Assessment of Cyanide Content of Some Cassava (*Manihot esculanta crantz*) Products Sold in Calabar, Cross River State, Nigeria

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**ABSTRACT**

This research was carried out to analyzed hydrogen cyanide content of some cassava products sold in major markets in Calabar. The yellow garri concentration of cyanide across the month recorded 0.35±0.01 in July, 0.35±0.02 in August and 0.36±0.02 in September. The ANOVA showed no significant difference (P > 0.05). The white garri concentrations of cyanide across months recorded 0.55±0.01 in July, 0.55±0.01 in August and 0.55±0.02 in September. Similarly ANOVA showed no significant difference (P > 0.05). The analysis of variance for edible starch was not significant (P > 0.05). The average mean of cyanide for the three months showed no significant differences (P > 0.05) between months. But there was a significant difference (P < 0.05) in concentration of cyanide in yellow garri, white garri and edible starch. The concentration of cyanide in white garri was more compared to yellow garri and edible starch. The concentration of cyanide in these cassava product was in the order edible starch < Yellow garri < White garri. This research had shown that the concentration of cyanide in cassava products sold in Calabar between July to September, 2017 was below WHO/FAO permissible limit for cyanide in food products.

**Keywords:** Cyanides, Yellow garri, White garri, Edible starch.

**INTRODUCTION**

The tropical root crop cassava (*Manihot esculanta crantz*) constitutes one of the major stable foods for an estimated 300 million people in the tropical world (Akinrele, 1964). The major processed forms of the cassava tuber include instant cassava flour and garri. Garri is the most popular form in which cassava is consumed in West Africa. The unprocessed tuber contains small but significant amounts of Cyanogenic Glucose (Onwumere, 1975). Cassava is a highly productive crop in terms of food calories produced per unit land area per unit of time, significantly higher than other staple crops. Cassava can produce food calories at rates exceeding 250,000 cal/hectare/day compared with 176,000 for rice, 110,000 for wheat, and 200,000 for maize (corn). Cassava, like other foods, also has anti-nutritional and toxic factors. Of particular concern are the cyanogenic glucosides of cassava, which are linamarin and lotaustralin. These, on hydrolysis, release hydrocyanic acid (HCN). The presence of cyanide in cassava is of concern for human and for animal consumption. The concentration of these anti nutritional and unsafe glycosides varies considerably between varieties and also with climatic and cultural conditions. Selection of cassava species to be grown, therefore, is quite important. Once harvested, cassava must be treated and prepared properly prior to human or animal consumption. Cassava roots and leaves should not be consumed raw because of the presence of cyanogenic glucosides. Some commonly proceeded cassava meals include chips, “abacha”, “fufu”, “fio-fio”, tapioca, cassava flour and “Garri.”(Ihenkoronye et al., 1985., Iwuoha et al., 1996). Nevertheless, the dynamism in food habits coupled with industrial food processing and marketing needs have directed research attention toward new products. Cassava is also a source of feed to farm animals and raw materials for industries (Oboh and Elusiyan, 2007). Kamulu and Oghome (2012). Studied the starch and cyanide contents in Etche manufactured garri. In this study, they discovered that mechanical presser removed more starch at a shorter time than manual presser from garri. But at prolong time manual...
pressing removed slightly higher amount of starch. For the reduction of hydrogen cyanide which is carcinogenic, mechanical pressing should be used. For manually press garri, if the number of days for fermentation be increased, further reduction in the amount of HCN may occur. Anna et al., (2011). Worked on the total cyanide content of cassava food products in Australia. In this study, the survey revealed a wide range of cyanide concentrations in commonly available cassava based products in Australia. As the negative impacts of excess cyanide consumption are well known.

