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Toxicity Assessment of Residual Cyanide in Some Commercial Cassava Processed Products in Abraka, Delta State, Nigeria

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Abstract

Cassava is a plant that is mainly propagated for food. For the diverse majority of Nigerians, it is a very cheap source of carbohydrate. However, due to its high cyanide content, cassava first has to be processed to remove most of the toxic cyanide before it can be consumed. Depending on the effectiveness of the processing method employed, residual cyanide may persist in the finished product which may pose safety concerns. In this study, the concentration of residual cyanide in five selected samples of cassava processed products (Garri, Akpu, Abacha, Starch and Tapioca) sold at Abraka in Ethiope East Local Government Area of Delta State was determined to ascertain their safety. The concentrations obtained ranged from 0.00 mg/kg to 7.40 mg/kg. A sample of garri recorded a concentration of 4.60mg/kg, while akpu, abacha, starch and tapioca recorded cyanide concentrations of 3.20mg/kg, 7.40 mg/kg, 0.00mg/kg and 0.50 mg/kg respectfully. The concentrations of the cyanides recorded from the processed cassava products analyzed were below the recommended limit of 10mg/kg showing that the processed cassava products analyzed in this study were safe for consumption.

Keywords: Cassava, cyanogenic glycosides, cyanide, concentration, toxicity

INTRODUCTION

Cassava (Manihot esculenta.) is a food crop that is mainly propagated in the tropical parts of the world for dietary consumption and for industrial use [1,2]. As a main food for majority of the masses, cassava is cultivated in both subsistent and commercial practices by most farmers in Nigeria. This is because, it grows all year round and can also thrive in most soil types as long as there is availability of soil nutrients needed for its propagation. The crop is resilient and can withstand several tropical plant diseases, making it easier to be handled by farmers. After maturity, the tubers can also remain underground without spoilage until when the farmer is ready to harvest [3]. Despite the success of cassava as a food crop, the presence of cyanogenic glycosides in it renders it toxic to man if not properly processed. The cyanogenic glycosides are a group of nitrile-containing compounds that give out toxic cyanide during enzymatic metabolism in plants. Apart from cassava, cyanogenic glycosides are also found in some seeds of fruits such as apple, which are often consumed [4, 5]. Although various processing methods can reduce the cyanide content in food, improperly processed cassava products would contain some amount of residual hydrogen cyanide. This can result in the potential toxicity of the cassava products when consumed. Some cases of cyanide toxicity from the consumption of inadequately processed cassava products include, goiter, cretinism, growth retardation and outright poisoning [6, 7].

The objective of this research was to determine the concentration of residual cyanide in selected cassava processed products sold in Abraka market with a view of ascertaining their safety. This was done by analyzing selected samples of processed cassava products using a UV Spectrophotometer.

MATERIALS AND METHODS

Chemicals used for the analysis include: Potassium Cyanide stock solution, KCN, Sodium Hydroxide, NaOH and Ninhydrin (2,2-dihydroxyindane-1,3-dione) solution, $C_9H_6O_4$. All chemicals were of analytical grade from Sigma Aldrich.

Collection of Samples and Preparation

All processed cassava products (garri, akpu, abacha, starch and tapioca) were bought without further processing at Abraka main market in Ethiope East Local Government Area of Delta State.

10g of each homogenized sample (garri, akpu, abacha, starch and tapioca) was mixed with 50 ml of water in a corked conical flask and allowed to stand for 24 hours to extract any residual cyanide left in the samples. The mixture was subsequently filtered to obtain the soluble extract containing cyanide which was then analyzed.

Preparation of Working Solutions from Standard Potassium Cyanide Stock Solution

Standard working solutions of KCN with concentrations of 0.5, 2.5, 5.0, 7.5 and 10 mg/L were prepared from the stock solution of KCN by diluting with 2M NaOH to the corresponding volumes. Distilled water was used for the blank. Thereafter, 0.5 mL of ninhydrin solution was further added to each of the standard cyanide solution prepared including the blank. The mixture was homogenized and left to stand for 15 minutes [8].

