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Yield, Suitability and Sensory Evaluation of Gari Produced from Two Cassava Varieties at Different Age

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Abstract

The age at which some cassava roots are harvested can affect the yield and it's suitability of gari prepared from them. Two improved cassava varieties, TME 419 and TMS 30572 were investigated in this study. They were planted in April and harvested in the following year at the ages of 9, 12 and 15 months. 10kg of each fresh cassava varieties at different ages were weighed and processed into gari. The effects of age at harvest on selected cassava varieties on yield and suitable of gari were studied. Some investigated parameters on gari includes: percentage yield (Y), moisture content (MC), swelling index (SI) and sensory evaluation (SE). Results showed that gari yield (Y) % of the TME 419, 9, 12 and 15 months were 27%; 35% and 35% while TMS 30572, 9, 12 and 15 months were 21%; 39% and 52% respectively. (MC) of TME 419, 9, 12 and 15 months were 3.3; 5.3 and 2.6 while TMS 30572, 9, 12 and 15 months were 3.1; 3.4 and 4.8 respectively. (SI) showed that TME 419, 9, 12 and 15 months were 2.92; 2.96 and 3.0 while TMS 30572, 9, 12 and 15 months were 3.02; 3.0 and 3.2. Sensory analysis results indicated that almost all the samples were highly rated, however, TMS 30572 and TME 419 of 9 months were dislike in terms of taste. The study has shown that the age at which some cassava roots are harvested can affect the yield and the suitability of gari prepared from them. There was varietal effect on the yield and suitable of the two varieties. It can be concluded from the study that cassava age 12 months and 15 months of both varieties were suitable for gari than their 9 months.

Keywords: cassava; age; yield; varieties; suitability.

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1. Introduction

Cassava {Manihot esculenta (crantz)} root is one of the major root tubers produced in the forest zones of Nigeria. Cassava is propagated by stem cutting and it is ready for harvesting and processing after a period of eight months to one year, depending on the variety [1]. Cassava roots yield more carbohydrates per hectare than cereal crops and can be grown at a lower cost [2] however, is one of the most drought tolerant crops and can be successfully grown on marginal soils, giving reasonable yields where many other crops do not thrive well [3]. It is a major source of staple food in West Africa, providing basic diet to millions of its teeming population across the different socio-economic classes [4]. Nigeria is the world largest producer of cassava with an estimated annual production of 54 million tons from an estimated area of 1.7 million hectares of land [5].

However, cassava roots spoil quickly after harvest due to its relative high moisture and cyanide content. In order to avoid this loss, they must be processed into by-products or into dry forms that can be store for longer periods and lower cyanide levels [6, 7]. Generally, cassava are suitable to be processed into various products. Cassava and its products are rich in carbohydrates and are a good source of energy, a moderate source of minerals, vitamins, and a poor source of proteins, in fact prominent amongst these products is gari [4]. Gari is a fermented roasted granule prepared from peeled cassava root through a series of processing steps such as grating, drying, milling, pressing, sieving and roasting in an open steel pan. This is either consumed immediately or further processed into various forms that combine diversity, convenience and nutritional value [8, 9]. However, In Nigeria, similar to other West African countries, higher or more than 70% of the cassava root is processed into gari, a staple and convenient food [10]. Gari is the major form in which cassava is consumed in West Africa. With the current food crisis in most part of the world it is important to maximize the yield and quality of gari products through the ages of cassava plant. However, little was known about the effect of cassava age on the yield and suitable of gari products. The objective of this study therefore, was to determine whether age at harvest and varietal difference had any effect on the yield and suitability of gari prepared from cassava root.

2. Materials and method

2.1. Description of the study area

The experiment was conducted within Ogbomoso. Ogbomoso is located on Latitude 8° 10' N and Longitude 4° 10' E, with an altitude about 342 m above the mean sea level. The study area has a bimodal rainfall pattern, with rainfall peaks in the months of July and September and breaks in August. The mean annual rainfall is approximately 1200 mm while the mean maximum temperature is 33°C and minimum temperature is 16°C [11]. The relative humidity of the area is not less than 80% between the months of April-November while it is low between December-March when dry wind (harmattan) blows from the northeastern part of the country [12].

2.2. Processing of cassava tubers into gari

The method described by [13,14] were adopted. Fresh cassava tubers of the two improved cassava cultivars of TMS 30572 and TME 419 were used in this study. The two cassava varieties were selected for their recognition among cassava growers in Nigeria.