Paul and Okey (2013). Worked on Cyanide and Aflatoxin loads of processed cassava tubers (garri) in Njaba, Imo State, Nigeria. In this study fermentation scheme for garri production in 48hours caused significant (p<0.05) reduction, but did not obliterate the cyanide content of cassava tuber conversely, the 48hours fermentation scheme promoted the elevation pf AFT levels, but was relatively reduced in garri samples treated with palm oil. Orjiekwe et al., (2013). Worked on determination of cyanogenic glucosides in cassava products sold in okada, Edo State, Nigeria. Show that the cyanogenic glucosides levels in the three cassava products studied ranged from 5 to 10 ppm which is relatively very safe and within the acceptable limit of 10mg HCN equivalent/kg body weight recommended by FAO. Among the three samples tested for cyanide fufu has the highest cyanide concentration of 10 ppm, cassava flour has 6 ppm, and garri has the lowest of 5 ppm. The variation in cyanide levels for the three products may probably be a factor of differences in processing techniques for each product. Relevant Government agencies should mount aggressive campaign to sensitize and educate the peasant farmers and cassava millers on intake of high cyanide concentration cassava foods. The aim of this study was to assess the cyanide content in white garri, yellow garri and starch sold in Calabar metropolis. To compare the result to World Health Organization (WHO) and Food and Agricultural Organization (FAO).

Materials and Methods

Description of Study Area

Location

The study was conducted in Calabar. The state capital of Cross River State, Nigeria. It lies within latitude 4o57’ N and longitude 8o19’ E.

Sample Collection

Samples were collected randomly from the major markets. The 10kg samples each of yellow garri, white garri and starch was transported in a well labelled polythene bags to water board laboratory along marain road Calabar for analysis. Samples were stored in a dry place at room temperature.

Preparation of Samples for Analysis

About 15g of each sample was measured into 800ml flask containing 200ml of distilled water and allowed to stand for three hours at 25oc.

Determination of Hydrogen Cyanide Content

The hydrogen cyanide content in white garri, yellow garri and edible starch was determined using Alkaline titrating method. A 150 ml of distillate was collected in 20 ml 25% of sodium hydroxide, (NaOH) solution and further diluted to 250 ml with distilled water. Next, 100 ml of the diluted distillate was mixed with 8.0 mL of 6.N Ammonium hydroxide (NH4 OH) and 2.0 ml of 5% KI indicator solution and titrated against 0.02N Silver Nitrate (AgNO3). The end point was indicated by a faint permanent turbidity appearance. The experiment was repeated in triplicate and this research lasted for three months from July to September.

Statistical Analysis

Apart from the routine calculation of mean and standard deviation, statistical methods such as ANOVA (analysis of variance), was used to analyse the data obtained in course of this study.

Results

Cyanide Concentrations in Yellow Garri, White Garri and Edible Starch in Samples for the Months of July to September

The Analysis of Cyanide Contents in Samples for the Month of July.

In the month of July, the analysis of 10kg weight of yellow garri recorded the mean average of 0.35±0.01, while white garri recorded the mean average of 0.55±0.02 and edible starch of 10kg weight recorded 0.24±0.01 mean average (Table 1).The World Health Organization (WHO) and Food and Agricultural Organization (FAO) standards for hydrogen cyanide (HCN) in food is 10mg/Kg.
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Table 1. Analysis of Cyanide Content in Samples for the month of July

<table>
<thead>
<tr>
<th>Sample</th>
<th>Cyanide concentrations (X±SD)</th>
<th>Weight (Kg)</th>
<th>WHO/FAO permissible limits for HCN</th>
</tr>
</thead>
<tbody>
<tr>
<td>YG</td>
<td>0.35±0.01</td>
<td>10</td>
<td>10mg/kg</td>
</tr>
<tr>
<td>WG</td>
<td>0.55±0.02</td>
<td>10</td>
<td>10mg/kg</td>
</tr>
<tr>
<td>ES</td>
<td>0.24±0.01</td>
<td>10</td>
<td>10mg/kg</td>
</tr>
</tbody>
</table>

YG=Yellow garri, WG= White garri, ES= Edible starch, X=mean, SD=standard deviation.

The Analysis of Cyanide contents in samples for the month of August

In the month of August, the analysis of 10kg weight of yellow garri, white garri and edible starch recorded the mean average of 0.35±0.02, 0.55±0.01 and 0.24±0.01 respectively (Table 2).

Table 2. Analysis of Cyanide Content in Samples for the month of August

<table>
<thead>
<tr>
<th>Sample</th>
<th>Cyanide concentrations (X±SD)</th>
<th>Weight (Kg)</th>
<th>WHO/FAO permissible limits for HCN</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>ES</td>
<td>0.24±0.01</td>
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<td>10mg/kg</td>
</tr>
</tbody>
</table>

YG=yellow garri, WG= White garri, ES= Edible starch, X=mean, SD=standard deviation.

