COMPARATIVE EVALUATION OF QUALITY OF GARI SAMPLES FROM SIX PROCESSING CENTRES IN ORIADE LGA OF OSUN STATE, NIGERIA.

By

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Abstract

Gari samples were collected from six processors in six centres of Oriade Local Government Area of Osun State. The gari samples were compared for proximate composition, functional properties and microbiological quality. The ash and crude fibre contents of the gari samples were higher than the standard of 1.5% 0 2% and the moisture content (10%). Only Erin B centre falls within the normal range recommended by Standard Organization of Nigeria. There were significant differences ($p<0.05$) in the proximate compositions of the gari samples. The hydrocyanide content of the gari samples ranged between 0.34ppm and 0.68ppm which did not fall within the regulatory standard of less than 0.02ppm of HCN. However, the gari samples were significantly ($p<0.05$) different in their functional properties (swelling capacity, water absorption capacity and bulk density).

Keywords: Cassava, Gari, Quality Assessment, Proximate Composition, Functional.

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Introduction

Cassava (Manihot esculenta Crantz) is a major staple food in the tropics supplying about 70% of the daily calorie of Nigerian populace (Oluwole *et el*., 2004). It has also been estimated that more than 500 Million of the world's population derive food from cassava (Abu *et al*., 2006). Different types of f oods are derived from cassava in Nigeria, among which are "Lafun", "Akpu", "Gari", and "Fufu" (Omodamiro *et al*., 1998, Okoro, 2007). Usually, these products are processed from freshly harvested cassava roots and their qualities have been severally documented (Oyewole and Afolami, 2001). Cassava roots are highly perishable and a lot of post-harvest losses occur during storage due to physiological activities and high moisture content. This factors limit the uses as industrial raw material.

Despite the desirability of cassava as food and animal feed, there is a limiting factor caused by the presence of toxic compounds like cyanogenic glucosides, linamarin and lotaustralin which can be reduced substantially by processing (Oguntimehin *et al*., 1994) such as found in gari production. In Nigeria, up to 70% of harvested cassava roots are processed into gari (Oluwole *et al*., 1992). Gari is a product obtained by fermenting peeled, washed and grated fresh roots (for about 72hrs) dewatering and roasting (Ekwu and Ugwuona, 2007). It is consumed either soaked in cold water or reconstituted in hot water to make a paste called (eba) in South Western Nigeria. It may be consumed with sauces or stews. Gari is the most consumed and traded of all products from cassava roots in Nigeria (Sanni *et al*., 2008) and in many West African countries (Oduro *et al*., 2000). It is easy to prepare gari for eating and it has a long shelf life compared to other cassava products (Sanni *et al*., 2005).

There are export opportunities for Nigerian gari in West African countries such as Niger and Mali (Philips *et al*., 2004). This high demand and high price has great tendency of encouraging short-cut in the processing. There is reduction in the four-day fermentation period to one day in many cases to save time and ensure quick returns (Sanni *et al*., 2005).

There is apparent lack of quality consciousness among gari producers and sellers in Nigeria in general and Oriade Local Government Area of Osun state in particular, considering the fact that gari is a staple food among low income earners. In view of this, there is the need to evaluate the quality of gari among the producers in Oriade Local Government Area of Osun State to regulate and standardize the product within the environment.

This paper reports the results of our studies on the physic-chemical and functional properties as well as microbial quality of gari from six processing centres in Oriade Local Government Area of Osun State.

Materials and Methods

Materials

Six gari samples were randomly collected from six processing sites in three towns of Ipetu-Ijesha, Owena-Ijesha and Ikeji-Arakeji in Oriade Local Government Area of Osun State. The samples were stored in high density polyethylene bags and stored at room temperature (25±3^{o}C) to prevent the entrance of spoilage agents before laboratory analyses.

Laboratory Analyses

Chemical Properties

Moisture, cyanide, total acidity, ash and crude fibre were determined according to standard method (AOAC, 2004)..