Fresh cassava tubers of the TME 419 and TMS 30572 cultivars were harvested at maturity ages of 9, 12 and 15 months. 10kg tubers of each of the two varieties at different ages were weighed with weighing scale. The processing of cassava tubers into Gari began on the day at harvest to avoid the rotten of the tubers. However, before processing into Gari they were carefully and respectively peeled subsequently, separately and neatly unrolled from the flesh without any flesh loss to the peel. They are washed, drained and grated in a mechanized commercial grater. The grated pulp (mash) was loaded into jute bags and tied up with a thread. The mash was left to naturally fermentation for a period of 5 days at ambient temperature before pressing out the juice with hydraulic press. The pressed out mash (cake) were manually crushed and sieved with (1.50 mm mesh) to remove fibers before roasting over a low fire. The roasted granules (Gari) was then sieved through a cane mesh. The Gari was allowed to cool and weighed before packaging to determine the Gari yield and its suitability.

2.3. Percentage yield determination of gari

The yield of the samples was determined according to [15]. This was done to establish the basis for comparing the yield obtained in the two varieties at different ages. The total amount of gari obtained, expressed as a percentage of the fresh cassava roots is calculated as follows;

% Yield =
$$\frac{\text{Mass of gari obtained}}{\text{Mass of cassava that produced the gari}} \times 100\%$$
 1

2.4. Moisture contents

The moisture contents was calculated using the formula by [16]. Different grams of dried samples of gari were weighed in a moisture dish and dried at 60° C for 6 hours. The moisture content of gari were calculated by:

$$Mc \text{ (wb)}\% = \frac{Ww - Wd}{Ww} X \ 100$$
 2

Where;

Ww is the weight of wet sample (g),

Wd is the weight of dried sample (g),

Mc is moisture content wet basis.

2.5. Swelling index (SI)

The Swelling index (SI) was determined using [17] method. The gari samples were dried at 60° C for 6 hours. A 100 ml graduated measuring cylinder were filled with dried gari samples to 25 ml level and filled to the 100 ml marked with water. The top of the cylinder was tightly covered and the content mixed by inverting the cylinder. After 2 minutes, the cylinder was inverted again. The cylinder was then left to stand for 3 minutes (5 minutes total) and final volume occupied was recorded.

$$SI = \frac{Vf}{Vi}$$
 3

Where,

SI = Swelling index

Vf = Final volume of sample in water;

V i = Initial volume of sample in water.

2.6. Sensory evaluation of gari

The gari samples were subjected to sensory evaluation using 20 semi-skilled randomly selected panelists comprising of male and female to eliminate contrast effect and positional bias. The panelists were asked to evaluate the samples for colour, appearance, taste, aroma, texture and overall acceptability. Each panelist's score was reflected on a nine point hedonic scale ranging from nine (like extremely) to one (dislike extremely) as described by [18].

2.7. Statistical analysis

All analytical determinations were done in triplicates. Data were subjected to statistical Analysis of Variance (ANOVA) using SPSS version 10.0. Means were separated using Duncan Multiple Range Test (DMRT).

3. Results and discussion

These results showed the effect of cassava age on yield and suitability of gari.

3.1 Gari yield

The yield of gari in this study was determined according to [15]. The weight of gari obtained was divided with the weight of the cassava root that produced gari multiplied by 100. (Table 1) Yield of gari from the whole roots is necessary in revealing the cassava age that gives maximum gari yield for each cassava variety. Young cassava roots may have most of their carbohydrates in the form of sugars and these may be lost through fermentation and leaching [13;19] during gari preparation. Over-aged cassava roots, on the other hand, may have more fibrous than the young age, hence yielding gari of low quantity and quality. The yield values obtained for gari were in these order and the values were in percentage: 52, 39, 35, 35, 27 and 21 for TMS 30572 of 15 months, TME 419 of 12 months, TME 419 of 15 months TME 419 of 9 months and TMS 30572 of 9 months respectively. Although, some factors that may affect gari yield includes cassava varieties, tubers age, soil composition and dry matter of the roots among others.

