QUALITY CHARACTERISTIC OF TAPIOCA FROM DELAYED PROCESSED CASSAVA

Bamgbose A; Bello T. K, and Adeboye A. S
Department of Food Technology
Moshood Abiola Polytechnic, Abeokuta, Nigeria

ABSTRACT

This study investigated the effect of delay of cassava before processing on the quality characteristics of tapioca grits. The cassava tubers were obtained from Agbadu village in Abeokuta, Nigeria. The pasting properties of the tapioca grits were measured on the Rapid Viscosity Analyser [RVA]. The proximate composition, functional properties and the sensory qualities of tapioca were determined. The moisture content obtained for all the tapioca grits were below the 10% stipulated of the revised regulation of the Standard Organization of Nigeria. For the sensory assessment, the tapioca produced from 24 hours and 120 hours stored cassava was the most acceptable. Highest peak viscosity and trough were recorded for tapioca produced from 120 hours stored cassava (1549.0±86.27). There was no significant difference ($p<0.05$) in functional properties, pH and total titrable acidity of the starch produced. All the tapioca grits can be stored for up to 7 months.

Keywords: Cassava, delayed in processing, proximate, pasting properties

INTRODUCTION

A major constraint to cassava utilization is that cassava deteriorates rapidly. Cassava has a shelf life of 24-48 hours after harvest (Wenham, 1995). Hence, fresh cassava roots must be processed into a more shelf-stable form within 2 to 3 days from harvest. One of such cassava product is tapioca grit. Tapioca grit is a partially gelatinized dried cassava starch, which appears as flakes or irregularly shaped granules. It is consumed in many parts of West Africa, and widely accepted as a convenient diet (Hollesman and Aten, 1956). Tapioca is a starch extracted from the root of plant species *Manihot esculenta.* It has unlimited importance industry and food can be modified to suit various applications can be modified to suit various applications using inexpensive methods making it deal for a number of uses (Satin, 2006). This is why cassava presents one of the most important sources of starch given its case of extraction and high purity with less protein and other associated compounds (Ceballos *et al* 2007). In particular, cassava produces high amount of starch compared to other crops such as rice and maize. Given the increasing trends of production of this crop, exploitation of starch form cassava is a necessary option to cater form the increased demand especially in the dietary and industrial sector (FAO, 2008) of which tapioca grit is one of such product.

Cassava is often castigated as an inferior food crop "poor people's crop" Hahn and Keyser (1958) and as a dangerous crop" these label on cassava were due to some limitations of the crop including low quality and quantity of protein, the presence of cynogenic glycosides (Cooke and coursey, 1981) and poor storage of the tuber (Akingbala *et-al*, 2005). We are not aware of any researcher who had worked on the quality characteristics of tapioca from delayed cassava before. Idowu and Akindele (1994) worked on the effect of storage of cassava roots at ambient temperature for (0-4 days) on percentage yield, chemical compositions and sensory qualities of garri and fufu. Since it has been reported by Satin, 2006 that starch has unlimited importance in industry and food and can be modified to suit various application using in expensive methods making it deal for a number of uses of which Tapioca grit is one of such products.This work therefore aimed at knowing the effect of delayed processing of cassava on the quality characteristics of Tapioca grits.

MATERIALS AND METHODS

Materials

The materials used for the production of Tapioca were: Cassava tubers, knife, potable water, diesel engine powered mechanical grate (action zone made of 3mm stainless steel, Nigerian made) Muslin cloth, plastic buckets, stainless pot and plates, trays and weighing balance.

Source of Materials

Cassava tubers were harvested from Agbadu village, Moshood Abiola Polytechnic, Ojere, Abeokuta, Nigeria. The diesel engine powered mechanical grater was also obtained from the village, knife, stainless pots and plates, trays, plastic buckets and muslin cloths was purchased from Kuto market while the weighing balance was purchased from Sapon market.

Mode of Storage for the Cassava Tubers

The cassava tubers was harvested and stored on the farm by proper covering of the cassava tubers with leaves to avoid interaction with sunlight and direct contact with rain.

