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Assessment of Cyanide Content in White, Light Yellow and Deep Yellow Cassava Grit (Gari) Sold in Damaturu Metropolis

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Abstract

Different species of Cassava are planted in Nigeria for commercial and domestic uses; there was a reported case of cyanide poison as a result of consumption of poorly processed Cassava. This research work assessed the Cyanide content of white, light yellow and deep yellow Cassava grit “Garri” from three areas of Damaturu metropolis. The cyanide was determined using the titrimetric method of analysis. Raw cassava was also sample as a positive control. The result showed that, in new layout (Sabon Pegi) the cyanide level was 31.51±0.09 $mgkg^{-1}$ in white “Garri”, 25.24±0.06 $mgkg^{-1}$, and 17.64±0.1 $mgkg^{-1}$ in light yellow “garri” and deep “garri” respectively. Behind Motor Park (Bayan Tasha), 38.83±0.15 $mgkg^{-1}$, 21.43±0.03 $mgkg^{-1}$, 15.42±0.17 $mgkg^{-1}$ in white garri, light yellow garri and deep yellow garri respectively. In “pompomari”, Area the Cyanide content in white, light yellow and deep yellow garri showed Cyanide level of 32.06±0.20 $mgkg^{-1}$, 24.14±0.3g $mgkg^{-1}$, 19.48±0.20 $mgkg^{-1}$ respectively. The variation may be due to poor processing, and other additives. Cyanide was present in all the three types of “Garri” sold in Damaturu metropolitan, but at a level tolerable to human consumption but above WHO recommended a standard of 10 $mgkg^{-1}$.

Keywords

Autolysis, Cassava, Cyanogenic Glycosides, Damaturu, Toxicity, Turbidity, Stomach Ache

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1. Introduction

Cassava *Manihot esculenta* cranta is a dicotyledonous plant and widely grown root crop in tropical regions of Africa, latin America and Asia [8]. Two varieties of cassava are known. The sweet cassava is known for low cyanide content and the bitter cassava with its characteristic high content of cyanogenic glycosides (CGs) that is highly toxic when consumed [16]. Total cyanide in cassava products exists in form of CGS (Linamarin and lotaustralin), cyanohydrin and free hydrocyanic acid (HCN) [22]. The CGs notwithstanding, cassava meal provides dietary energy to over 500 million people in the world [17]. According to FAO, [5] 172 million tons of cassava was produced world – wide in 2000 with Africa accounting for 45%, Asia 28% and Latin America and the Caribbean 19%. The five top producing countries are Nigeria, Brazil, Thailand, Congo (DRC) and Indonesia. The crop plays a prominent role in the daily subsistence of many indigenous communities in southern Nigeria. Some commonly proceeded cassava meals include chips, “Abacha”, “fufu”, “liolio”, tapioca, cassava flour and grit also known as “Gari” [9]. Nevertheless, the dynamics in food habits coupled with industrial food processing and marketing needs to have directed research attention toward new products. Cassava is also a source of feed to farm animals and raw materials for industries [18]. The characteristic taste and flavor of Garri are mainly from its lactic acid content produced during fermentation [3]. Traditional production of Garri involves

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peeling off the cassava roots and grating into a fine pulp. Next, the pulp is transferred to hessian sack and compressed to drain and ferment for 4days. The fermented detoxified and relatively dewatered pulp wi ll be sieved to remove fibrous materials, and palm oil could be added for coloring according to preference [20]. Roasting is carried out in large frying pan to yield gelatinized 'Garri' granules of reduced moisture content, which can be stored for a 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 'Gari' [19].

Inorganic cyanides, such as sodium cyanide, NaCN, present as the negatively charged polyatomic cyanide ion (CN^-); which are regarded as salts of hydrocyanic acid, are highly toxic. The cyanide ion is iso–electronic with carbon monoxide and with molecular nitrogen [13]. Organic cyanides are usually called nitriles; in these, the CN group is linked by a covalent bond to a carbon – containing group, such as methyl (CH_3) in methyl cyanide [10]. Hydrocyanic acid, also known as hydrogen cyanide, or HCN, is a highly volatile liquid used to prepare acrylic fibers, synthetic rubber and plastics [11]. Cyanides are employed in some chemical processes, including fumigation, case hardening of iron and steel, electroplating and in the concentration of ores [24]. In addition, cyanide is also used in some industries and found at low levels in air from car exhaust. Cyanide is extremely toxic to humans [21]. Chronic (long-term) inhalation exposure of humans to cyanide results primarily in adverse effects on the central nervous system [2]. EPA has classified cyanide as a group D, chemical not classifiable as to human carcinogenicity by United State Environmental Protection Agency [23].

