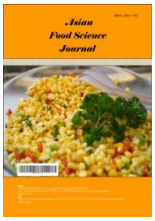

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Microbiological Analysis, Cyanide and Moisture Content of Different Garri Samples

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Three *garri* samples from three differents markets in Afikpo North L.G.A of Ebonyi State were collected and the microbial, moisture content and cyanide content of the samples (A, B, C) were assayed to ascertain their quality and safety. The Microbial analysis, the total plate counts were 7.9 x 10^5 cfu/g, 2.6 x 10^5 cfu/g, and 1.6 x10^5 cfu/g in samples A, B and C respectively. On the other hand the fungal counts were 1.6 x10^5 cfu/g, 0.8 x10^5 cfu/g and 0.2 x 10^5 cfu/g in samples A, B and C respectively. *Staphylococcus* spp was isolated from all the garri samples while streptococcus spp was isolated in samples A and B. However *Escherichia coli* was isolated only in sample A. The fungi isolated were *Aspergillus* spp in samples A and B while *Penicillium* spp was isolated in all samples A, B and C. Cyanide content of the samples were also determined. The values were 0.688 mg/kg, 0.750 mg/kg and 0.630 mg/kg in samples A, B, and C respectively. The moisture content determination of the garria the values of 16%, 14% and 13% in samples A, B, and C respectively. Thus, the microbial counts of the garri samples were within safe limits of the international food standard (<10^5 cfu/g). The cyanide contents were also within safe limits of the international standard (<IHCH/100 g). Moreover, the absence of food borne pathogens of microbiological safe.

Keywords: Garri; microbial; cyanide; quality; moisture.

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1. INTRODUCTION

Grarri is a fermented, gritty, starchy food or free flowing dry granular product, produced from cassava [1]. It is also creamy white, granular flour with a slightly sour taste made from fermented gelatinized fresh cassava tubers. It is the most popular fermented food product made from cassava (*Manihot esculenta crantz*) and is widely consumed when processed by millions of people in West Africa where it forms a significant part of their diet [1]. Garri is a convenience food with a short preparation time [2].

It is consumed principally as a main meal (eba) or taken as a snack when soaked in cold water, sweetened with sugar and consumed with roasted groundnut, coconut and sometimes dry fish [3,4].

The major factor that limits the use of cassava as food is the toxicity of hydrogen cyanide (HCN). Therefore the presence of cyanogens in the cassava varieties used for processing garri in Nigeria, when not properly processed it makes the product unsafe for consumption. In Nigeria, the sale and distribution of garri in local markets is associated with practices such as display of product in open buckets, bowls and mats at point of sale and the use of bare hands during handling and sales. These unhygienic practices may lead to microbial contamination due to deposition of bioaerosols on exposed products, transfer of microbes from dirty hands and utensils.

Microorganisms can cause deterioration in food quality, spoilage and serious food borne illness. The main agents that contaminate and spoil garri are moulds, insect and mites [5]. Mould growth has been associated with garri during storage and distribution. Such growths result in changes in organoleptic, microbiological and nutritive quality of garri and can lead to spoilage [6,7].

Some students in Akanu Ibiam Federal Polytechnic Unwana in Afikpo North L.G.A mostly the hostel dwellers complain of stomach pain after the consumption (drinking/soaking) of garri popularly known as CASSA. Hence the need to carry out this study on the microbial, cyanide and moisture content of different garri samples sold within Afikpo markets to determine the safety since these factors can in one way or the other affect the microbial load, safety and spoilage of garri.

2. MATERIALS AND METHODS

2.1 Sample Preparation

Three different samples of garri were bought from markets in three villages (Enohia, Amasiri and Okposi) known for large scale Garri production in Afikpo North L.G.A of Ebonyi State. Three samples were taken from each location and a composite samples formed. These composite samples which were labeled A, B, C were taken to the microbiology laboratory of Science Laboratory Technology Department in Akanu Ibiam Federal Polytechnic, Unwana for microbial analysis while some were transported to Food Science and Technology Laboratory, Ebonyi State University where the cyanide and moisture content analysis were carried out.

2.2 Microbial Analysis

The colony –forming unit (cfu/g) of the garri samples was determined by pour plate method [8]. Also the method described by Monica [8] was adopted for bacterial identification.

2.3 Cyanide, Moisture Content

The recommended methods of the association of official analytical chemists [9] was adopted for moisture content determination while the cyanide content was determined by the method described by Knowles and Wattins [10].