Functional Properties

Swelling Capacity

The swelling capacity was determined according to the method of Sanni *et al*., (2001), a 50ml glass measuring cylinder was filled with gari samples to the 10ml mark. Distilled water was added at room temperature (25±3^{o}C) to give a total volume of 50ml. the top of the cylinder was tightly covered and the contents mixed by inverting the cylinder, after 2 min, the cylinder was inverted again and then left to stand for 3 min (5 min total time) and the final volume occupied by the gari recorded. The swelling capacity was thus determined by dividing the volume of the gari in water by the initial volume of gari

$$Swelling\ Capacity = \frac{V2}{V1} X\ 100$$

V1 = Initial volume of gari
V2 = Volume of gari in water

Water Absorption Capacity

Water absorption capacity (WBC) was determined according to the method of Nuwamanya *et al*., (2011) with some modifications. An aqueous suspension was made by dissolving 1 g of starch in 10 ml of water. The suspension was agitated for 3 min on shaker and allowed to stand for 10 min after which it was centrifuged for 10 min at

3000 rpm. The free water was decanted from the wet starch, drained for 10 min and weighed. The difference in the weight of the water was recorded as water absorbed.

$$Water\ Absorbtion\ Capacity = \frac{Weight\ of\ water\ bound}{Sample\ Weight}\ X\ 100$$

Bulk and Tap Density

Bulk and tap density were determined in triplicate in a weighed 250ml cylinder according to Picker-Freyer and Brink (2006) with slight modification. 100g of the sample was gently filled into the cylinder. Bulk volume was read and bulk density calculated. The cylinder was tapped at least 50 times to a constant volume. Tap volume was read and tap density calculated.

$$Bulk\ Density = \frac{Weight\ of\ Sample}{Loose\ Volume\ of\ Sample}$$

$$Tap\ Density = \frac{Weight\ of\ Sample}{Packed\ Volume\ of\ Sample}$$

Microbial Analysis

Bacterial and fungal analysis

Microbial analysis was carried out according to the method of Ojokoh and Gabriel (2006). 1 g of sample was weighed and crushed to powder with sterile mortar and pestle. It was then placed in a sterile test tube and dissolved with 10 ml of distill water to make the stock. Serial dilution was done to the necessary dilution factors and pour-plated. The plates were left to gel and then incubated. The bacteria plates were incubated at 37 ^{o}C for 48 h while the fungal plates were incubated at 25 ^{o}C for 72 h. At the end of each incubation period, the colonies were counted and sub-cultured onto fresh media maintained on slants and preserved at 4 ^{o}C in the refrigerator.

Total coliform test

The total coliform test was carried out by multiple tube techniques according to Cheesbrough, (2002). 5g of gari sample was weighed into 45ml distilled water. It was well shaken and filtered. 1ml of the filtrate was diluted in 9ml distilled water. A serial dilution was prepared up to 10^{-3}. The sample was cultured in MacConkey agar and incubated at 37 ^{o}C for 48 h.

Confirmatory coliform test

The confirmatory coliform test was done according to Mishra (1993) method. A subculture of the colony from the previous sample was streaked and grown in Emb agar. It was inverted inside the incubator at 24 ^{o}C for 24 h

Mould and yeast

The mould and yeast were evaluated using multiple tube techniques according to Purseglove (1974) method. Serial dilution was prepared up to 10^{-3}. The samples were cultured in potato dextrose agar and incubated at 25^{o}C for 120 hrs

