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Short Communication

Determination of Residual Hydrocyanic Acid (HCN) in White and Yellow *Garri* Flour Processed from Cassava (*Manihot Esculata Crantz*)

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Abstract

Twenty samples of white and yellow garri flour produced from cassava (Manihot esculenta Crantz) that were processed for 0, 24, 48, 72 and 96 hours using the combination methods of grating, dewatering, fermentation and frying were analysed for residual hydrocyanic acid concentration using the Spectrophotometeric alkaline Picrate method, (AOAC, 2000). Analysis of results showed that the mean concentration and percentage of HCN concentration lost to processing from 0 to 96 hours in white and yellow garri flour are not significantly different. Therefore, the length of processing time and the combination of grating, dewatering, fermentation and frying methods are responsible for the removal of HCN in both white and yellow garri flour.

Keywords: Cassava, Garri Flour and Residual HCN.

Introduction

Manihot esculenta Crantz is widespread in the tropical world, and commonly known as manioc, cassava, tapioca, mandioca[1]. Its primary attraction is that in its tuberous root, it is the highest yielding starchy staple where yields are as high as 50 to 82 metric tones per hectare have been recorded. Albeit with lesser yield, it can be grown on marginal soils where economic yield cannot be obtained from other crops, also, it is attacked by few pests other than rodents [2]. The major deterrent to its cultivation is that is known to reduce K^+ in soil which is probably due to its high yields. Cassava is believed to have originated from Brazil and was introduced into West Africa[3]. Cassava product such as *garri* flour is a major staple food in most African and Latin American countries[4]. The proximate nutritive value of cassava tuber was expressed as: moisture ($59.4 g.kg^{-1}$), total carbohydrate ($38.1 g.kg^{-1}$), lipid ($0.2\ g.kg^{-1}$), protein ($0.7\ g.kg^{-1}$), Ca^+ ($50\ mg.kg^{-1}$), P ($40\ mg.kg^{-1}$), Fe^+ ($0.9\ mg.kg^{-1}$), niacin ($0.3\ mg.kg^{-1}$), vitamin C ($25\ mg.kg^{-1}$), thamin ($0.05\ mg.\ kg^{-1}$) and riboflavin ($0.1\ mg.kg^{-1}$)[5].

Cassava tubers are traditionally processed by a range of multistage processes of grating, dewatering, and fermentation and frying, which reduces their toxicity, improve palatability and convert the perishable fresh root into stable products such as *garri* flour, tapioca etc[6-8].

Several authors have reported the toxicity caused by consuming improperly processed cassava products with respect to hydrocyanic acid[9]. Acute toxicity of cyanohydrin causes calcific pancreatitis, apnea 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[10-13].

A number of processing steps involved in the production of *garri* influenced the levels of residual hydro- cyanide[6,7]. In this research, the concentration of residual hydrocyanic acid was studied at different fermentation time and treatment in red and white *garri* flour.

Material and Methods

Twenty samples of white and yellow *garri* flour produced from fifteen months old white and bitter cassava tubers harvested in Aragba-Orogun Delta State, Nigeria were used for the analysis. Each grated species were divided into ten: five portions were mixed with red palm oil (yellow *garri*). The twenty samples were packed separately into twenty jute bags and dewatered using a locally fabricated hydraulic press. The cassava pulps in each bag were separated into five groups and left to ferment for 0, 24, 48, 72 and 96 hours respectively. After sieving and subsequent frying (120-200^{0}C) in rectangular frying pan (1.5/.7m), the *garri* was cooled, packed labeled and sealed. Residual hydrocyanic acid was determined in white (ten) and yellow (ten) *garri* flour samples[14].

Results and Discussion

Concentrations of residual hydrocyanic before and after fermentation are presented in table 1. The concentration of residual hydrocyanic acid in table 1 showed that there is a step wise reduction of HCN content in all samples (A-D) from 0 to 96 hours of processing. In sample A, 0 hours recorded 10.824 $\mu g.g^{-1}$ while 24 hours and 48 hours recorded 7.576 $\mu g.g^{-1}$ and 5.402 $\mu g.g^{-1}$ respectively. Similarly 72 hours and 96hrs processing hydrocyanic acid concentrations are 3.267 $\mu g.g^{-1}$ and 2.190 $\mu g.g^{-1}$ respectively. Results also showed that sample B

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HCN concentration ranged from 10.791 to 2.170 $\mu g.g^{-1}$. Similarly, in sample C the recorded residual hydrocyanic acid concentration ranged between 11.871 and 3.221 $\mu g.g^{-1}$. Analysis of results in sample D showed that the concentration of hydrocyanic acid ranges between 11.861 and 3.221 $\mu g.g^{-1}$. Also, the concentration of hydrocyanic acid lost to processing from 0 to 96 hours in sample A, B, C and D showed that the concentration of hydrocyanic acid in bitter cassava is higher than sweat cassava which is in agreement with other work [15]. However, table 2 showed that there is no significant difference in the mean of the test samples.

