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RESEARCH ARTICLE

Effects of fermentation periods on the chemical properties of Garri produced from cassava

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ABSTRACT

The study aimed at determining the effect of fermentation time on the proximate composition of garri produced from cassava. Garri was fermented for 48, 72 and 96 hours. The samples were subjected to proximate analysis and it was observed that the garri samples had moisture range of 8.21% – 11.12%, the ash content increased from 2.84 to 2.97 after 72hours of fermentation. Further fermentation of the garri to 96 hours led to a subsequent drop in its ash to 2.03%, The crude protein ranges between 2.60 to 3.01% as fermentation time increases from 48 to 96 hours, crude fat content reduces as the fermentation period increases with the range of 1.71% - 0.92%, the 48hours fermented sample had the highest value (1.71%) while the 96 hours fermented sample had the least value (0.92%), Crude fibre content increased between 4.00 to 7.50% as fermentation duration changed from 48 to 96 hours while carbohydrate content decreased from 80.64% to 75.42% as fermentation time surged between 48 to 96 hours. Garri is generally known for its high carbohydrate content and low in protein content, the study have shown that an increasing fermentation time can increase the protein and fibre content of garri, hence, recommended that grated cassava mash should always be fermented between 24hours to 96 hours to reduce the carbohydrate and fat content and to improve the quality of the processed garri.

Keywords: Cassava, Chemical Properties, Fermentation, Garri, Proximate Composition

1. INTRODUCTION

Cassava (*Manihot esculenta*) is a major food crop in Nigeria, supplying about 70% of the daily calorie over 50 million people in Nigeria [1]. With 93 million tons, cassava accounted for the largest share of root crops consumed as food in Tropical Africa in 1996 [2]. It is also estimated that cassava provides food for over 500 million people in the world [3]. Edible part of the fresh cassava root contains 32-35% carbohydrate, 2-3% protein, 75-80% moisture, 0.1% fat,1.0% fiber and 0.70-2.5% Ash [4]. A wide variety of foods are produced from cassava from fermentation, V12 Garri, fufu, lafum, Affieke, farinha dermadioca, to mention a few cassava plants are two (2) varieties namely; Sweet cassava (*Manihot Utilisima*) also known as the Oko-yawo variety and bitter cassava (*Manihot Palmata*). Both varieties are known to contain cyanogenic glycosides. The two major cyanogenic glycosides: Linamarin

and Lotaustralin are hydrolyzed to produced hydrocyanic or prussic acid (HCN) a poison, when it comes into contact with the enzyme Linamarase, which is released when the cells of the cassava roots are ruptured. In total cyanogenic glycoside in Linamarin is 95% while the remainder is Lotaustralin. It was observed that the roots rapidly develop toxicity after grinding unless the pulp is heated immediately. Therefore, all forms of cassava processing decrease level of cyanogenic glycoside and Prussic acid in the final product.

Garri is a product obtained from fermenting peeled, washed and grated fresh cassava roots (for about 72 hours) dewatering and toasting [2]. In Nigeria, up to 70% of cassava roots are processed into garri. Garri is normally consumed by adding water and sugar to taste and eaten as a refreshing snack, drink or by pouring sufficient quantities in hot water to obtain a stiffen pudding (Eba) [5].

Garri is a granular starchy food prepared from cassava mash in a manner similar to Farinha demandioc. The cassava is in form of paste made with hot water (EBA) is eaten with vegetable sauce or soaked in cold water with sugar, coconut, roasted groundnut, dry fish or boiled cowpea as complements. The characteristic taste and flavours of garri is mainly from its lactic acid content produced during fermentation [6]. Traditional production of garri involves peeling of the cassava roots and grating into fine pulp. Next, the pulp is transferred into hessian sacks and compressed to drain and ferment for 4 days. The fermented and relatively dewatered pulp was sieved to remove fibrous and palm oil could be added according to preferences. Roasting is carried out in large frying pan to yield gelatinized Garri granules of reduced moisture content which can be stored for relatively long time. Palm oil is added to cassava mash to give the garri an esthetic value and source of vitamin A. Therefore, yellow garri is more nutritious and preferably cherished than white garri.

Whether garri can be relied upon as staple will to a large extent depend on how well it can be processed in safe forms [7]. Market expansion for garri, to some extent depends largely on the degree to which the quality of the processed garri can be improved upon to make it attractive to potential consumers. Quality is the degree of excellence and acceptance. Products with superior quality can get higher prices and can also sell larger quantities. The quality of garri available in the local market varies from batch to batch among the traders. Variations are observed in the colour, fiber content, moisture, particle, size, starch content and residual cyanide. These variations are caused by cassava variety, age at the time of harvest, processing methods and equipment, and duration of fermentation.