Hence, the high yield values obtained for gari was TMS 30572 of 15 months (52%) and 12 months (39%) age of the tubers, though, it was less fibrous and few waste material were generated from them (Table 1), however,

TME 419 have the same yield in 12 and 15 months (35%) while it was lower in 9 months of the two varieties TME 419 (27%) and TMS 30572 (21%). Meanwhile, six cassava cultivars studied in the Rivers State in Nigeria, gave gari yields in the range 21 to 34% [13], and these were slightly lower than yields obtained in the current study. This maybe correlated with [13]; [19] that says young cassava plants may have most of their carbohydrates in the form of sugars and these may be lost through leaching and fermentation. This implies that is not too good to be harvesting cassava at earlier age. Secondly, the values in these case were good which agreed with the report of [17] that the yield of gari should not be less than 25% for maximum economic value for gari production. It can be deduced from both results that gari yield of cassava tubers of TMS 30572 and TME 419 of 12 and 15 months will give the processors more profit than their 9 months (Figure 1)

Table 1: Percentage yield of gari samples of the two varieties at different ages

Samples	%
	Yield
TME 419 ₉	27
TMS 30572 ₉	22
TME 419 ₁₂	35
TMS 30572 ₁₂	39
TME 419 ₁₅	35
TMS 30572 ₁₅	52

Subscript used for various samples indicate age of tuber



Variety samples

Figure 1: Percentages of gari yield

3.2 Moisture contents of gari

Moisture contents of gari ranged between 2.6 - 5.3 % (Table 2). Different factors such as roasting during processing to gari can affect its moisture content. Moisture contents of 9.54 - 11.57% was reported by [20] from their studies on gari. However, when comparing values obtained in this study with the reported values, it is little higher than the present study. However, the result gotten was within specification. Lower moisture content is preferred for suitability of gari for better storage, therefore all the gari samples are under safe limit. Codex standards for gari [21] gave a maximum value of 12.0% for moisture.

Samples	Moisture contents (%)			
TME 419 ₉	3.4			
TMS 30572 ₉	3.1			
TME 419 ₁₂	5.3			
TMS 30572 ₁₂	3.4			
TME 419 ₁₅	2.6			
TMS 30572 ₁₅	4.8			

Subscript used for various samples indicate age of tuber



9 12 15



3.3 Swelling capacity

Swelling index is important in determining gari suitability. The higher the swelling capacity, the greater its suitability for use in most West African dishes such as 'eba', which are typically Nigerians delicacies. Swelling capacity (Figure 3) of gari also indicates its starch content and the extent of gelatinization of starch, since it is the starch component of gari that enable it to swell [20]. Good quality gari is expected to swell to three times its initial volume when placed in water [22]. Values obtained in this studied ranged 2.92–3.20 (Table 4) and swelling index of 2.53 - 2.93 was reported by [20] from their studies on gari, this values is on the same phase





Variety samples

Figure 3: Swelling index of gari samples

Samples	Initial volume (ml)	Final volume (ml)	Swelling index
TME 419 ₉	25	73	2.92
TMS 30572 ₉	25	75.5	3.02
TME 419 ₁₂	25	74	2.96
TMS 30572 ₁₂	25	75	3
TME 419 ₁₅	25	75	3
TMS 30572 ₁₅	25	80	3.2

 Table 3:
 Gari swelling index

Subscript used for various samples indicated age of tuber

3.4 Sensory evaluation

Table 4: The results of the sensory evaluation test on gari samples

Samples	Taste	Colour	Appearance	Aroma	Texture	Overall acceptability
TME 419 ₉	2.2 ^b	2.3 ^b	2.8 ^b	2.5 ^b	2.5 ^b	2.6 ^b
TMS 305729	1.2 ^a	1.5 ^a	1.5 ^a	1.6 ^a	1.6 ^a	1.4 ^a
TME 419 ₁₂	2.7 ^b	2.6 ^b	2.7 ^d	2.5 ^b	2.5 ^b	2.3 ^b
TMS 30572 ₁₂	1.4 ^a	1.3 ^a	1.2 ^a	1.1 ^a	1.3 ^a	1.4 ^a
TME 419 ₁₅	2.4 ^b	2.3 ^b	2.0°	2.5 ^b	2.4 ^b	2.3 ^b
TMS 30572 ₁₅	1.4 ^a	1.4 ^a	1.3 ^a	1.2 ^a	1.6 ^a	1.5 ^a

Subscript used for the samples indicated age of tuber. Mean values with different superscript(s) in the same column are significantly different at p < 0.05.

The attributes evaluated for sensory taste, colour, aroma, appearance, texture and overall acceptability for gari as presented in Tables 4. The results of sensory evaluation for gari were generally different in terms of colour, texture, appearance, taste and overall acceptability.

4. Conclusion

The study has shown that the age at which some cassava roots are harvested can affect the yield and its suitability of gari prepared from them. There was varietal effect on the yield and suitability of the two varieties that produced gari. It is concluded from the study that cassava tubers of 12 and 15 months of TMS 30572 and TME 419 are suitable for gari and their 9 months were not good in yield and suitability. This will give the grower of cassava tubers and processors the varieties that will give them maximum profit.

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