The primary source of cyanide in the air is from car exhaust. Other airborne sources include emissions from chemical processing industries and municipal waste incinerators [6]. Smoking is another significant source of cyanide, may be found in water from discharges from organic chemical industries, iron and steel works, and sewage treatment facilities. Exposure to cyanide may also occur in the workplace [6]. No studies were located on the reproductive or developmental effects of cyanide in humans from inhalation exposure [12]. Likewise, the implication of cyanide in cassava meal poisoning and toxicity are often not considered, poorly reported and taken for granted. Therefore, it has become imperative to study, and document levels of cyanide in Garri sold in Damaturu metropolis. The aim of this research work is to assess the degree of cyanide in White, Light Yellow and Deep yellow Garri sold in Damaturu.

2. Materials and Methods

The White, Light Yellow and Deep yellow Garri was bought from the various localized spot in Damaturu Metropolis, store in sample container and transport to the laboratory for pretreatment and further analysis.15g sample was measured into 800ml Kjeldahl flask containing 200ml of distilled water and allowed to stand for 3h at 25±5°C. Autolysis was carried out with the apparatus connected to a distiller. A 150ml of distillate was collected in 20ml 25% of NaOH solution and further diluted to 250ml with distilled water. Next, 100ml of the diluted distillate was mixed with 8.0ml of 6.0N NH_4OH and 2.0ml of 5% KI indicator solution and titrated against 0.02N $AgNO_3$. The end point was indicated by a faint permanent turbid appearance. The cyanide content of the sample was evaluated from the expression: 1.0ml 0.02N $AgNO_{3\equiv}$ 11.08mgHCN [4].

3. Statistical Analysis

All samples result were calculated from the triplicate assay and expressed as the means ± standard error means (SEM). Statistical analysis was carried out using Kruskal-Walis at (α=0.05).

4. Results

The result of Cyanide Contents of White, Light Yellow and Deep Yellow Garri are presented in the figures below;

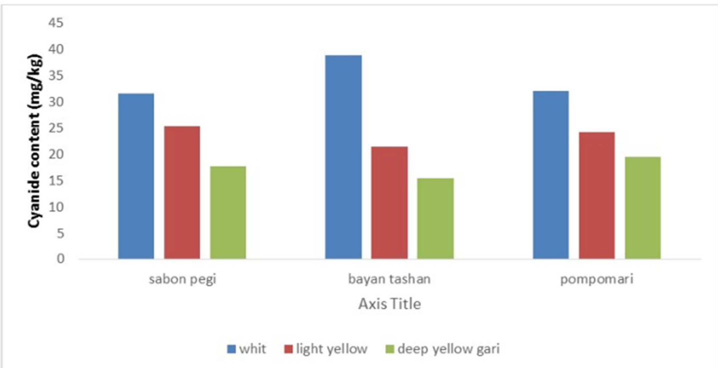

Figure 1. Concentration of Cyanide in different types of Gari mgkg^{-1}.

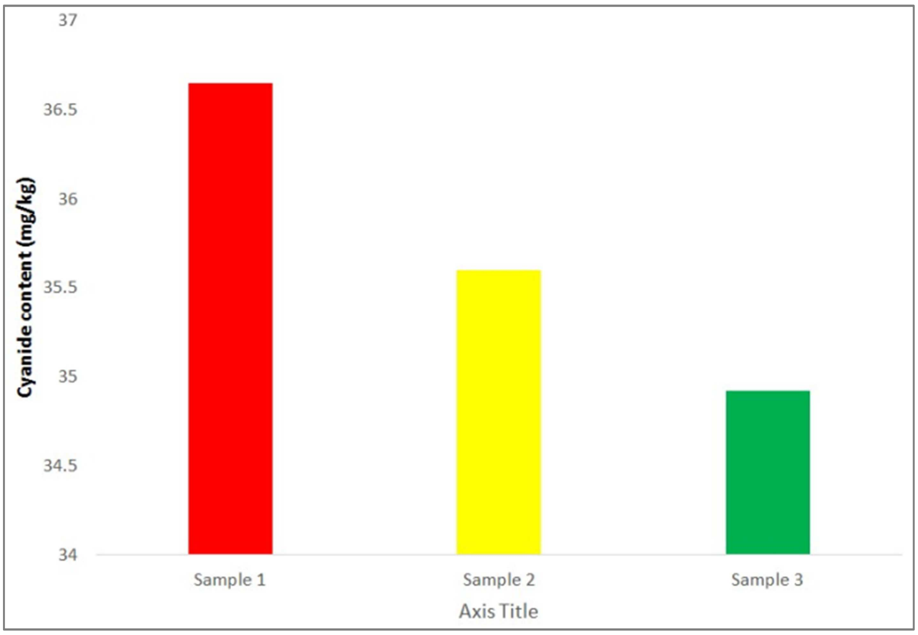

Figure 2. Cyanide Concentration in the samples of Raw Cassava ($mgkg^{-1}$).

Table 1. The cyanide contents of white, light yellow and deep yellow Garri in three area in Damaturu ($mgkg^{-1}$).

