

Research Article

Assessment of cyanide content in white, light yellow and deep yellow Garri flour produced from CASSAVA (*Manihot esculenta Crantz*) in four L.G.A of Abia State, Nigeria

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Abstract

The Cyanide content in white, light yellow and deep yellow Garri in four Local Government Areas of Abia State, Nigeria was investigated using alkaline picrate method. The result showed that, In Bende L.G.A, the cyanide level was 31.51 ± 0.09 mg/kg in white Garri, 25.24 ± 0.06 mg/kg and 17.40 ± 0.1 mg/kg in light yellow Garri and deep yellow Garri respectively. In Ohafia L.G.A, 32.92 ± 0.14 mg/kg, 20.86 ± 0.09 mg/kg and 15.83 ± 0.05 mg/kg in white Garri, light yellow garri and deep yellow Garri respectively. In Umuahia North and Isiala Ngwa North L.G.A the cyanide content in white, light yellow and deep yellow Garri showed cyanide level of 38.83 ± 0.15 mg/kg, 19.42 ± 0.03 mg/kg, 19.41 ± 0.17 mg/kg and 31.06 ± 0.20 mg/kg, 24.14 ± 0.36 mg/kg, 19.48 ± 0.20 mg/kg respectively. The results were compared to the maximum value of 50mg/kg authorized by the World Health Organization (WHO). This reduction of cyanide in the final products of cassava varies with the type of processing techniques used and the volume of palm oil added together with the environmental factors such as temperature, humidity and age of the cassava.

Keywords: White Garri, Light yellow Garri, Deep yellow Garri, Picrate method and Cassava

INTRODUCTION

Cassava (*Manihot esculenta Crantz*) is an extensively cultivated tuber crop and a staple food for millions of people in the tropical regions of Africa, Latin America and Asia. It is a dicotyledonous plant and widely grown root crop in this part of the world. Two varieties of cassava are known; the sweet cassava known for low cyanide content and the bitter cassava with its high characteristic content of cyanogenic glycosides (CGs) that is highly toxic when consumed (Ihenkoronye and Ngoddy, 1985). Globally, in terms of annual production, it is the fifth most important food crop after maize, rice, wheat and potato (Jonathan *et al.*, 2013). While starchy tuberous roots are the main food source, the young leaves, which are high in protein, are also consumed, particularly in Africa (Sekhon *et al.*, 1996; Tewe and Iyayi, 1989).

Garri is a granular starchy food prepared from cassava mash in a manner similar to Farinha de Mandioc. The cassava meal is in the form of paste made with hot water ("eba") is eaten with vegetable sauce or soaked in cold water with sugar, coconut, roasted groundnuts, dry fish or boiled cowpea as complements. The characteristic taste and flavor of Garri is mainly from its lactic acid content produced during fermentation (Amoa-Awua *et al.*, 1996). 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 four (4) days. The fermented and relatively dewatered pulp was sieved to remove fibrous materials and palm oil could be added according to preference. 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 (Orakpo, 2013).

The FAO estimates that 25% of the world food crops are contaminated by mycotoxin, of which the most notorious are the aflatoxins (AFTs). AFTs are metabolites produced primarily by the fungi *Aspergillus flavus* and *Aspergillus parasiticus*. There are four major naturally produced AFTs, referred to as B1, B2, G1 and G2. The B1 is the most toxic of the AFTs and potent naturally occurring liver carcinogen. Reports estimated that more than five (5) billion people in developing countries world-wide are at risk of chronic exposure to AFTs through contaminated foods (FAO, 2001). AFTs affect livestock and poultry causing reduced feed efficiency, subtle immunosuppression, growth rate and death of animals (Bryden, 2011). Other economic adverse effects of AFTs include low yields of food and fiber crops. Cassava contains two cyanogenic glucosides, linamarin and a small amount of lotaustralin, which are catalytically hydrolyzed to release toxic hydrogen cyanide (HCN) when the plant tissue is crushed (Balagopalan, 1988; Cardoso *et al.*, 2005). Several varieties of processed cassava have been identified and grouped into white, light yellow and deep yellow Garri. The consumption of cassava and its derived products which contain large amounts of HCN may be responsible for such visible manifestations as goiter and cretinism, tropical ataxic neuropathy (Gueye, 2008; Konzo and Osuntokun, 1994).