Preparation of Samples

The method described by Sanni *et al* 1997 for processing of Tapioca grit was used with little modification. 20kg of fresh cassava roots were peeled, washed in potable water and then grated; the resulting pulp was diluted with water and sifted to extract starch milk solution from the pulp. The filtrate starch milk was allowed to settle for 9 hours before decanting off the water. The thick starch cake was further pulverized. The pulverized starch cake was then roasted in flat hot stainless pot under direct flame heating with constant stirring. The dried irregular flakes and grains that resulted is the tapioca grits. The procedure was repeated for cassava tubers after 24 hours, 48 hours, 72 hours, 96 hours and 120 hours of storage respectfully.

Analytical Determination

The moisture, protein, crude fat, Ash, crude fibre and carbohydrate contents of the samples were determined using the AOAC 1996 method. The Bulk density of the starch produced from the stored cassava was determined using a method described by the Sathe (1982), swelling and solubility of the starch was determined using a method described by Abbey (1988). Foaming capacity and stability of the starch was determined by using method described by Adebowale et-al (2005).

Pasting properties were determined using a Rapid Visco Analyser (RVA) (model RVA 3D +; Network Scientific, 5 Australia). The sample was turned into slurry by mixing 3g with 25ml of water inside the RVA can and inserted into the tower, which was then lowered into the system. The slurry was heated from 50 to 95^{o}C and cools back to 50^{o}C within 12min rotating the can at a speed of 160rpm with continuous stirring of the content with a plastic paddle. Parameters estimated were peak viscosity, setback viscosity, final viscosity, pasting temperature, trough and time to reach peak viscosity.

Evaluation Of Sensory Qualities Of The Tapioca Paste Produced From Delayed Processed Cassava

500g of each sample were weighed and soaked in 1 liters of water for 7 hours. For each sample 1 liters of water was boiled to 100^o and the sample was poured into the boiled water and was stirred continuously for 10 minutes. Twenty panelists were obtained from the department of food technology Moshood Abiola Polytechnic. The samples were coded to be R, 112, 218, 321, 345, and 543 respectively. A well prepared questionnaire was given to the panelist whereby the coded samples were presented to them and was accessed in terms of color, aroma, viscosity, taste, appearances, sourness and general acceptability

STATISTICAL ANALYSIS

Mean and standard deviation were calculated. Data were subjected to analysis using SPSS Version 15 software at P<0.05 means were separated using Duncan's multiple range Test.

RESULTS AND DISCUSSION

Proximate Composition

The effect of delayed processing of cassava on the chemical properties of tapioca grits are presented in Table 1. The tapioca grit produced from 72 hours stored cassava had the highest moisture while the tapioca grits produce from 24 hours delayed cassava had the least moisture. The lower the initial moisture content of products to be stored the better the storage stability of the product. Also the lower the initial moisture content of the product, the more the efficiency of the drying method, because this shows that much of the water contained in the fresh sample had been removed during drying. The moisture content of all the tapioca grits were below 10% stipulated standard of the revised regulation of the standard organization of Nigeria (SON, 1988; Sanni *et-al* , 2005). All the tapioca grits can be stored for up to 7 months because their moisture content were below the level reported by Ukpabi and Ndimele (1990). Who found that gari samples with a moisture content of <16% but >13% could be stored for 2-7 months without mould infestation. The variation in the data obtained for moisture is as a result of changes that occurred in the weather conditions during storage. The protein content and Ash content of the Tapioca grits ranged from 1.63± 0.12 to 3.80 ± 0.01 and 3.37 ± 0.15 to 3.17 ± 0.06 While the carbohydrate content which is the major key composition used in characterizing the chemical composition of tapioca grits varied from 79.90 ± 0.10 to 82.63 ± 0.31 respectively which was similar to the study of Obadina et al., 2010 on Tapioca. The high carbohydrate contents of the tapioca signifies its good source of energy. Cassava roots have energy 580.00KJ/100g (Osagie and Eka, 1998)..

