down the carbohydrate molecules than for TMS 30555 and bitter carotene. Retting ensured that carbohydrate molecules in the cassava varieties were completely reduced to cassava paste thereby breaking down starch granules that otherwise would have produced coarse texture in the resultant flour. Again retting roots lead to tissue disintegration and permits rapid hydrolysis of glucosides which effectively reduces residual cyanide in the products (Hahn, 1977). Earlier, Peter, (2012) reported that high quality cassava flour was obtained from direct processing (unfermented) method. However, the result of this study shows that the retting (fermentation) method is best for production of high quality cassava flour for fufu preparation with respect to better texture, degree of stickiness and other parameters. Stickiness helps long or medium rice grain to mould better. Fufu is a kind of porridge or strong paste or sticky dough made from cassava flour derived from sundried root pieces or from fermented dried or wet pulp (Hahn, 1997).

Generally cassava tuber contains a high proportion of starch which is a subset of complex carbohydrate; when processed unfermented into flour, the resultant carbohydrate is sure to produce crust or granules that will impose grittiness on resultant flour. This explains why flour obtained through the blanching and direct cassava flour processing technique had poor texture across the sampled (TMS 30555 and bitter carotene) cassava varieties. High level of acceptability in flour colour obtained across the various cassava varieties with the direct blanching method of cassava flour processing observed in this study can be attributed to caramelization process. Heat generally enhances the process of caramelization in products with high carbohydrate content

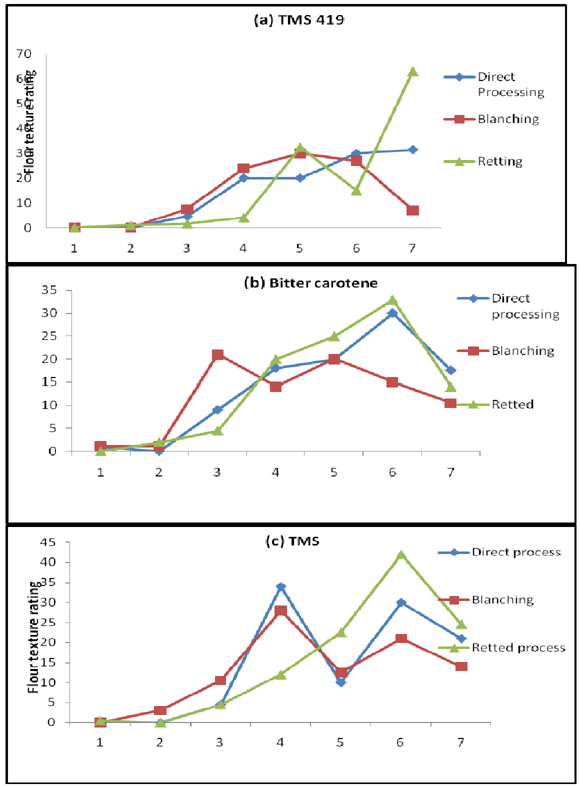

Figure 1. Effect of {(a) TMS 419 (b) bitter carotene (c) TMS 30555} processing method on flour texture.

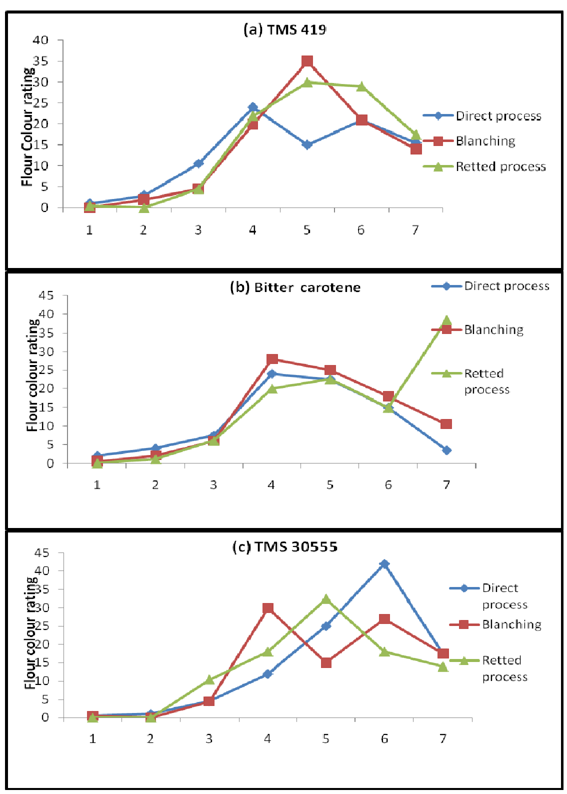

Figure 2. Effect of {(a)TMS 419 (b) bitter carotene (c.) TMS 30555} processing methods on flour colour.