In some countries such as Cote d'Ivoire, Benin and Nigeria, people have quickly recognized the need to transform cassava into derived products (Cossettes, Chikwangu, Fufu, Gari, Attieke and Tapioca (Amani *et al.*, 2007 and Bokanga, 2001) whose gain is usually higher than the fresh roots. The processing methods used traditionally are sun drying, frying, soaking and fermentation followed by cooking. These processing methods could lead to reduced cyanide content in cassava products (Akintonwa *et al.*, 1994) to improve its palatability and convert it into a storable form. It is worth indicating that, in Nigeria, the level of cassava consumption is very high. In this country, it is generally consumed as major food in the daily meals of households (Diouf, 2006). This study therefore aimed at evaluating the cyanide content of three varieties of cassava product (white, light yellow and deep yellow Garri) from four local government areas of Abia State, Nigeria.

MATERIALS AND METHODS

Sample collection

Cassava samples used for this research work were obtained (harvested) from Umuhu Ezechi in Bende L.G.A, Ohokobe in Umuahia North, Abriba in Ohafia L.G.A and Osusu in Isiala Ngwa North L.G.A all in Abia State, Nigeria.

Sample preparation

The cassava roots (tubers) were peeled manually and washed in clean water and was grounded with engine powered grating machine made for that purpose. The mashed cassava pulp was divided into three portions (A, B and C); two portion was mixed with palm oil, 25ml in 2kg of cassava mash, B portion 50ml in 2kg of cassava mash and C portion was not mixed with oil. They were separately packed into three different jute bags and dewatered using locally fabricated mechanical press. Pressure was applied to remove the unwanted liquid from the mashed cassava pulp by tightening two big nuts fitted to the pressing machine, the cassava pulp in each case was fermented for 48hrs (2days) at ambient conditions with occasional application of pressure to squeeze out unwanted liquid. Some quality of the fermented cassava pulp was taken sieved and subsequently roasted (60-82°C) in a circular frying pan (diameter 70 cm). Sample A yielded light yellow Garri, sample B deep yellow and sample C yield white Garri.

REAGENT PREPARATION

Alkaline picrate paper/ solution

The alkaline picrate paper was prepared by soaking strips of absorbant filter paper in alkaline picrate solution. 5.0g of picric acid powder and 25g of anhydrous sodium carbonate were dissolved in distilled water and made up to liter. The prepared solution was labeled and stored in amber colour reagent bottle.

Standard cyanide solution (HCN)

2.5g of KCN crystals was dissolved in distilled water and made up to 100ml in a volumetric flask to obtain stock solution, aliquots were taken to prepare working solutions as the need arose 0.5 of stock solution was diluted to 100ml in distilled water to obtain 0.05mg/ml KCN solution used as standard.

METHOD OF ANALYSIS

The alkaline picric acid colorimetric method (Onwuka, 2005) was used. 1g of each test sample was dispersed in 150ml of freshly distilled water and mixed very well. A moist strip of alkaline picric acid paper was hung over the mixture in a conical flask and held in place with a rubber bung which was used as a stopper for the flask. Care was taken to ensure that the picric acid paper did not touch the surface of the mixture. The set up was allowed to incubate at room temperature for eighteen (18) hours (over night). After that, the picric acid paper was carefully brought out and at the edge where the stopper held it (i.e. to collect only the portion inside the flask). It was eluted in 60ml of distilled water. The eluted was used for colorimetric analysis.

The picric acid paper was also accordingly eluted in 60ml of distilled water like the samples. The absorbance of the elutes were determined with a spectrophotometer at a wavelength of 540nm.

Statistical analysis

Data was subjected to analysis of variance using the Statistical Package for Social Sciences (SPSS), version 15.0.

RESULTS

Table 1. The Hydrogen Cyanide Contents of White, Light Yellow and Deep Yellow Garri in Four Different L.G.A in Abia State Nigeria

L.G.A	WHITE (mg/kg)	LIGHT YELLOW (mg/kg)	DEEP YELLOW (mg/kg)
Bende	31.51±0.09	25.24±0.06	17.64±0.1
Isiala Ngwa	31.06±0.20	24.14±0.36	19.48±0.20
Umuahia	38.83±0.15	19.43±0.03	15.42±0.17
Ohafia	32.92±0.14	20.86±0.09	15.83±0.05