The Analysis of Cyanide contents in samples for the month of September

In the same vein, the analysis of 10kg each of yellow garri, white garri and Edible starch for the month of September recorded the mean average of 0.36±0.02, 0.55±0.02 and 0.23±0.01 respectively (Table 3)

Table 3. Analysis of Cyanide Content in Samples for the month of August

<table>
<thead>
<tr>
<th>Sample</th>
<th>Cyanide concentrations (X±SD)</th>
<th>Weight (Kg)</th>
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<tbody>
<tr>
<td>YG</td>
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YG=yellow garri, WG= White garri, ES= Edible starch, X=mean, SD=standard deviation.

DISCUSSION

Discussion on the Analysis of Cyanide Concentration in Yellow Garri, White Garri And Edible Starch for the Months of July to September

In the month of July the cyanide concentration in yellow garri average 0.35±0.01, white garri 0.55±0.02 and edible starch 0.24±0.01. This result is below the World Health Organization (WHO) and Food and Agricultural Organization (FAO) permissible limit for cyanide concentration in food stuff. This may be due to more than 48 hours fermentation process practice by the people of Cross river state. The white garri in this study for the month of July recorded the highest concentration of cyanide content of 0.55±0.02. This was higher than the number recorded by yellow garri which is 0.35±0.01. This result for yellow garri must have been influence by the red palm oil used in the processing. This is in line with the study conducted by Stephonet et al.,(2015) who assessed cyanide contents in white, light yellow and deep yellow garri flour produced from cassava in Abia state, Nigeria. According to the research the total cyanide contents in white garri were higher than light yellow and deep yellow garri. It is also believed and experimented that cassava grown during drought (dry seasons) are especially high in cyano genic glucosides (White et al., 1998; Bhatia, 2002). In the same vein, Paul and Okey (2013) worked on cyanide and Aflatoxin loads of processed cassava tubers (garri) in Njaba, Imo state, Nigeria. In this study fermentation for 48 hours caused significant (P < 0.05) reduction in cyanide content and was relatively reduced in sample treated with palm oil. The analysis of variance for the month of July showed significant differences in cyanide content in yellow garri, white garri and edible starch respectively. Above all, the edible starch showed the least average mean of cyanide content. In the month of August, the average cyanide content of yellow garri, white garri and edible starch recorded 0.35±0.02, 0.55±0.01 and 0.24±0.01 respectively. This result is similar to the result recorded in July. This may be as a result of the season. The edible starch recorded the least 0.24±0.01. The yellow garri recorded
The month of September recorded the average mean concentrations of 0.36±0.02 in yellow garri, 0.55±0.02 in white garri and 0.23±0.01 in edible starch. These results for yellow garri, white garri and edible starch are not too different from what was obtained or recorded in July and August. This may be due to the fact that the research was carried out during the same season and the same methods of cassava processing. This is in agreement with the work carried out by Ojo et al., (2013). In this research the percentage cyanogens lost to multistage processing showed that the processing methods involved are efficient resulting in cyanogens levels that are not high enough to cause cyanide toxicity when the amount of cassava product consumed in a meal is taken into consideration. Cooke et al.,(1985) recorded that palm oil played a better role in reducing cyanide level in sweet and bitter cassava than groundnut oil and coconut oil. The average means of cyanides for the month of August showed a significant difference in yellow garri, white garri and edible starch (P > 0.05) ANOVA. The samples for the month of July and August showed no significant differences (P > 0.05).

The concentration of cyanide in white garri was more compared to yellow garri and edible starch. The concentration of cyanide in these cassava product was in the order edible starch < Yellow garri < White garri. This research had shown that the concentration of cyanide in cassava products sold in Calabar between July to September was below the WHO/FAO permissible limit for cyanide in for food products. These Cassava products in Calabar are very safe for consumption. For further reduction of HCN, the fermentation period can be increase beyond 48 hours. Cassava products should be regularly monitored and analyze to avoid cyanide poisoning. Hence the processed Cassava products are safe for consumption and combinations of many processing methods which enable maximum removal of cyanogens contents of the cassava should be encouraged.
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