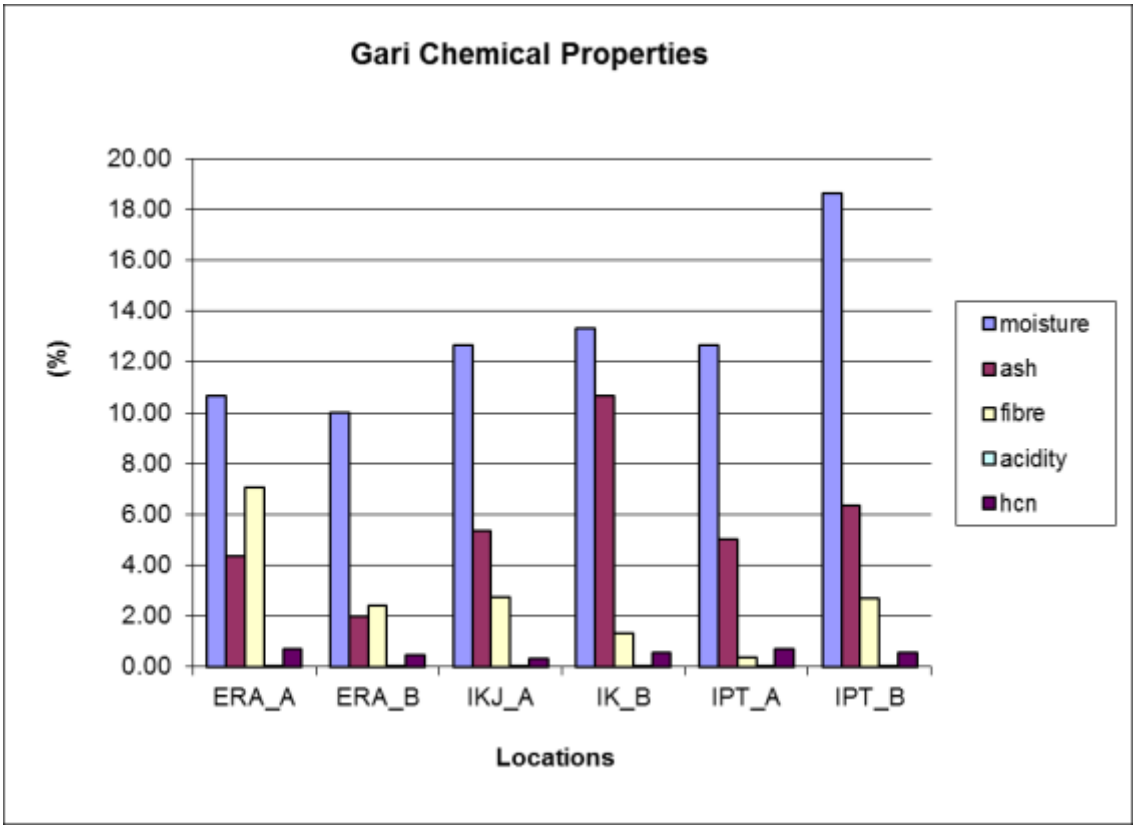
Statistical analysis

Statistical analysis of all data will be done with the Statistical Analysis Systems (SAS) package (version 8.2 of SAS institute Inc, 1999). Statistically significant differences ($P<0.05$) in all data will be determined by Analysis of Variance procedure (ANOVA).

Results

Chemical Properties

The result of the proximate compositions of the gari samples is presented in Fig 1 below. The moisture ranged from 10.00 % to 18.67%. Samples from Ipetu (A) had the highest moisture content of 18.67%, while the sample from Erin A had the lowest moisture content of 10.00%. There was significant difference ($P<0.05$) in the moisture content of gari samples. However the gari sample from Erin (A) falls within the stipulated standard of the revised gari regulation of 10% (Sanni *et al*., 2005) and other samples having higher moisture content might be due to the method of garification, storage condition in the processing centres as well as the humid condition as at the time of sample collection from the centre. It can be deduced from this study that, majority of the gari samples analysed for moisture may still be within the normal range of storage up to 2-7 months without mould infection. The report indicated that gari samples with moisture content of less than 16% but greater than 13% could store for 2 to 7 months. The moisture content of any food product is of significance to shelf-life, packaging and general acceptability (Okaka and Okaka, 2001).



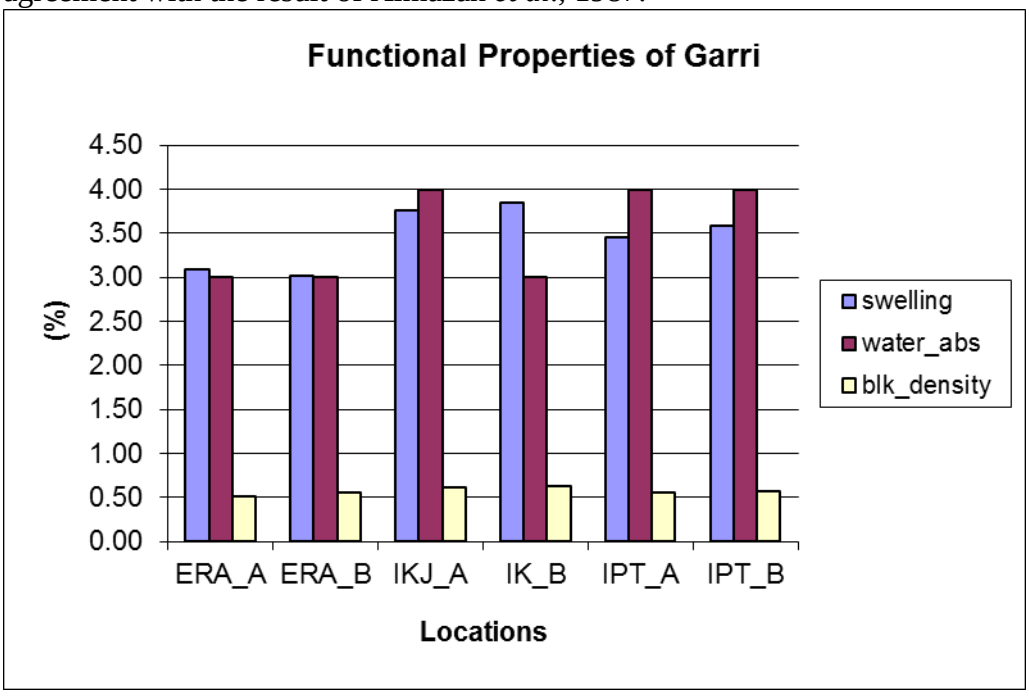
The Ash content ranged from 2.00 % to 10.67%. Samples from Ikeji (B) had the highest ash content of 10.67% while sample from Erin (B) had the lowest ash content of 2.00%. Almost all the samples do not comply with the regulatory standard of not more than 1.5% ash content (Sanni *et.al*., 2005). There was no significant difference ($P<0.05$) in the ash content of the gari samples. The variation in the ash content might be due to contamination with particles or metals from the garification medium and this reflected in the gari from the rural areas, Ikeji (B), having high ash content of 10.67.