PASTING PROPERTIES

Tapioca grits are usually cooked into paste referred to a tapioca meal before consumption. Although some consumers prefer eating tapioca grits as snack. The pasting properties becomes important in predicting the behavior of tapioca paste during and after cooking. (Adebowale *et-al* 2005) peak viscosity as shown in Table 2 and pasting curves which was the maximum viscosity developed during or soon after the heating portion of the pasting test (Newport Scientific, 1998), was higher compared to values obtained for tapioca grit from different cassava varieties which was the peak viscosity for Odongbo [449-30], Peak viscosity for TMS 30572 [477-83] Peak viscosity for Oko-iyawo [467-30] respectively. This could be as a result of variety of cassava used for this research which was Texaco as described by the farmers of Agbadu Village, and also the variation in this study could occurred as a result of the occurrence stated above.

Trough or hot paste viscosity which is the minimum viscosity value in the constant temperature phase of the RVA profile and it measures the ability of paste to withstand breakdown during cooling. Large value for trough is said to indicate little breakdown of sample starches (Newport Scientific, 1998). Therefore the higher values obtained for trough in this work as compared to other varieties reported by Adebowale *et al* (2008) could be as a result of the delay of the cassava tubers before processing. The breakdown viscosity is the ability of a mixture to withstand heating and shear stress that is usually encountered during processing. The breakdown obtained for this work is not significantly different from the result obtained by (Adebowale *et al* , 2008). Hence, as the number of days of storage increases the breakdown values increases up to 72 hours of storage and then decrease for tapioca produced from 96 hours stored cassava. This could be as a result of hot weathers that occurred during the hours of storage. The final viscosity indicates the ability of the starch based food to form a viscous paste or gel after cooking and cooling. The values obtained decreases up to 48 hours of storage and then increases. This could be as a result of the changes that occurred in the weather conditions during storage.

The setback recorded for the samples varies from 378.00±39.59 to 751.00±18.38. The setback involved retrogradation or re-ordering of starch molecule. The 0hour tapioca has the highest setback and thus highest tendency to retro gradate while tapioca of 48 hours delayed will retro gradate least when compared with syneresis or weeping during freeze/thawing cycle (Newport Scientific, 1995). The peak time is the measure of the cooking time (Adebowale *et al* 2005). Tapioca produced from 0-96 hours stored cassava has no significant difference in the peak time while tapioca produced from 120 hours of storage has the highest peak time, this shows that the storage periods affect the cooking time of the final product. The pasting temperature is a measure of the minimum temperature required to cook a given food sample. There was no significant differences in the pasting temperature of the samples except for tapioca produced from 48 hours stored cassava that had the lowest pasting temperature compared to other samples.

Functional Propertiesss

There was no significant difference in the swelling capacity, foaming, stability and bulk density [loosed and packed] of the starch. The variation in the foaming capacity and water absorption could be as a result of changes in weather conditions.

pH

The results of the pH showed that all the samples had very weak acidity level as presented in table 4. There was no significant difference in the pH and total titrable acidity of the starch produced from delayed processed cassava.

Sensory Evaluation

There was no significant difference in the colour, taste, Aroma, sourness and appearance of the tapioca grits. As the numbers of days of storage increases, there are decrease in the viscosity of the tapioca meal. It shows in the sensory report on table 6 that tapioca produced from 24 hours and 120 hours stored cassava is the most acceptable followed by tapioca produced from 48 hours stored cassava, and 72 hours stored cassava while the tapioca produce from 96 hours stored cassava has the least acceptability.

CONCLUSION

This study has revealed that in characterizing the chemical composition of tapioca grits from delayed processed cassava, moisture and carbohydrate content are the key component of variation in chemical composition of tapioca. While in pasting properties, the peak viscosity, trough and setback period are the key component of variation in the tapioca grits. Therefore at commercial level, to avoid wastage and quick deterioration of the end product, the producers that uses cassava raw material should pay more attention to the moisture of the cassava because some might have been harvested 2 days or the previous day by the farmers to safe time before the collection from farm for industrial use of which changes in the weather conditions might have brought about variations in their moisture content.

REFERENCES

Abbey, BW (1988); Functional Properties of raw and heat processed cowpea flour – Journal of food science 46: 972-973.