Analysis of results in table 1 and figure 1 showed that there is 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*[4,16]. 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[17]. This could be responsible for the low concentration of hydrocyanic acid in the red *garri* flour.

Therefore, fermentation and increase in fermentation time could be responsible for the removal of residual hydrocyanic acid in both red and white *garri*[18-21]. Secondly, the significant loss of residual hydrocyanic acid in the test samples from 0 to 96 hours of processing showed that the combination of grating (which allowed endogenous and microbial enzymes to hydrolyze cyanogenic glucoside by 95% within 3hours), hydraulic jack dewatering (which removed substantial amount of free cyanide from the cassava pulp), fermentation and frying (reduced the level of antinutrients and drive off the cyanide formed) processing methods are responsible[21,6,7, 22]. Therefore, the use of red oil in the production of *garri* flour is basically to protect it from mould attack, give appealing look and reduce vitamin A deficiency[23].

Table-1
Concentration of Residual Hydrocyanic Acid in Sample A –D ($\mu g.g^{-1}$ dry matter)

Sample Fermentation in hours	Sweet Cassava				Bitter cassava			
	A	% Loss	B	% Loss	X C	% Loss	D	% Loss
0	10.824±0.014		10.791±0.019		11.871±0.109		11.861±0.110	
24	7.576±0.017	29.9	7.531±0.042	30.21	8.614±0.067	27.44	9.524±0.344	19.70
48	5.402±0.053	50.0	4.350±0.044	59.69	5.393±0.046	54.57	5.357±0.066	54.84
72	3.267±0.043	69.8	3.231±0.010	70.06	4.322±0.006	63.59	4.322±0.006	63.56
96	2.190±0.034	79.7	2.170±0.006	79.89	3.239±0.073	72.72	3.221±0.148	72.84

Results are expressed as means of quadruplet determination: A: yellow *garri* (addition of palm oil prior to fermentation), B: white *garri*, C: yellow *garri,* D : white *garri*

Table-2
Significant Relationship between sample obtained by Pearson correlation n = 5, df==4 α=0.05

Couph	p>0.05
A – B	0.992
A – C	0.991
A – D	0.982
B – C	0.999
B – D	0.994
C – D	0.994

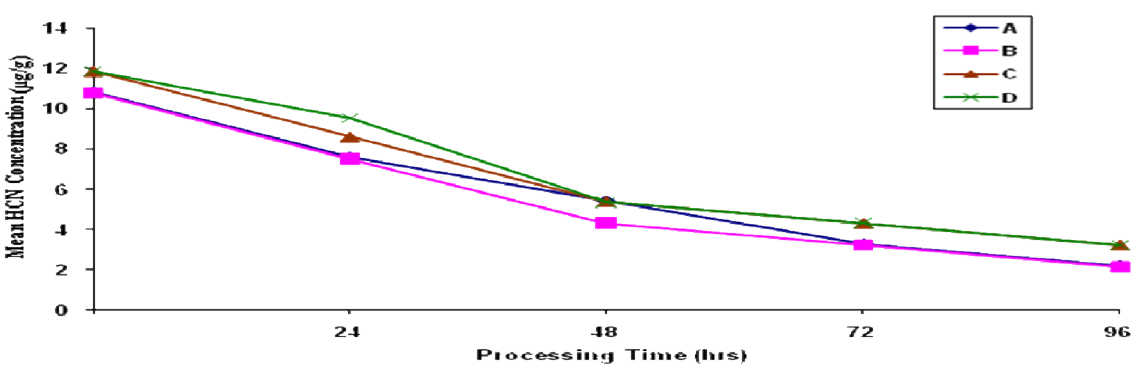

Figure-1
Hydrocyanic acid Concentration at Different Processing Time

Conclusion

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 white and 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. Because of the acute and chronic toxic effects of cyanide in cassava by-products, increasing processing time and the combination of processing methods should be applied to enable maximum removal of cyanide in the production of *garri* flour. Further research on the effect of red palm oil on starch concentration in *garri* flour should be carried out.

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