2.4 Statistical Analysis

The SPSS version 16 was used for the statistical analysis. This involved analysis of variance (ANOVA) and means separation by Duncan multiple range test was used to determine significant differences at 5% probability level.

3. RESULTS

The microbial counts of the garri samples are shown in Table 1. The total bacterial counts ranged from (7.93×10^5 cfu/g) for sample A, (2.63×10^5 cfu/g) for B and (1.60×10^5 cfu/g) for sample C. It was observed that sample A (7.93^a) had the highest bacterial load. On the other hand, there was no significant difference at ($p < 0.05$) between samples B and C. Moreover, the fungal counts showed significant differences at ($p<0.05$) between samples A, B, and C with sample A having the highest fungal count of ($1.60^a \times 10^5$ cfu/g) and sample C the lowest fungal count of ($0.23c \times 10^5$ cfu/g).

The bacteria isolated from the garri samples are shown in Table 2. While the fungi isolated are shown in Table 3.

The bacteria isolated from the garri samples were *Staphylococcus* spp, *Streptococcus* spp and *Escherichia coli*. While the fungi isolated include *Aspergillus* spp and *Pericillium* spp.

Table 1. Microbial load of garri samples

Samples	Total bacteria count (x 10^5 cfu/g)	Total fugal counts x 10^5cfu/g
A	7.93a	1.60^a
B	2.63b	0.83^b
C	1.60b	0.23^c

Mean scores with the same superscript on the same column are significantly not different (p<0.05)

Table 2. Bacteria isolated from garri samples

	Samples		
Bacteria	**A**	**B**	**C**
Staphylococcus spp	+	+	+
Streptococcus spp	+	+	-
Escherichia coli	+	-	-

+ = presence; - = absence

Table 3. Fungi isolated from garri samples

	Samples		
Fungi	**A**	**B**	**C**
Aspergillus spp	+	+	+
Penicillium	+	+	-

+ = Presence: - = absence

4. DISCUSSION

The microbiological quality of any food determines the microbial safety. From this study it was shown that sample A had the highest bacterial and fungal counts (7.93 and 1.60 x 10^5 cfu/g). Sample C had the lowest bacterial and fungal counts of 1.60 and 0.23 x10^5 cfu/g. The result was within the acceptable safe limit of $\leq$ log 10^5 cfu/g [11]. It was also revealed from the result that samples B and C were not contaminated with food pathogens but contained opportunistic microorganisms. Thus the absence of *E. coil* and other serious food borne pathogens in samples A and C makes the food safe for human consumption.

Sample A contained *E. coil* which is an indicator for microbiological quality of water and food. Its presence in food indicates fecal contamination and such food is not safe for human consumption. Isolation of *Aspergillus spp*, in samples A and B may lead to poisoning since many of the fungi are toxin producing organisms.

The isolation of fungi such as *Aspergillus* spp, Penicillium as well as bacteria such as staphylococcus and streptococcus is similar to the reports of Adeniyi [6,5,12] who isolated these organisms from garri samples in their different research.

Garri temperature is capable of eliminating the microorganisms which may have been present yet the microbial growths observed could be due to possible contamination during handling and storage which may involve unclean utensils, poor handling and exposure to open market. Staphylococcus presence may be due to contamination from the skin, nose or mouth of the garri handlers after processing. The cyanide content which was 0.69, in sample A; 0.75 in B and 0.63 in C where lower than the 2 – 3 mg/HCN/100 g regarded as an acceptable level of cyanide in garri.

IITA [13], the garri samples are safe from cyanogenic intoxication. The moisture content of garri indicates the level of processing (dewatering and garrifying) as well as the shelf stability. Samples A and B have moisture content of 16% and 14% thus higher than the 12-13% moisture level recommended by Okpugo et al. [14] for locally processed good quality garri. Frazier and Westhoff [15] stated that the growth of microorganisms occur when the moisture content is > 13%. Hence high microbial load observed in samples A and B could be due to the high moisture content. The moisture content of the garri samples are higher than the safe level for storage <12% recommended for good quality garri NSPRI [16]. The garri samples may not be good for storage and thus should be consumed within short period to avoid lumpness and mouldiness.

5. CONCLUSION

Garri samples A and C contained microbial contaminants but no food borne pathogens. Therefore both are good for consumption. Sample A contains a food borne pathogen (*E. coli*) this makes the garri unsafe especially for drinking. The low cyanide contents observed indicates the suitability of the samples for consumption. Adequate processing (dewatering and garrifying) and handling should be carried

out to reduce the level of moisture content thereby reducing the microbial load and increasing storage time. Garri should be properly stored to avoid absorbing moisture.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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