Adebowale, AA, Sanni, LO, and Onitilo, MO (2008). Chemical Composition and Pasting Properties of Tapioca Grits from Different Cassava Varieties and Roasting Methods. African Journal of Food Science: 2: .077-082

Adebowale, KO, Olu Owolabi, BI, Olayinka, OO and Olajide, OS(2005). Effect of heat Moist treatment and annealing on the physic-chemical properties of red sorghum. African. J. Biotechnology; 4: 928-933

Akingbala, JO, Oyewole, OB. Uzo-Peter, PI. Karim, RO and Bacuss – Taylor, GS

(2005). Evaluating stored cassava quality in gari production, Journal of food, Agriculture and environment. 3: 75-80

Agboola, SD (1985) A food storage system for Nigeria; A catalogue of alternatives first annual lecture-Nigerian Institute of Food Science and Technology. 7 Dec. 1985. Abeokuta, Nigeria

Akingbala, JO, Osunsami, AT and Oguntimehin, GB (1989). Effect of storage on starch content and modification of cassava starch/starke 41, 54-57

Akingbala, JO, Oyewole, OB. Uzo-Peter, PI. Karim, RO and Bacuss – Taylor, GS (2005). Evaluating stored cassava quality in gari production. Journal of food, Agriculture and Environment 3, 75-80

Association of official Analytical chemist (AOAC), 1996. Official methods of Analyses. 15th Edition, AOAC Arlington USA

Ceballo SH, Fregence M, Lentini, Z, Sanchez T, Puentes, Y, Perez J, Rossert, A, Tofino, A (2007). Development and Identification of high value cassava clones ISHS Acta Horticulture 703:11

Cooke, RD and Coursey, D (1981). Cassava: A major cyanide in Biology, B. Vennesland (ed) Academic Press London.

FAO (2005-2008). FAOSTAT statistical database- Agriculture Rome. Italy.www.fao.org

Hahns, SK and Keyser, J (1985) Cassaval A basic food of Africa – outlook on Agriculture 14-95-100

Hollesman, LW, and Aten, SA (1956). Processing of cassava and cassava products in rural Industries. FAO Agricultural Development Paper (54)

Idowu, MA and Akindele, SA (1994). Effect of storage of cassava roots on the chemical composition and sensory qualities of gari and fufu.Food Chemistry, Volume 51, Issue 4, 1994, Pages 421-424

Newport scientific (1998). Applications manual for the rapid visio analyser using thermochine for windows. Newporrt scientific pty ltd, ½ Apollo street, Warried Wood NSW 2102, Australia pp 2-26.

Newport scientific (1985). Operational Manual for the scenes 3 rapid visco analyser using thermodine for windows. Newscientific Pty

Obadina, AO, Oyewole, OB, Olaleye, AO (2010) Development and Evaluation of Fortified Tapioca Meal with Coconut and Banana Pulp. Nigerian Food Journal, 28(2) : 294-301

Osagie, AU and Eka, OU (1998) Nutritional Quality of Plant Foods Postharvest Research Unit. Department of Biochemistry, University of Benin, Nigeria (UNIBEN)

Sanni Lateef Oladimeji; Charles Atere and Ayoade Kuye, 1997: Moisture Sorption Isotherms of fufu and Tapioca at different temperature. Journal of food Engineering 34: 203-212

Sanni, LO, Maziya-Dixo B, Akanya, CI, Alaya Y, Egwuonwu CV, Okechikwu RU, Ezedinma C, Akoroda M, Lemchi J, Ogbe F, Okoro E, Tarawali G, Mkumbira J, Patino M, Ssemakula G. Dixon A (2005). Standards for cassava products and guidelines for export. International Institute of Tropical Agriculture, Ibadan, Nigeria. Pp 11-39

Satin M. [2006]. Functional properties of starches, chief Agro-Industries and post-harvest management service FAO. Italy www.fao.org/ags/agsi/starch

Sathe S. K. [1982]; functional properties of lymp seed <lupines> metabolism protein and Journal of food science 47: 491-497.

Standard Organization of Nigeria (SON) (1988). Nigeria industrial standard for Gari. 188:189

Wenham, J. E (1995). Postharvest deterioration of cassava. A biotechnology perspective. FAO plant production and protection FAO, Rome.paper 130.