Standard Calibration Curve of Working Solutions

The absorbance of the standard working solutions of cyanide was measured using the UV-Spectrophotometer (Hach Spectrophotometer DR 6000). The absorbance was taken at a wavelength of 485nm [8]. A calibration curve of the absorbance against the concentrations of working solutions was obtained.

Determination of Cyanide Concentrations in Processed Product Samples

The absorbance of cyanide in each processed cassava product was measured using the UV-Spectrophotometer and recorded at a wavelength of 485nm for all samples. Using the absorbance obtained, the concentrations of Cyanide in the product samples were deduced from the calibration curve of the standard working solutions of potassium cyanide that was first obtained [8].

RESULTS AND DISCUSSION

Table 1. Concentrations of Cyanide in Processed Cassava Products

Samples	Conc. of Cyanide (mg/kg)
Garri	4.60
Akpu	3.20
Abacha	7.40
Starch	0.00
Tapioca	0.50

The concentrations of residual cyanide in the processed cassava products are given in Table 1. The concentrations ranged from 0.00 mg/kg to 7.40 mg/kg. Garri recorded a concentration of 4.60 mg/kg, while akpu, abacha, starch and tapioca recorded cyanide concentrations of 3.20 mg/kg, 7.40 mg/kg, 0.00 mg/kg and 0.50 mg/kg respectfully. The 0.00 mg/kg recorded for starch showed that starch extracted from cassava contains no cyanide. The process of starch extraction results in complete hydrolysis of cyanogenic glucosides and cyanohydrins [9, 10].

A low cyanide concentration was also recorded for tapioca (0.50 mg/kg). Tapioca is typically made from the solid residues sieved out during starch production. It contains only fibers since it had been thoroughly washed and drained of almost all the starch, sun dried or placed close to a heat source to remove all water content [10, 11].

Abacha recorded the highest residual cyanide content of 7.40mg/kg (although still below the limit for safe consumption) The processing method can only reduce cyanide to as much as 80% [12].

The concentrations of cyanide recorded in the samples were due to the effect of various processing methods on the cassava. The fresh unprocessed cassava has high cyanide content that is potentially toxic to man when consumed [4]. Cyanide in cassava is usually found as the glucosides, cyanohydrins, and free cyanide. Each of the three forms exhibit different toxicity and reacts differently to processing techniques that can remove cyanide [4, 13]. Thus, it is very important to put into consideration the proportion of each cyanide form in the processed cassava. There are several processing methods available for cassava treatment. Depending on the nature and duration of the processing methods, the residual level of cyanides in cassava products will differ. Some of the processing methods used, such as peeling, drying, grinding, drying, frying. soaking, boiling, and fermentation have been reported by several

studies to cause significant reduction in the cyanide content of processed foods. [14].

The concentrations of the cyanides recorded from the samples were all below the recommended limit of 10mg/kg. Above this limit, cyanide becomes toxic to man leading to several health implications [15]. For cassava to be consumed safely, it first has to be processed to eliminate significantly most of the cyanide. Several methods are used in the processing of cassava to reduce the cyanide content [4, 16].

CONCLUSION

The concentrations of the cyanides recorded from the processed cassava products analyzed were all below the recommended limit of 10mg/kg [16]. This showed that the various cassava processing methods adopted were effective in cyanide removal. It also showed that the processed cassava products analyzed in this study were safe for consumption. Apart from cassava, cyanogenic glycosides are also found in some seeds of fruits such as apple, which are often consumed. Further works will look into processed juice extracts of these fruits to examine the cyanide concentration present.

CONFLICT OF INTEREST

Authors declared no conflict of interest.

FUNDING

There was no funding received for this work.

ETHICAL STATEMENT

This work required no ethical statement.

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