This work was aimed at determining the effect of fermentation time on the chemical qualities of garri.

2. METHODS AND MATERIALS

2.1. Sample Collection

Fresh cassava roots of four local varieties were collected and used in this study. These roots were harvested 12 months after cultivation from different farmers in Nnewi North LGA. In

each region, three samples of roots were extracted per cultivar.

2.2. Processing of Cassava into Garri

The cassava tubers were processed into garri using modified traditional method. Tubers were peeled and grated into mash and then packaged into jute bags in three separate portions. They were subjected to hydraulic press and left to ferment for varying length of 48hours, 72hours and 96hours. At 24 hourly intervals, dewatered fermented mash was sieved and garified by roasting in deep frying pan (120-140°C) resulting in a product called garri. The product was allowed to cool sufficiently (about 1-2 hours) before packaging in polyethylene chloride bags and labeled.

Chemical analyses were carried out on garri samples produced with each cassava varieties at different fermentation periods.

2.3. Proximate Analysis

2.3.1. Determination of Moisture Content

Two grams (2g) of the sample(s) was placed in the crucible and heated at 105˚ C until a constant weight was attained. The moisture content of sample was calculated as loss in weight of the original sample and expressed as percentage moisture content.

2.3.2. Determination of Crude Protein

The crude protein was determined by the Kjeldahl method with slight modification. The determination of crude protein involved three steps namely; digestion, distillation and titration.

Digestion

1 g of ground sample was weighed into a digestion flask. 15 g potassium sulfate, 0.04 g anhydrous copper sulfate, 0.5 to 1.0 g alundum granules, 16.7 g K_2SO_4, 0.01 g anhydrous copper sulfate, 0.6 g TiO_2 and 0.3 g pumice was added. Then 20 mL sulfuric acid was added. The flask was placed on preheated burner (adjusted to bring 250 mL water at 25 °C to rolling boil in 5 minutes) and the mixture was heated until white fumes clear bulb of flask was seen, swirled gently, and heating continued for 90 min for copper catalyst. The mixture was then cooled and cautiously 250 mL of distilled water was added to room temperature.

Distillation

A mixture of 15 mL of hydrochloric acid and 70 mL of water (HCL) was added to the titration flask. In addition, two to three drops of tributyl citrate, an antifoam agent was added to digestion flask to reduce foaming. This was then followed by addition of another 0.5 to 1.0 g alundum granule. Slowly down side of flask, sufficient 45% sodium hydroxide solution (approximately 80 mL) was added to make mixture strongly alkali. The flask was connected to distillation apparatus and distilled until at least 150 mL distillate was collected in titrating flask.

Titration

Excess acid was titrated with standard 0.1M sodium hydroxide solution to orange endpoint (color changed from red to orange to yellow) and volume was recorded to nearest 0.01 mL (NaOH). The reagent blank (B) was titrated

similarly. Calculation was done as by equation 1:

$$\%N \text{ (DM basis)} = \frac{((HCL \times NHCL)-(BK \times NNaOH)-(NaOH \times NNaOH))}{1.4007 \times W \times \text{Lab DM}/100}$$

Where;

DM = dry matter;
NaOH = standard NaOH (to titrate sample)
HCL = standard HCL pipetted
N NaOH = Normality of NaOH
N HCL = Normality of HCL
BK = standard NaOH (to titrate 1 mL standard HCL minus B)
B = standard NaOH (to titrate reagent blank carried through method and distilled into 1 mL standard HCL)
1.4007 = milli equivalent weight of nitrogen x 100;
W = sample weight in grams.

Calculation for crude protein (CP) was done using equation 2:

Crude Protein (DM basis) = % N (DM basis) X F

Where:
F = 6.25

2.3.3. Determination of Crude Lipid

This estimation was performed using the Soxhlet extraction method. 10 g of the powdery form of each plant sample was weighed and wrapped with a filter paper and placed in a thimble. The thimble was covered with cotton wool and placed in the extraction column that was connected to a condenser. 200 ml of n – hexane was used to extract the lipid.

2.3.4. Determination of Crude Fibre

Five grammes of the powdery form of each flour and 200 ml of 1.25 % H_2SO_4 was heated for 30 min and filtered with a buchner funnel. The residue was washed with distilled water until it was acid free. 200 ml of 1.25% NaOH was used to boil the residue 30 minutes; it was filtered and was washed several times with distilled water until it was alkaline free. Further rinsed once with 10% HCL and twice with ethanol and finally with petroleum ether thrice. The residue was put in a crucible and dried at 105°C in an oven overnight. After cooling in a desiccator, it was ignited in a muffle furnace at 550°C for 90 minutes to obtain the weight.