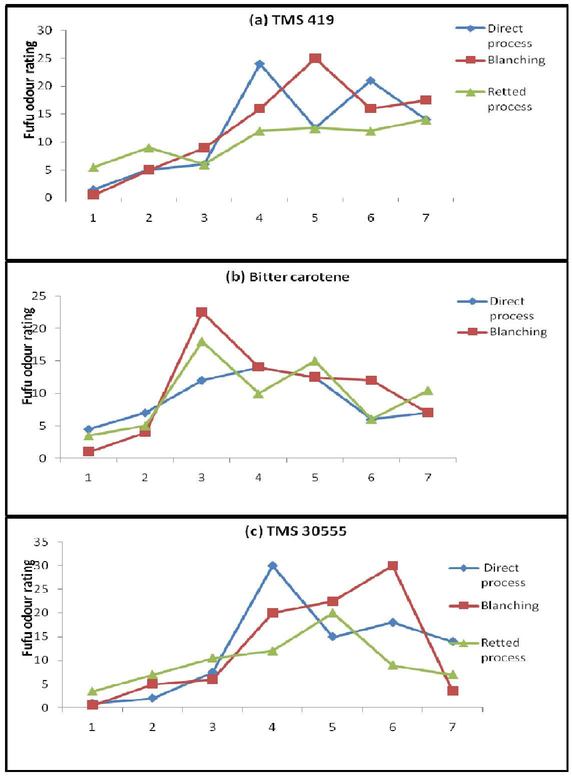

Figure 3. Effect of {(a) TMS 419 (b) bitter carotene (c) TMS 30555} processing methods on fufu odour.

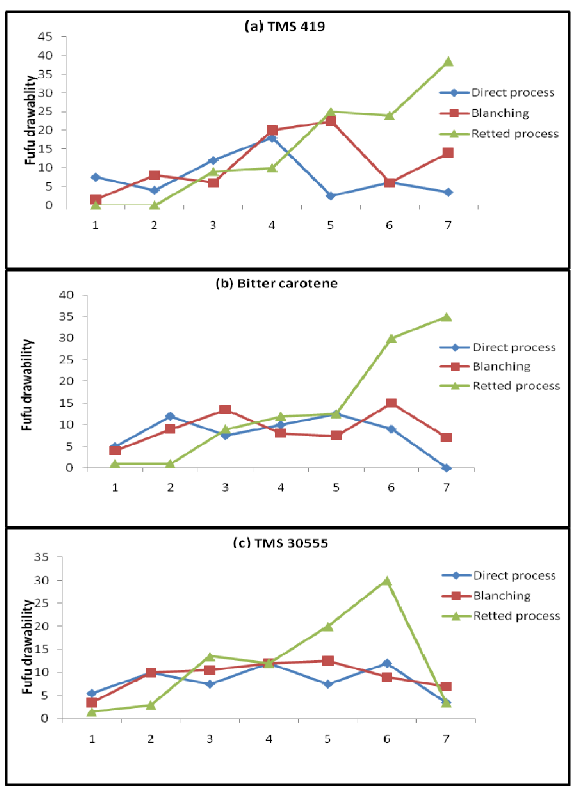

Figure 4.Effect of {(a) TMS 419 (b) bitter carotene (c) TMS 30555} processing methods on fufu stickiness.

