World Journal of Medical Sciences 13 (3): 204-207, 2016
ISSN 1817-3055

DOI: 10.5829/idosi.wjms.2016.204.207

Comparative Assay of Cyanide Content in Cassava from Selected Parts of Imo State, Nigeria

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Abstract: A comparative study was carried out on the level of cyanide in cassava selected from different parts of Imo State Nigeria. Samples were collected from four different locations in Imo State namely Ihiagwu in Owerri West, Logra in Ngor-Okpala, Izombe in Uguta and Ezimoha in Isiala Mba-ano Local Government Areas of Imo State. The levels of hydrogen cyanide were determined by using the alkaline picrate solution by Balagopalan Spectrophotomeric method. The results obtained showed the cyanide content of the test samples ranged from 1.0 ± 0.01ppm to 2.5 ± 0.02 ppm. The highest level of cyanide was found in sample C4 representing cassava from Ezimoha in Isiala Mba-ano, while the lowest was observed in sample C1 representing Ihiagwa in Owerri West, both in Imo State Nigeria. Based on the results, the cyanide level of the investigated cassava products falls within the acceptable limits of 10 mg HCN equivalent/Kg dry weight recommended by FAO for safe cassava products. This means that cassava products do not pose any health risk to the consumers of these products.

Key words: Cassava root · Cyanide · Fermentation · Picrate method and Imo State

INTRODUCTION

No continent in the world depends so much on cassava *(Manihot esculenta)* in feeding its population as does Africa. Since the introduction of cassava by Portuguese traders from Brazil in the 16th century, the crop has become the continent's most important staple food which is often referred as the 'bread of the tropics' [1]. With the exception of sugar cane, cassava plant gives the highest yield of carbohydrates per cultivated area [2]. Cassava is a major source of carbohydrates and its success as a staple in developing countries is as a result of its ability to do well on poor agronomic soils and with low rainfall and most importantly as a perennial crop, it can be harvested whenever it is required round the year [3]. Although cassava roots are poor protein but they are very rich in starch and contain significant amounts of calcium (50 mg/l00g), phosphorus (40 mg/l00g) and vitamin C (25 mg/l00g). On the other hand, cassava leaves are a good source of protein, but lack the amino acid lysine and methionine [4, 5]. Aside serving as staple for human, cassava is used for production of renewable biofuel, animal feed and ethnomedicine [6, 7]. An estimated 70 million people obtain more than 500 cal/day from cassava in Africa, Asia and South America where at present is considered as a staple food. Cassava can be utilized in many ways as food such as *abacha* (tapioca) prepared by drying flakes of cassava; *fufu* made from the starchy cassava-root flour; *eba* prepared with hot water; *gari* soaked in water with sugar as a delicacy and *fried cassava* (after boiling or steaming) which gives distinctive flavour.

Cassava contains some substances such as cyanogenic glucosides, linamarin and lotaustralin some of which are lethal when cassava is consumed poorly processed or raw [7, 8]. The enzymatic breakdown of the glucosides releases hydrogen cyanide which is known to be toxic to human health. Therefore the importance of fermentation in cassava processing is based on its ability to reduce the cyanogenic glucosides to relatively insignificant levels. Fermentation is the slow decomposition by micro organisms of large organic molecules such as starch into smaller molecules. The hydrogen cyanide is liberated during fermentation through the spontaneous hydrolysis of the cyanogenic glucosides especially at low pH. For effectiveness, soaking should take from 3 to 5 days [9,10]. It is very important because it detoxifies the cyanide in cassava.

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Brief soaking (4 hours) of cassava is not sufficient, but soaking for 18-24 hours can remove up to half the level of cyanide [11]. Drying may not be sufficient, either. For some smaller-rooted sweet varieties, cooking is sufficient to eliminate all toxicity. The cyanide is carried away in the processing water and the amounts produced in domestic consumption are too small to have environmental impact [12-15].

Hence the longer fermentation process, the lower the residual cyanide content [16]. Various traditional steps such as peeling, grating, processing, fermenting, sifting and roasting are used to process cassava based on the products expected. Some of these steps reduce cyanide more effective than others. Roots and leaves of cassava are to supposed to be eaten raw as they two major cyanogenic glucosides namely linamarin and lotaustralin. When they are decomposed by linamarase, hydrogen cyanide $(HCN)_6$ is released. Cassava varieties often categorized as either sweet or bitter, signifying the absence, presence or toxic level of cyanogenic glucosides [17]. Cyanides are produced by certain bacterials, fungi and algae and are found in a number of foods and plants. Many cyanide-containing compounds are highly toxic, such as nitriles, hexacyanoferrates (ferrocyanide and ferricyanide, but the most dangerous cyanides include hydrogen cyanide and salts derived from it, such as potassium and sodium cyanides. The cyanide ion is an inhibitor of the enzyme hence cassava must be processed into various forms to reduce cyanide content because in so doing the hydrogen cyanide content in cassava products like *garri* is reduced to a safer level when prepared into "*eba*" [18-21].