Sample	"Sabon Pegi"	"Bayan Tasha"	"Pompomari"
White Garri	31.51±0.09	38.83±0.15	32.06±0.20
Light yellow Garri	25.24±0.6	21.43±0.03	24.14±0.36
Deep yellow Garri	17.64±0.1	15.42±0.17	19.48±0.20

Value was mean of triplicate ±SEM

Table 2. Assessment of cyanide contents in raw Cassava ($mgkg^{-1}$).

Sample 1	36.65± 0.16
Sample 2	35.60 ± 0.10
Sample 3	34.92 ± 0.08

Value was mean of triplicate ±SEM

5. Discussion

This work has assessed the Cyanide content of white, light yellow and deep yellow Garri sales in Damaturu Local Government Area. 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 may be the factor leading to reduction of Cyanide content as a result of complex ion formation. World Health Organization recommendation on cyanide level in food and water is 10 $mgkg^{-1}$. A person could die instantly if the HCN concentration is above 270ppm, and after 10 and 30 minutes respectively if the HCN concentrations are respectively 180 and 130ppm [14]. Figure 1 shows the Cyanide content of white, light yellow and deep yellow Garri in three areas in Damaturu. It was observed that deep yellow Garri showed the lowest Cyanide concentration compared to the other produces. This is because of the presence of palm oil which greatly reduces cyanide.

The main symptoms of acute poisoning by cyanides are due to the interference of cyanide in the assimilation and distribution of oxygen in the body. Whether the cyanide source is HCN or ingestion of food containing a water salt, the poisoning mechanism is the same. The cyanide ions react irreversibly with the iron, in particular with the iron in the cytochrome C oxidase and hemoglobin [6]. Since cyanides interfere with the absorption of oxygen and thus with the production of energy in the body, increased exposure to cyanide will gradually results in headache, nausea, confusion, weakness, fatigue, loss of coordination, hyperventilation, cardiac arrhythmia, bradycardia, loss of consciousness and coma [12]. Death typically occurs due to problems with the nervous system or the heart. Post-mortem analysis of blood of cyanide poisoned people shows that concentrations of about three (3) micrograms cyanide per ml was sufficient to kill a person. Exposure toxicity of cyanide, mainly HCN, via the breathing, is a lot more rapid than via ingestion [15]. The total cyanide content of 91 mg $HCN^{-1}kg$ was obtained in ready to eat chips cassava in two Australia cities of Melbourne and Camberra had been reported for a period of six years, prior to the introduction of 10 ppm maximum limit by Australia and Zealand Standards [1].

Worth note in Cassava flour processing is that; Washing should be carried out thoroughly to avoid contamination of the final product with peel, sand, and so on. Fermentation must be adequately controlled, as too short a period could result in incomplete detoxification and a bland product. However, too long a period could give the product a strong sour taste. Both over – and under fermentation also badly affect the text of the final gari. If too much liquid is pressed from the grited cassava, the gelatinization of starch during subsequent roasting is affected, and the product is whiter [17]. If sufficient liquid is not removed, however, the formation of granules during roasting is affected, and the dough is more likely to form into lumps. The ideal moisture content is 47 – 50%, and this is assessed visually by experience garri producers [7].

6. Conclusion

This study revealed that New Layout (Sabon Pegi) Cyanide contents in white Garri 31.51±0.09 $mgkg^{-1}$, was higher than Light yellow 25.24±0.06 $mgkg^{-1}$, and deep yellow Garri 17.64±0.1 $mgkg^{-1}$ respectively. Behind Motor Park (Bayan Tasha), garri's cyanide content were 38.83±0.15 $mgkg^{-1}$, 21.43±0.03 $mgkg^{-1}$, 15.42±0.17 $mgkg^{-1}$ in white garri, light yellow garri and Deep yellow garri respectively. In "pompomari" Area, the Cyanide content in white, light yellow and deep yellow garri were 32.06±0.20 $mgkg^{-1}$, 24.14±0.3 $mgkg^{-1}$, 19.48±0.20 $mgkg^{-1}$ respectively. It was observed that the present of palm oil was able to reduce total cyanide content in Garri. The result also showed that the white Garri have the highest Cyanide content. It is recommend that people should be taking the deep yellow Garri because of the presence of palm oil that significantly reduce the Cyanide content. Althoug, the mechanism of its reduction is in fact poorly understood. The presence of cyanide in cassava is of concerned for human and animal consumption. The concentration of these anti-nutritional and unsafe glycosides varies considerably between varieties and also with the climatic and cultural condition. Excess cyanide residue from improper preparation is known to cause acute cyanide toxicity, goiters and has been linked to ataxia; a neurological disorder affecting the ability to walk. However, the cassava tested had cyanide content above the WHO recommended level (10 $mgkg^{-1}$). Consumption of these cassava unprocessed/inadequately processed may lead to serious health challenges, and therefore, the effort is required to reduce cyanide content at least to the recommended level.

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