INFLUENCE OF FERMENTATION PERIOD AND PARTICLE SIZE ON CYANOGENIC CONTENT OF GARI IN IBADAN METROPOLIS

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ABSTRACT

Gari constitutes an important staple food in the tropical region. The consumption of cassava and its products is on the increase thus the need to examine the safety of gari produced. The study assessed the cyanogenic content in gari of various particle sizes. Two major processing Centres in Ibadan Metropolis were purposively selected. Each gari sample was sieved using different mesh sizes; 425µm, 850µm, and 1000µm. The free and total cyanide content was analyzed. In Centre 1, the fermentation time of the samples collected varied while in Centre 2, all samples were allowed to ferment for one day and some were mixed with red palm oil. There was a gradual decrease in the free cyanogenic content with increasing particle size of the gari samples. The highest residual HCN in Centre 1 was recorded in sample A (10.19, 9.29, 8.66 and 7.44ppm) while Centre 2 recorded the highest residual HCN in sample M-T (13.73, 13.32, 11.53 and 10.14 ppm) with aperture size of <425µm, 425-850µm, 850-1000µm and >1000µm respectively. The mean HCN concentration with increasing particle size of gari (white and yellow) in the two processing Centres were however not significantly different ($P>0.05$). Fermentation had a significant effect ($P<0.05$) on the cyanogenic content of gari. Fermentation was a veritable tool in gari production and particle size distribution of gari may be an important tool in achieving a safer consumption of the product since the larger the particle size, the lesser the cyanide content.

Keywords: (Gari, cyanogenic content, particle size, fermentation)

INTRODUCTION

Cassava production in Nigeria is by far the largest in the world, a third more than production in Brazil and almost double the production of Indonesia and Thailand (FAO, 2006). It is the most important root crop in Nigeria and Ghana in terms of food security, employment creation and income generation for crop producing households (Afoakwa, 2010). It is a staple food that used to be within the purchasing power of all categories of people in a society irrespective of their income (Sanni and Ikuomola, 2001). Cassava roots are consumed in many forms. The most common method of preparation is fermentation. One major factor which may influence the amount of cyanide that is retained in the foods is the physical form or size to which the roots are reduced during processing (Delange *et al.*, 1994). Various products obtained from cassava which include gari, lafun flour, starch, smoked cassava balls "kumkum" among others. World's processed products commonly known are gari, lafun flour and fufu a dry granular meal made from moist and fermented cassava commonly used in West Africa (FAO, 1970) and are produced for human consumption.

Fermentation is one of the oldest and most important traditional food processing and preservation techniques. Fermentation of food involves the use of microorganisms and enzymes for the production of foods with distinct quality attributes that are quite different from the original agricultural raw material (Aworh, 2008). The conversion of cassava (*Manihot esculenta, Crantz*) to gari illustrates the importance of traditional fermentations. To extend shelf life, inhibit spoilage and pathogenic microorganisms, impart desirable sensory qualities and improve nutritional value or digestibility. It is believed that these microorganisms also contribute to the liberation of cyanide from grated cassava during gari production. Elimination of cyanide from cassava products can be optimized by identification and use of microorganisms with linamarase activity in fermentation (Ahaotu *et al.,* 2013).

Consumption of cassava and cassava products containing large amounts of cyanide can cause acute intoxication, with symptoms of dizziness, headache, nausea, vomiting, stomach pains, diarrhea and sometimes death (Mlingi *et al.*, 1992). The lethal dose of cyanide is proportional to body weight thus, children tend to be more susceptible to outright poisoning than adults. In regions where there is iodine deficiency, which causes goitre and cretinism, cyanide intake from cassava exacerbates these conditions (Delange *et al.*, 1994). Ihedioha and Chineme (2003) in their work suggested that shortening the fermentation period of cassava mash to about 24 hours constitutes a health hazard to consumers of gari.