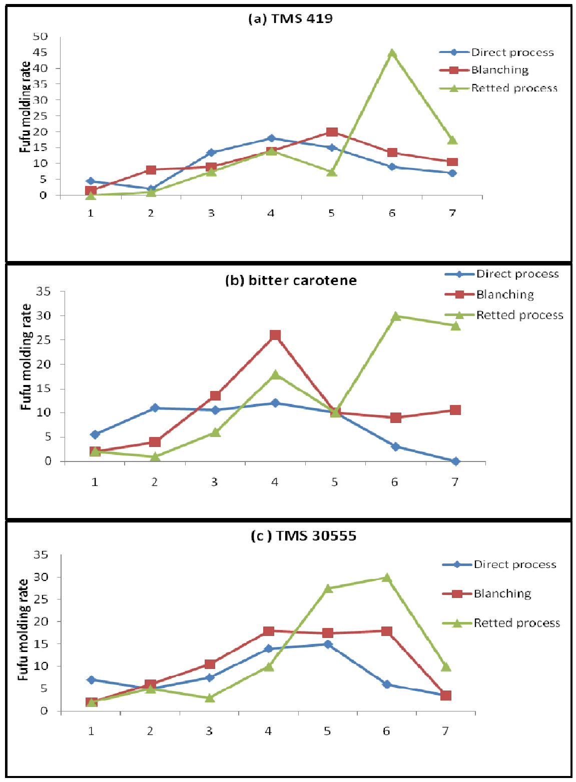

Figure 5.Effect of (a) TTMS419 (b) bitter carotene (c) TMS 30555 processing on fufu moulding and consumption suitability**.**

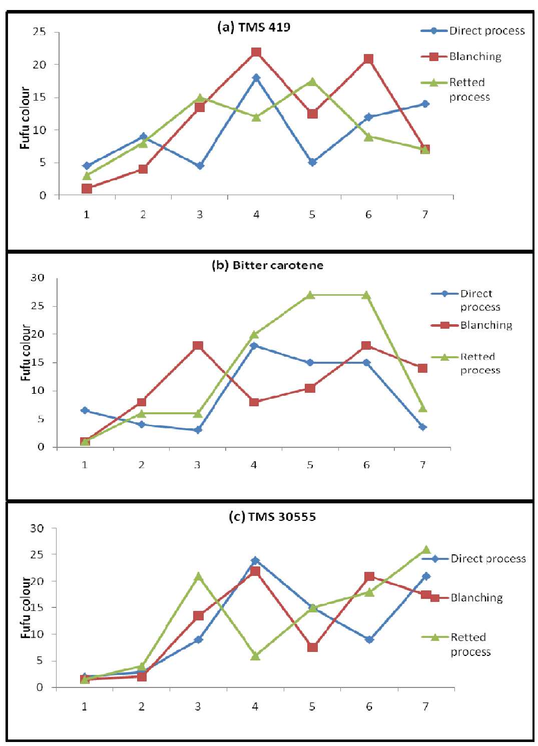

Figure 6.Effect of processing methods on {(a) TMS 419 (b) bitter carotene (c) TMS 30555} Colour of fufu.

like cassava. The carbohydrate component of the cassava chips probably have melted into a thick syrup or similar product leading to a change in colour (caramels) due mainly to applied heat arising from the blanching process. Starch content of the cassava chips may have been denatured to a complex carbohydrate as a result of applied heat to a form whose colour is more acceptable to the consumers. Variability in flour texture and colour for processed food to a large extent affects consumers' preference and market value of products.

The illustrated variability of fufu aroma (odour) across TMS 30555, bitter Carotene and TMS 419 cassava varieties did not show any significant difference by the various cassava processing methods. Though Kinyuru et al. (2006) in their study attributed a change in taste and aroma observed in baked burns treated with edible termites to millard reaction. The observed difference in fufu aroma obtained in this study with the use of retting method (fermentation) to process cassava tuber is associated more with caramelization than with millard reaction (Billaud *et al.,* 2005).

Conclusion

Of the three cassava varieties investigated, TMS 419 variety produced higher and better cassava flour processed by retting for fufu making. In this study, the sticky index for fufu made from flour gotten through blanching and direct methods of cassava processing had low level of acceptability due mainly to poor drawability rate. Drawability in this context is a measure of the degree of stickiness of the fufu, poor stickiness eventually will translate into poor moulding suitability, as was recorded across blanching and direct cassava tuber processing methods of the sampled cassava varieties. For high level acceptability of cassava flour for fufu making, TMS 419 cassava variety and processed by retting is therefore recommended.

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