

Cyanide Content of Commercial Gari from Different Areas of Ekiti State, Nigeria

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Abstract Gari, a creamy-white granular flour made from fresh cassava tubers have been known to contain residual cyanide (hydrocyanic acid) after processing. Cyanide is poisonous and ingestion of Gari beyond the permissible limit can lead to chronic toxicity. This study therefore investigated the presence of this chemical in Gari samples taken from different areas of Ekiti State in Nigeria to ascertain whether or not they are below the permissible level. Random samples of commercial Gari processed locally were collected from 6 areas of Ekiti State in South West Nigeria and screened for residual cyanide content. The alkaline picrate method was used for the screening. Four of the samples contained cyanide in the range of 2.10-9.10 mgHCN/kg which falls below the permissible limit while the remaining two samples had higher residual cyanide of 11.78 and 15.30mgHCN/kg which is above the permissible limit. WHO permissible limit of cyanide concentration is 10.0mgHCN/kg. The samples with concentration above 10mgHCN/kg are from areas where the cassava mash was fermented for less than 12 hours.

Keywords: Gari, cyanide, permissible limit, alkaline picrate method

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1. Introduction

Cassava (*Manihot esculenta crantz*) is a staple food that matches the population growth in Nigeria (Cock, 1985). Nigeria cassava production is by far the largest in the world, a third more than production in Brazil and almost double the production in Indonesia and Thailand (FAO, 2006). The fresh tubers are highly perishable and cannot be kept in the fresh condition for more than a few days after harvest without serious deterioration in quality (Leaky and Wills, 1977). In order to extend the shelf life of the tubers, cassava is processed into dried products in a variety of ways in different parts of the world to meet the local needs, taste and tradition for use and storage (Onwueme, 1978). Of all these, the main form in which cassava is eaten in West Africa is a roasted granular product prepared from peeled, grated and fermented cassava tubers known as Gari (Asiedu, 1989). The cassava tubers can also be processed into wet chips, cassava noodles (abacha), cassava flour, and fufu (akpu) (NRCRI, 1987). The use of cassava as food is limited by its perishability, low protein content and potential toxicity. Some processing methods have therefore been devised to reduce their toxicity and at the same time convert the highly perishable tubers to more stable products. These processes include sun drying, soaking and fermentation followed by drying or roasting (Cooke and Coursey, 1981). The poisonous chemical substance present in high concentration in raw cassava tuber is hydrocyanic acid

(HCN) or simply called cyanide. HCN is obtained from the hydrolysis of the two cyanogenic glucosides, linamarin and lotaustralin present in cassava tuber (Coursey, 1973; Conn, E.E. (1969)). The raw cassava can contain about 130-200mg HCN/kg (Akinrele et al., 1962). The cyanogenic glucosides can be hydrolysed to hydrocyanic acid by the endogenous enzyme linamarase when the plant tissues are damaged during harvesting or processing (Cock, 1985). Fermentation process has been known to enhance detoxification of cassava through the liberation of hydrocyanic acid. Apart from detoxification, this process also leads to development of flavor and also contributes to the keeping quality of the final product (Vasconcelos et al., 1990; Nambisan, 2011 and Lambri et al., 2013). There have been occasional reports of death, several abdominal upsets and other discomforts following the consumption of gari in some communities. This is due to the fact that there is increasing demand for gari and this makes some commercial centers to process in a hurry without allowing for sufficient fermentation to cause appreciable cyanide reduction. It is in view of the foregoing that random sampling of gari from different areas of a cassava producing state in Nigeria was carried out and residual cyanide present in the samples were determined.

2. Materials and Methods

2.1. Sampling

Commercial Gari samples were randomly collected in triplicate from six communities in Ekiti State. The areas are: Ilawe, Emure, Igbara-Odo, Ado-Ekiti, Egbira and Igbo. Samples of about 100g were put in tightly sealed envelopes and kept in field cellophane bags prior to analysis.

2.2. Extraction of Cyanide Sample

Five grammes of each sample was weighed using weighing balance into a conical flask and 50ml of distilled water was added and corked. This was allowed to stay overnight and then filtered. The extract was used for cyanide determination.

2.3. Preparation of Alkaline Picrate Solution

Twenty five grammes of anhydrous sodium carbonate and 5g of anhydrous picric acid were added to a 1- litre volumetric flask. The mixture was dissolved in a minimal amount of warm distilled water and the solution was made up to the mark with cold distilled water. The alkaline picrate method as described by Ikediobi et al., 1980 and Olugboji, 1987 was used.