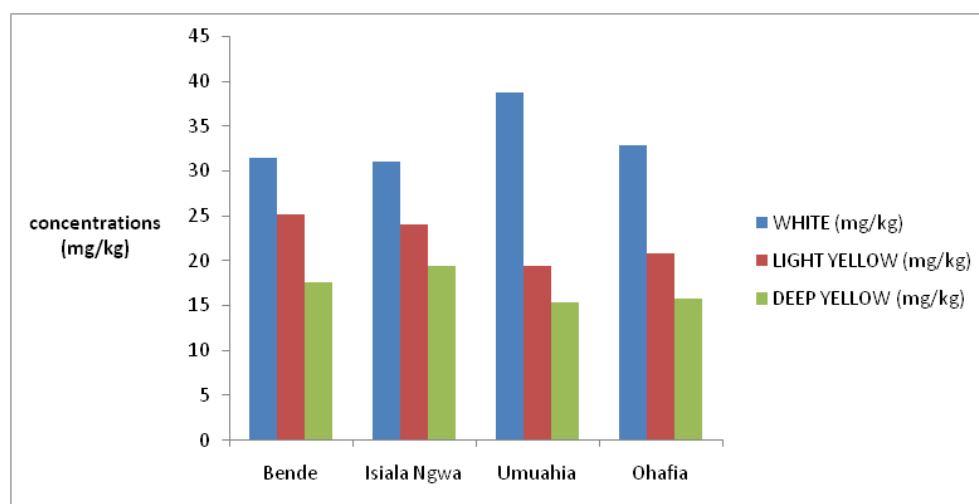


Figure 1. The Hydrogen Cyanide Contents of White, Light Yellow and Deep Yellow Garri in Four Different L.G.A in Abia State Nigeria

DISCUSSION

Several authors have reported the toxicity caused by consuming improperly processed cassava products with respect to hydrocyanic acid. Acute toxicity of cyanohydrin causes calcific pancreatitis, apnoea and cardiac arrest with death following in a matter of minutes. While chronic toxicity could result in weakness and a variety of symptoms including permanent paralysis, goiter, with tropical ataxic neuropathy. In the present study the percentage reduction in cyanide with respect to different processing methods showed that the Cyanide content varies with respect to their varieties (sources), and methods of processing. The result showed that the addition of red oil to the Garri sample greatly reduced the cyanide content. These can be attested to the report of Emoyan *et al.* (2012) who stated that there is a proportional reduction of residual hydrocyanic acid in both red and white Garri samples from 0 to 96 hours of processing. The rate of

hydrolysis of cyanogenic glucoside in cassava to produce the poisonous hydrogen cyanide was due to palm oil in Garri. However, the low level of cyanide in palm oil Garri flour could be related to the sequestration of CN⁻ by palm oil components into a complex and therefore unavailable for quantitative measurement. This could be responsible for the low concentration of hydrocyanic acid in the red Garri flour. Cyanide is liberated when cyanogenic glycosides are hydrolysed.

It was observed that deep yellow Garri showed the lowest cyanide concentration compared to the other products. This is because of the presence of palm oil which greatly reduces cyanide. Cardoso *et al.* (1998) reported that palm oil delays the decomposition of the cyanogenic glycosides. The result showed that the Garri from Umuahia had the highest cyanide content. However, Paul and Okey (2013) noted that the basis for the disparity in cyanide content was the difference in ecological factors and soil chemistry in the various regions. Furthermore, they observed that key components of soil such as potassium, calcium and magnesium adversely affected the biosynthesis and translocation of cyanide to storage organs, which invariably contributed to inconsistencies in cyanide content in the plant tissues harvested from the various regions. The concentration of hydrocyanic acid and the percentage of hydrocyanic acid lost to multistage processing showed that fermentation and increase in fermentation time is responsible for the proportionate removal of hydrocyanic acid from red Garri flour. Secondly, the combination of grating, dewatering, fermentation and frying processing methods contributed substantially to the removal of hydrocyanic acid from the test samples.

CONCLUSION

This study revealed that the total cyanide contents in white Garri were higher than light yellow and deep yellow Garri and these cyanide contents varied in cassava varieties from Nigeria. We established that the methods of cassava processing were able to reduce total cyanide contents in processed cassava. Moreover, Gari and cassava flour prepared from palm oil varieties showed the residual cyanide content below the level of 15 mg HCN/kg that is considered safe by the WHO. These results may be used on a household and cottage-industry to ensure food safety.

COMPETING INTEREST

Authors have declared that no competing interests exist

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