2.3.5. Determination of Ash Content

The total ash content of a substance is the percentage of inorganic residue remaining after the organic matter has been ignited. 2 g of the pulverized plant samples was placed in a crucible and ignited in a muffle furnace at 550°C for 6 hours. It was then cooled in a desiccator and weighed at room temperature to get the weight of the ash.

2.3.6. Determination of Carbohydrate

The carbohydrate content was determined by subtracting the summed up percentage compositions of moisture, protein, lipid, fibre, and ash contents from 100

2.4. Statistical Analysis

All analyses were conducted in duplicates with SPSS version 22. Data were subjected to analysis for variance, and Duncan multiple range test was used to separate the means [8].

3. RESULTS AND DISCUSSION

The results of the proximate composition of garri samples fermented at different time were shown in Table 1. The results revealed that that the moisture content of the samples ranged between 8.21–11.12%. However, the moisture content increases with the increment in fermentation period, this conforms with the findings which reported an increase in moisture from 7.85 to 14.97% for garri fermented for 120 days [9]. Irtwange and Achimba (2016) [10] reported a similar trend of moisture increase with increase time of fermentation (7.45-8.18%), the available moisture in the sample solely depends on the degree of dryness during garifrying, although values obtained were lower than the recommended 13% for Gari [11].

The ash content increased from 2.84 to 2.97 after 72 hours of fermentation. Further fermentation of the garri to 96 hours led to a subsequent drop in its ash to 2.03%, this initial increase as the fermentation period increased is an indication of improvement in the mineral composition of the sample. this fluctuations of ash composition of garri contradicts the findings of [10] who reported a regular increase in the ash composition of garri (1.74 to 2.19%) with increasing fermentation time which also conforms to the findings of Ipeghan and Anaele (2018) [9] who also reported an increase in ash composition of fermented garri from 0.75 1.0% after 96 hours of fermentation but subsequently dropped to 0.9% after 120 hours of fermentation period. Meanwhile contrary to these findings, Irtwange and Achimba (2009) [12] reported a regular decrease in ash composition as fermentation time increase.

Table 1. Proximate Analysis of Fermented Garri

Proximate (%)	Sample A	Sample B	Sample C
Moisture content	8.21	8.79	11.12
Ash content	2.84	2.97	2.03
Protein content	2.60	2.88	3.01
Fat and oil	1.71	1.18	0.92
Crude fiber	4.00	5.22	7.50
Carbohydrate	80.64	78.96	75.42

Sample A: garri fermented for 48 hours
Sample B: garri fermented for 72 hours
Sample C: garri fermented for 96 hours

The crude protein ranges between 2.60 to 3.01% as fermentation time increases from 48 to 96 hours which indicates that the protein content was improved as fermentation time increases, a similar range and values of protein (2.44% - 2.72%) were also reported in garri fermented between 0 – 8 days [10], while Ipeghan and Anaele (2018) [9] recorded lower values of protein but similar trend of increase in protein with increase in fermentation time 1.313 to 2.212%. It is also reported that an increase in protein (2.33 to 2.48%) was observed as fermentation period increases [12].

It could also be observed from the Table 1 that crude fat content reduces as the fermentation period increases with the range of 1.71% - 0.92%, day 48 fermented sample had the highest value (1.71%) while the 96 days fermented sample had the least value (0.92%). Oluwafemi and Udeh (2016) [10] reported similar drop in fat composition (1.20% - 1.50%) in garri samples fermented for 0 to 8 days which disagreed with the findings of Ipeghan and Anaele (2018) [9] who reported an increase in fat composition of garri from 0.40 to

1.00% between 12 to 96 hours fermentation time. The temperature is known to have an effect on the physical index of certain foods decreases, hence, this temperature could probably be the reason for the rate of decrease of crude fat [13]. The lower level of fat in the eight days fermented sample could give a higher probability of a longer shelf life in term of the onset of rancidity.

Crude fibre content increased between 4.00 to 7.50 % which shows that the crude fibre content in the sample increased as the fermentation duration increases (Table 1). It contradicts with the findings of Oluwafemi and Udeh (2016) [10] who reported a continuous decrease in fibre from 2.60% - 3.20% as the garri fermentation time increases but agreed with other reports which suggested that the fibre increased from 11.907 to 24.292 % [9]. Fiber is renounced in the control of cholesterol and cardiovascular illnesses, therefore fermentation of food have shown to aid in the fight against heart diseases.