MATERIALS AND METHODS

Sample Collection: Four samples of cassava varieties were collected randomly from four different locations in Imo State, Nigeria including the following points, *viz*:

C1: Cassava from Ihiagwa in Owerri West Local Government Area

C2: Cassava from Logra in Ngor-Okpala Local Government Area

C3: Cassava from Izombe in Uguta Local Government Area

C4: Cassava from Ezimoha in Isiala Mba-ano Local Government Area

Preparation of Alkaline Picrate Solution: Five grams (5.0g) of picric acid and 25.0g of sodium carbonate were weighed and transferred into a 500ml volumetric flask. Distilled water was added up to mark, inverted up and down to homogenize the mixture as prescribed by Egan *et al.,* [22].

Preparation of Standard Solution of Potassium Cyanide: One gram (1.0g) of potassium cyanide was dissolved in 1000 ml of distilled water. Different dilutions of it were prepared as follows:

- 15ml of the standard solution was added to 100ml of distilled water
- 210ml of the standard solution was added to 100ml of distilled water
- 315ml of the standard solution was added to 100ml of distilled water
- 420ml of the standard solution was added to 100ml of distilled water.

Sample Preparation: The collected cassava samples were peeled sliced and sun-dried. The dried slices of cassava were further grounded and sieved to obtain the cassava flour following process prescribed by Oyewole [23]. A measured weight (5.0g) of each sample of ground cassava flour was soaked in 50ml of distilled water. A ratio of 1:10 w/v was obtained and allowed to stand for 36 hrs (overnight) at room temperature. The mixture was filtered out with paper to obtain the extract.

Determination of Hydrogen Cyanide: This was done using the alkaline picrate solution by Balagopalan Spectrophotomeric method. A measured volume (2ml) of sample extract from each sample stock was pipetted into clean test tubes. Similarly, the same volume of the standard potassium cyanide solution and distilled water were measured into separate test tubes to serve as the standard and blank respectively. Equal volume (2ml) of the alkaline picrate solution was added to each of the test tubes and thoroughly mixed. The test tubes were allowed to stand for about 5 to 10 minutes at room temperature and their absorbance were taken at 520 nm wavelength using spectrophotometer (722S model).

The level of cyanide in cassava consumed in selected Zone of Imo State was analysed using Spectrophotometer (722S model). Four replicate tests were carried out for each sample. The absorbance of these replicate samples were read from the Spectrophotometer at 520nm wavelength and average absorbance recorded. The corresponding concentrations were traced from the standard curve which

Table 1: Cyanide content in the Investigated Cassava Samples

Samples Codes	Mean Concentration (ppm)
C1	1.0±0.01
C2	1.1±0.01
C3	1.7±0.02
C4	2.5±0.02

was obtained from Table 1. The graph of the absorbance against concentration of tested samples shown above indicates significant correlation between the levels of cyanide in both the standard and the samples.

RESULTS

The results in Table 1 below shows that the cyanide contents of different cassava samples labelled as C1, C2, C3 and C4 were 1.0ppm, 1.1ppm, 1.7ppm and 2.5ppm, respectively.

DISCUSSION

The results showed that the level of cyanide in the cassava sample was increased in the order C1 > C2 > C3 > C4. The levels were within the acceptable limits of 10 mg HCN equivalent/Kg dry weight [24]. The strongly suggested that all the investigated samples were safe for human consumption. Levels of cyanide in this work were less than those reported by Orjiekwe *et al.,* [25], though they were also within the acceptable limit. However, the results reported by Odemelam *et al.,* [26], were far above the acceptable limit and consequently resulted to death cases. The cyanide level in this work is significantly lower than oral toxicity standard of 50 to 90 mg HCN equivalent/Kg body weight [34]. Low levels of cyanide observed in this work could be as a result of the length of time in which the water soaked cassava flour was allowed to stand.

CONCLUSION

The levels of cyanide in this work were not only within the acceptable limit of 10 mg HCN equivalent/Kg body weight recommended by FAO but they significantly lower than values reported by other researchers in Nigeria. Low level of cyanide is essential for the benefit of the health of the consumers. Regular evaluation of cyanide content in cassava is very expedient in determining the safety of the consumers.

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