Table 1. Proximate composition of tapioca grits produced from delayed processed cassava

PARAMETERS	A	B	C	D	E	F
Moisture	8.87.0[a]±0.15	8.63[a] ±0.15	9.10[a] ±0.17	9.13[a] ±0.21	8.93[a] ±0.58	8.70[a] ±0.10
Protein	2.37[c] ±0.06	3.43[a] ±0.06	2.73[a] ±0.06	3.17[a] ±0.06	3.80[a] ±0.10	1.63[b] ±0.12
Ether extract	0.97[a] ±0.06	1.17[a] ±0.15	1.03[a]±0.06	1.23[a]±0.06	1.43[a] ±0.06	0.87[a] ±0.06
Ash	3.17[a] ±0.12	3.33[a] ±0.06	3.17[a] ±0.02	3.30[a] ±0.10	3.37[a] ±0.15	3.37[a] ±0.15
Crude fiber	2.67[a]±0.12	2.57[a] ±1.12	2.77[a] ±0.06	2.77[a]±0.15	2.57[a]±0.15	2.80[a]±0.10
Carbohydrate	81.97[a]±0.42	80.87[a]±0.21	81.17[a] ±0.15	80.43[a]±0.40	79.90[b]±010	82.63[a] ±0.31

Mean value having the same superscript with rows are not significantly different [P<0.05]

A = Tapioca produced from 0 hour delayed cassava
B = Tapioca produced from 24 hours delayed cassava
C = Tapioca produced from 48 hours delayed cassava
D = Tapioca produced from 72 hours delayed cassava
E = Tapioca produced from 96 hours delayed cassava
F = Tapioca produced from 120 hours delayed cassava

Table 2: **Pasting Properties Of Tapioca Grits Produced From Delayed Processed Cassava**

PARAMETERS	A	B	C	D	E	F
Peak Viscosity	1347.0^{b}±184.55	996.00^{d}±45.25	980.50^{b}±369.82	1238.50^{c}±331.63	1212.50^{c}±54.45	1549.00^{a}±86.27
Trough	1091.50^{a}±24.75	721.50^{b}±31.82	587.50^{e}±137.80	801.00^{e} ±159.89	939.00^{b}±36.77	1053.50^{a}±92.63
Breakdown	256.00^{c}±159.81	274.50^{c}±13.44	393.00^{ab}±231.93	437.50^{a}±171.83	273.00^{a} ±17.68	495.50^{a} ±6.36
Final Viscosity	1842.50^{a} ±6.36	140.50^{cd}±47.38	965.50^{e} ±177.48	1264.50^{cd}±195.87	1493.50^{c}±62.93	1667.00^{b}±130.11
Setback	751.00^{a}±18.38	419.00^{c}±15.56	378.00^{d}±39.59	463.50^{c}±13.06	554.50 ^{bc}±26.16	613.50^{b}±34.48
Pasting Time	4.67^{b}±0.092	4.67^{b}±0.092	4.14^{bc} ±0.191	4.63^{b}±0.424	4.87^{b}±000	6.80^{a} ±1.131
Pasting Temperature	66.80^{a} ±1.13	67.35^{a} ±0.354	35.35^{b} ±49.99	63.40^{a}±3.54	67.53^{a}±0.74	66.35^{a}±1.77

Mean value having the same superscript with rows are not significantly different [P<0.05]

A = Tapioca produced from 0 hour delayed cassava
B = Tapioca produced from 24 hours delayed cassava
C = Tapioca produced from 48 hours delayed cassava
D = Tapioca produced from 72 hours delayed cassava
E = Tapioca produced from 96 hours delayed cassava
F = Tapioca produced from 120 hours delayed cassava