Carbohydrate was determined by different which depleted between 80.64% – 75.42% as fermentation time surged between 48 to 96 hours, which indicate that the carbohydrate content decreases as fermentation period increases these findings were in harmony with values (82.94% – 83.92%) posited with other reports who also suggested a drop in carbohydrate from 77.68 to 64.50% for garri fermented between 12 to 120 hours [9-10].

4. CONCLUSION

In this study, it could be concluded that the production of gari from different fermentation period has really assisted in the knowledge of the nutritional distribution and chemical composition of gari produced from each of the fermentation time chosen. As gari is generally known for its high carbohydrate content and low in protein content, from this study it was observed that the carbohydrate content decreases as the fermentation period increases whereas the protein content increases as the fermentation period increases, although still low compare to the Recommended Dietary Intake. Also, from the research work the moisture content obtained was still within standard storage requirement which is one of the factors that extends the shelf life of the sample. Therefore, the practice of harvesting cassava and processing the same cassava in one day should be discouraged and this is because of the various illnesses such as Endemic oiter and cretinism that is associated in consuming such products. And this illness is capable of killing human being. Any abuse in the processing of cassava into garri will certainly result in poor quality of garri with unacceptable starch level and this will be attributed to incomplete fermentation process.

5. RECOMMENDATION

The study confirms an improvement in some important classes of food in cassava due to fermentation; therefore it is recommended that grated cassava mash should always be fermented between 24hours to 96 hours to reduce the carbohydrate and fat content and to improve the quality of the processed garri. And also, that Regulatory Authorities in Nigeria such as the National Agency for food drugs and Administration Control (NAFDAC), Standard

Organisation of Nigeria (SON) and other Farmers Association should carry out awareness campaigns to educate the public on effect of fermentation time on the quality of processed garri product.

6. ACKNOWLEDGEMENT

NA

7. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

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9. REFERENCES

1. Oluwole R, Cushman JH, Nicholas RJ, Wyman CE (2004), Fuel Ethanol from cellulosic Biomass: Science, *New Series*; **251*(4999)***:1318-1323.
2. Scott MH, Henry W (2002), Fruit pomace as a fuel. *Transaction of American Society of Agricultural Engineers*; **121**: 11-14.
3. Abu JO, Badifu GTO, Akpapunam MA (2006). Effect of Crude palm oil inclusion on some physicochemical properties of gari –A fermented cassava Food product. *Nig. Food J.*; **24*(1)***: 73-75.
4. Oluwole OB, Olatunji OO, Odunfa SA (2004), A Process Technology for Conversion of Dried Cassava Chips into Gari, *Nigerian Food Journal*; **22**:65-77.
5. Bokanga M, Otoo E (1994), Cassava Based Foods: How safe are they? In: Tropical Root Crops in a Developing economy. Ofori, F. and Halin, S. K. (Eds.) Proceedings of the Ninth Symposium of International society for Tropical Root Crops. 20th-26th October, Accra Ghana.
6. Ernesto et al., (2002). Persistent konzo and cyanogens toxicity from cassava in northern Mozambique. *Acta. Tropica*. **82**: 357-362.
7. Bokanga, M. (2005). Biotechnology and Cassava Processing in Africa. *J. Food Technology*; **1**:86-90.
8. Duncan DB (2005), Multiple Ranges and Multiple F-tests. *Biometrics* **2**: 1-42.
9. Ipeghan JO, Anaele JV (2018), Application of Conservation of Mass on Modeling of a Dynamic Non-Isothermal Dehydrator of Natural Gas using Diethylene Glycol, *Journal of Scientific and Engineering Research*; **5*(10)***:290-298.
10. Oluwafemi GI, Udeh CC (2016), Effect of fermentation periods on the physicochemical and sensory properties of gari, *Journal of Environmental Science*; **10*(1)***:37-42.
11. FAO (2006), Bankable Investment Project Profile. Vol. IV: Cassava Production, Processing and Marketing Project. Food and Agriculture Organization of the United Nations Rome. Retrieved from: ftp://ftp.fao.org/docrep/fao/ 008/ag065e/ag065e00.pdf
12. Irtwange SV, Achimba O (2009), Effect of the Duration of Fermentation on the Quality of Gari, *Current Research Journal of Biological Sciences*; **1*(3)***: 150-154.
13. Collard P, Levi S (1959), A two stage fermentation of cassava, *Nature*; **183**: 620-621.