The Crude fibre content ranged from 0.38 % to 7.08%. Samples from Erin (A) had the highest crude fibre content of 7.08 while sample from Ipetu (A) had the lowest crude

fibre content of 0.38. The crude fibre of Ipetu (A) and Ikeji (B) also fall within the regulatory standard of 2% (Sanni *et al.*, 2005). There is significant difference (P< 0.05) in the fibre content of the samples. It has been reported that the less fibrous a gari sample is, the better the quality. This might be due to over matured cassava root used for the study.

The total acidity ranged from 0.01 to 0.04. Sample from Ipetu (A) had the highest total acidity of 0.04 while sample from Ikeji (A) had the lowest total acidity of 0.01.
The Hydro-cyanide content ranged from 0.34ppm to 0.68ppm. Samples from Erin (A) had the highest cyanide content of 0.68ppm while sample from Ikeji (A) had the lowest cyanide content of 0.34ppm. There was significant difference in the cyanide content of the gari samples (P< 0.05). However no sample from the 6 centres conform with the regulatory standard of less 0.02ppm of HCN (Sanni *et al*., 2005). The high cyanide level in the samples might be due to inadequate fermentation process as explained above and can also be attributable to the use of high cyanide containing cassava varieties (Sanni *et al.,* 2001). Storage conditions has also been reported to affect the residual cyanide in gari samples. The lethal dose of cyanide in adults is about 50-60ppm HCN. Gari samples from Erin (A), Erin (B), Ipetu (A) and Ipetu (B) falls within the safe level and sample from Ikeji (A) and Ikeji (B) do not fall within the safe level range as reported by these two authors

Functional Properties
The result of functional properties is presented in Fig.2 below; the swelling capacity ranged from 3.02 to 3.85. Sample from Ikeji (A) had the highest swelling capacity of 3.85, while the sample from Erin (B) had the lowest swelling capacity of 3.02. The samples were significantly different (P<0.05) in their swelling capacity. A good quality gari should swell to at least 3 times its volume when soaked in water , all the gari samples swell about 3 times their original volume when soaked in water which was in agreement with the result of Almazan *et al*., 1987.



The Water absorption capacity ranged from 3.00 to 4.00. Sample from Ipetu (B) had the highest swelling capacity of 4.00 while sample from Erin (A) had the lowest water absorption capacity of 3.00. There was significant difference in the water absorption

capacity (P<0.05). It was reported by Sanni *et al*., 2005 and Sanni *et al*., 2001 that the swelling index of granules reflect the extent of associative forces within the granule, therefore the higher the swelling index, the lower the associative forces.

The bulk density ranged from 0.52 to 0.62. Sample from Ikeji (A) had the highest bulk density of 0.62 while sample from Erin (A) had the lowest bulk density of 0.52. The samples differ significantly (P<0.05) in terms of their bulk densities. Plaami (1997) reported that bulk density was influenced by the structure of starch polymers. Thus the lower the bulk density the higher the floatation of gari samples on top of water as a result it may not soak properly in water and may in turn be rejected by consumers.