2.4. Construction of a Standard Curve for Cyanide Assay using Alkaline Picrate Method

A sample of potassium cyanide to be used as standard was first dried in the oven to constant weight. A stock solution was prepared by dissolving 8mg of this salt in 100ml of distilled water. This gives a concentration of $32\mu\text{g CN}^{-1}/\text{ml}$. From this stock solution, a series of 10ml-plastic stoppered test tubes containing from 3.2-64 μg of cyanide was set up. The volume of each was made up to 2ml with distilled water and 4ml of alkaline picrate added and mixed. The resulting solution was incubated in a water bath at 95°C for 5 minutes. Upon cooling to room temperature, the absorbance at 490nm of the deep orange color formed was read in a spectrophotometer. The absorbance at 490nm was plotted against cyanide concentration.

2.5. Quantitation of Residual Cyanide in Gari Samples

To 2 ml of the sample extract in a corked test tube, 4ml of alkaline picrate solution was added. It was incubated in a water bath at 95°C for 5 minutes. Upon cooling to room temperature, the absorbance of the orange-red color solution formed was read in a spectrophotometer at 490nm. The cyanide concentration was extrapolated from a standard curve previously prepared with potassium cyanide as standard.

3. Results and Discussion

The cyanide contents of gari obtained from some key gari producing communities namely; Igbo, Igbara-Odo, Ilawe, Emure, Ado-Ekiti and Egbira are 2.10 ± 1.01 , 4.90 ± 1.24 , 7.30 ± 1.80 , 9.10 ± 1.64 , 11.78 ± 2.02 , $15.3\pm 3.10\text{mg HCN/kg}$ respectively and are as shown in Table 1. In Igbo, Igbara-Odo, Ilawe and Emure, virtually all samples contained less than 10mgHCN/kg , the permissible level by WHO while

the samples from Egbira and Ado-Ekiti contained higher levels (FAO/WHO, 1999). The levels of residual cyanide in gari were of the order:

Egbira>Ado-Ekiti>Emure>Ilawe>Igbara-Odo>Igbo.

In the communities with low residual cyanide, fermentation generally tended to go on for 2-3 days apparently due to their preference for gari with a sour taste (usually due to long fermentation). This practice and sun drying are generally believed to lead to substantial decrease in residual cyanide. The Igbo community used to add palm oil to their gari and this may explain the reason why they contain the least quantity of cyanide. The samples with concentration above 10mgHCN/kg are from areas where the cassava mash was fermented for less than 12 hours: Egbira and Ado-Ekiti communities. Antinutritional factors like Hydrocyanic acid have been known to have negative effect on health. 200mg of HCN is the lethal dose for an adult human and an atmosphere containing 200ppm will result in death within a few minutes (Conn, 1969). Hydrocyanic acid is an effective inhibitor of many metalloenzymes, but cytochrome oxidase, the terminal oxidase of aerobic organisms is the principal site of action; cyanide poisoning therefore result in death due to oxygen starvation at the cellular level (Conn, 1969). Acute toxicity in humans usually terminates in the death of the victim while chronic toxicity has been associated with goiter and tropical ataxic neuropathy (Ekpechi, 1967; Delauge, 1976; Osuntokun, 1973).

Table 1. Cyanide concentration of gari samples from six areas of Ekiti State

Community	HCN (mg/kg)
Igbo	2.10 ± 1.01
Igbara-Odo	4.90 ± 1.24
Ilawe	7.30 ± 1.80
Emure	9.10 ± 1.64
Ado-ekiti	11.78 ± 2.02
Egbira	15.30 ± 3.10

Mean of triplicate determinations \pm std. deviation.

4. Conclusion

To reduce antinutritional factors in foods, food processing is being carried out. About 70% of gari samples screened contained tolerable levels of cyanide. These samples were found to have been fermented for 2-3 days prior to frying. Vasconcelos et al., 1990, Nambisan, 2011 and Lambri et al., 2013 have opined that the fermentation process is a key detoxification stage in gari production. The remaining 30% have values above 10mgHCN/kg which is the permissible limit by WHO. The result of this research study needs to be communicated to extension workers for onward transmission to the communities that are fond of fermenting cassava for less than two days to desist from the act so as to prevent chronic toxicity resulting from gari consumption in their locality.

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