Table 3 Functional Properties of Starch Produced From Delayed Processed Cassava

PARAMETERS	A	B	C	D	E	F
Swelling capacity	1.20.0^{a}±0.00	1.30^{a} ±0.00	1.30^{a} ±0.00	1.20^{a} ±0.00	1.20^{a} ±0.00	1.30^{a} ±0.00
Foaming capacity	24.73^{c} ±0.06	27.60^{b}±0.00	19.30^{e} ±0.26	29.47^{a} ±0.21	22.33^{d}±0.15	17.50^{f} ±0.17
Foaming stability	0.00^{a} ±0.00	0.00^{a} ±0.00	0.00^{a} ±0.00	0.00^{a} ±0.00	0.00^{a} ±0.00	0.00^{a} ±0.00
Lease gelation	4.00^{c} ±0.00	6.00^{a} ±0.00	4.007^{c}±0.00	5.67^{ab} ±0.58	4.00^{c} ±0.00	4.00^{c} ±0.00
Water absorption	150.00^{b}±0.00	160.00^{a}±0.00	130.00^{c}±0.00	165.00^{a}±0.00	150.00^{b}±0.00	130.00^{c}±0.00
Bulk density [Loosed]	0.50^{a}±0.00	0.50^{a}±0.00	0.49^{a} ±0.00	0.51^{a}±0.00	0.49^{b}±0.00	0.51^{a} ±0.01
Bulk density [packed]	0.82^{a}±0.00	0.83^{a}±0.00	0.82^{a}±0.01	0.83^{a}±0.01	0.82^{a}±0.00	0.81^{a}±0.00

Mean value having the same superscript with rows are not significantly different [P<0.05]

A = Starch produced from 0 hour delayed cassava
B = Starch produced from 24 hours delayed cassava
C = Starch produced from 48 hours delayed cassava
D = Starch produced from 72 hours delayed cassava
E = Starch produced from 96 hours delayed cassava
F = Starch produced from 120 hours delayed cassava

Table 4: pH and Titratable acidity of Starch produced from delayed processed Cassava

PARAMETERS	A	B	C	D	E	F
pH	3.30 ^{a}±0.00	3.43^{a}±0.57	3.60 ^{a} ±0.00	3.30 ^{a}±0.00	3.50^{a}±0.00	3.60 ^{a} ±0.01
Total titratable acidity	4.23 ^{a}±0.15	3.90 ^{a}±0.10	4.13 ^{a}±0.12	3.60 ^{a}±0.10	3.50 ^{a}±0.00	3.60 ^{a}±0.00

Mean value having the same superscript with rows are not significantly different [P<0.05]

A = Starch produced from 0 hour delayed cassava
B = Starch produced from 24 hours delayed cassava
C = Starch produced from 48 hours delayed cassava
D = Starch produced from 72 hours delayed cassava
E = Starch produced from 96 hours delayed cassava
F = Starch produced from 120 hours delayed cassava

Table 5. Sensory assessment of tapioca grits produced from delayed processed cassava

samples	colour	taste	aroma	appearance	sourness	viscosity	Generaacceptability
S1	6.50^{a}±1.61	6.00^{a}±2.00	5.90^{a}±1.77	6.90 ^{a} ±1.41	5.75 ^{a}±1.80	6.25 ^{a} ±1.52	5.90 ^{a} ±2.40
S2	6.01^{a}±1.67	5.55^{a}±2.04	5.80^{a}±1.67	5.85 ^{ab} ±1.76	5.50 ^{a}±1.88	5.20^{ab}±2.07	5.70^{a} ±2.22
S3	5.85^{a}±1.22	5.25^{a}±1.77	5.95^{a}±1.54	5.90^{ab}±1.48	5.10 ^{a}±1.62	5.25^{ab}±1.86	5.70^{a} ±1.84
S4	5.40^{a}±1.57	1.45^{a}±1.70	5.55^{a}±1.47	5.05 ^{ab} ±1.82	5.30 ^{a}±1.89	5.20^{ab}±1.58	5.30^{a} ±1.92
S5	5.75^{a}±1.47	5.30^{a}±1.75	5.60^{a}±1.43	5.95 ^{a}±1.70	5.40 ^{a}±2.14	4.70^{ab}±1.07	5.90^{a} ±1.41

Mean value having the same superscript with rows are not significantly different [P<0.05]

S1 = Tapioca produced from 0 hour delayed cassava
S2 = Tapioca produced from 24 hours delayed cassava
S3 = Tapioca produced from 48 hours delayed cassava
S4 = Tapioca produced from 72 hours delayed cassava
S5 = Tapioca produced from 96 hours delayed cassava