Microbial Characteristics

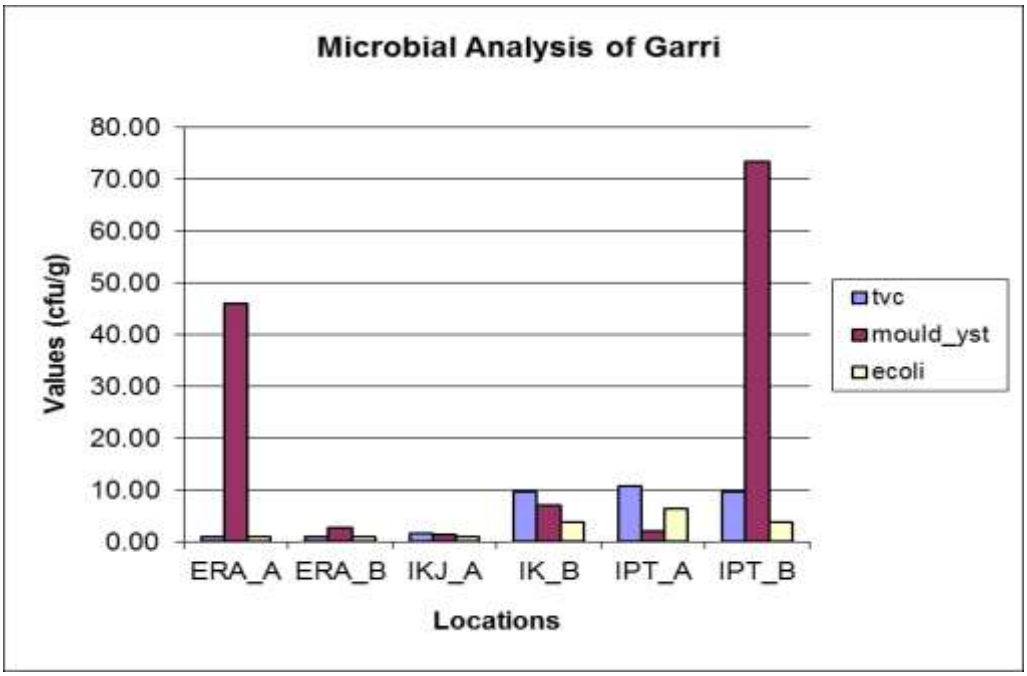
The result of microbial analysis of gari from different locations is presented in Figure 3. The total coliform count ranged from 1.00 to 10.67. Sample from Ipetu (A) had the highest total coliform count of 10.67 while sample from Erin (B) had the lowest total coliform count of 1.00. The total Mould and Yeast count ranged from 1.33 to 73.33. Sample from Ipetu (B) had the highest mould and yeast count of 73.33, while sample from Ikeji (A) had the lowest mould and yeast count of 1.33. The total Ecoli count ranged from 1.00 to 6.33. Sample from Ipetu (A) had the highest Ecoli count 6.33, while sample from Erin (B) had the lowest Ecoli count of 1.33.

Gram staining results carried out on gari samples to confirm presence of coliform showed that when it was Gram positive bacteria**,** there was significant different of total coliform count of (P<0.05), this might be due to contamination of the sample by the processors during processing. There is significant difference in the total mould and yeast count (P<0.05) present in the gari sample. There is significant difference in the Ecoli count (P <0.05), this may be due to the non hygienic of the materials used or hand of consumers during processing. Stain dark purple with crystal violet (or methyl violet) and are not decolorized by acetone or ethanol.

This was seen in gari sample from Erin (A), Ikeji (A), Ikeji (B) and Erin (B) respectively when viewed under oil immersion objective x (100) with the use of a microscope. When it was gram negative bacteria i.e Stain red because after being stained with crystal violet (or methyl violet) they are decolorized by acetone or ethanol and take up the red counterstain (e.g. neutral red, safranin, or dilute carbolfuchsin). This was seen in gari sample from Ipetu (A) and Ipetu (B) respectively when examined under oil immersion objective x (100) with the use of a microscope. (Monica Cheesbrough, 2006).

Conclusion

In conclusion, the entire gari samples conformed with the normal moisture range and therefore could be stored up to seven months (excluding gari from Ipetu B processor with higher moisture (18%). The ash content of the gari samples was higher than the recommended range. The crude fibres of the gari samples were significantly ($p<0.05$) different and did not conform with the Nigerian regulatory standard (except for samples from Ipetu A and Ikeji B which fall within the range of 2%). The hydrocyanide content



of the gari samples from all the centres did not conform with the stipulated regulatory standard of less than 0.02ppm of HCN, which may not be suitable for consumption. However, the number of isolates shows that the prod uct got contaminated after production. It is therefore advisable that gari should be aseptically filled into retail packs prior to selling.

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