In Africa, the processing of cassava for food is known to involve fermentation. The fermentation process is either induced or spontaneous. Whichever form of fermentation that occurs invariably involves the degradation of cyanogenic glucoside present by the enzymes β-glucosidases together with endogenous linamarase producing hydrocyanic acid (HCN) and acetone cyanohydrins which are often regarded, respectively as free and bound cyanide. Fermentation is responsible for the softening of the grated pulp to liberate hydrogen cyanide and production of organic acids that impact sour taste to gari. It is believed that these microorganisms also contribute to the liberation of cyanide from grated cassava during gari production. Elimination of cyanide from cassava products can be optimized by identification and use of microorganisms with linamarase activity in fermentation (Ahaotu *et al.*, 2013).

MATERIALS AND METHODS

This study was conducted in Ibadan, Nigeria. Two local governments were purposively selected for the study, Akinyele and Ibadan North West Local Government. A simple random sampling was used to select 10 gari fryers in each processing site. Grab samples taken from the top, middle and bottom of a sack were mixed together to make a composite sample which was analyzed for cyanogenic content in the laboratory. Each sample of gari was divided into subsamples; Subsample A - <425µm (very fine), subsample B – 425µm – 850µm (fine), subsample C – 850µm – 1000µm (medium) and subsample D - > 1000µm (coarse). The subsamples were achieved by passing each gari sample through Endecott sieves of different mesh sizes, 425µm, 850µm and 1000µm which were collected from Civil Engineering department, Federal

Polytechnic, Ilaro. The weight of each of the subsamples was recorded. Each subsample was analyzed for free and total cyanide content.

The gari samples collected was stored in air tight containers and were sieved immediately while the sub samples were kept in different sealable air tight ziploc nylons to avoid the absorption of moisture. The cyanide concentration was determined using the alkaline picrate method (Eleazu and Eleazu, 2012). Free and total cyanide was estimated spectrophotometrically at a wavelength of 490nm. The optical density measured was compared to a standard hydrocyanic acid curve to determine the concentration (μg/L). In Centre 1, samples A, B, C-D, E-G, H-I was allowed to ferment for 2 days, 4 days, 6 days, 8 days, 10 days and 12 days respectively while in Centre 2, all samples were allowed to ferment for one day although samples K-L was mixed with red palm oil.

Statistical Analysis

Data obtained were statistically analyzed using Analysis of Variance. Significant difference was accepted at 5% level ($p<0.05$).

RESULTS AND DISCUSSION

The study showed that gari had a decreased cyanide level as the particle size of the product increased. Figure 1 illustrates the residual hydrogen cyanide (HCN) content of gari samples in Centre 1. Sample A had highest values of 10.19, 9.29, 8.66 and 7.44 mg residual HCN/kg with particle size of <425μm, 425-859μm, 850-1000μm and >1000μm respectively. In Centre 1, the gari products were all below the safe limit, 10ppm stated by WHO for its safe consumption except for sample A with <425μm and <425-850μm size which had total cyanide content of

10.33 and 10.67ppm respectively as shown in figure 2. There was a high reduction in the cyanogenic content of the product as the number of fermentation days increased.

However, Centre 2 had majority of its gari product above 10ppm except for sample K-L which was mixed with red palm oil. As shown in figure 3, the high cyanide content of gari produced in Centre 2 can be attributed to the fact that the cassava pulp was only allowed to ferment for only one day. Consumption of the gari produced in Centre 2 is therefore not entirely safe for consumption. The relatively high cyanide content in gari produced in Centre 2 could be as a result of high proportion of bound cyanide in the cassava pulp before it was fried. Well fermented products however have enough time and the opportunity for their bound cyanide to be hydrolyzed and converted to different forms and volatile HCN gas which can be easily removed during the frying process. It has however been reported that fermentation is very important in cassava processing because of its ability to reduce cyanogenic glucosides. The findings in this study agreed with a study carried out by Asegbeloyin, *et al.*, 2007 in which cyanide content of two treatments (fermented and unfermented group) were analyzed. Highest percentage loss of cyanogenic content was recorded for the fermented group. This study also revealed that fermentation plays a major role in the reduction of cyanide content of gari products.

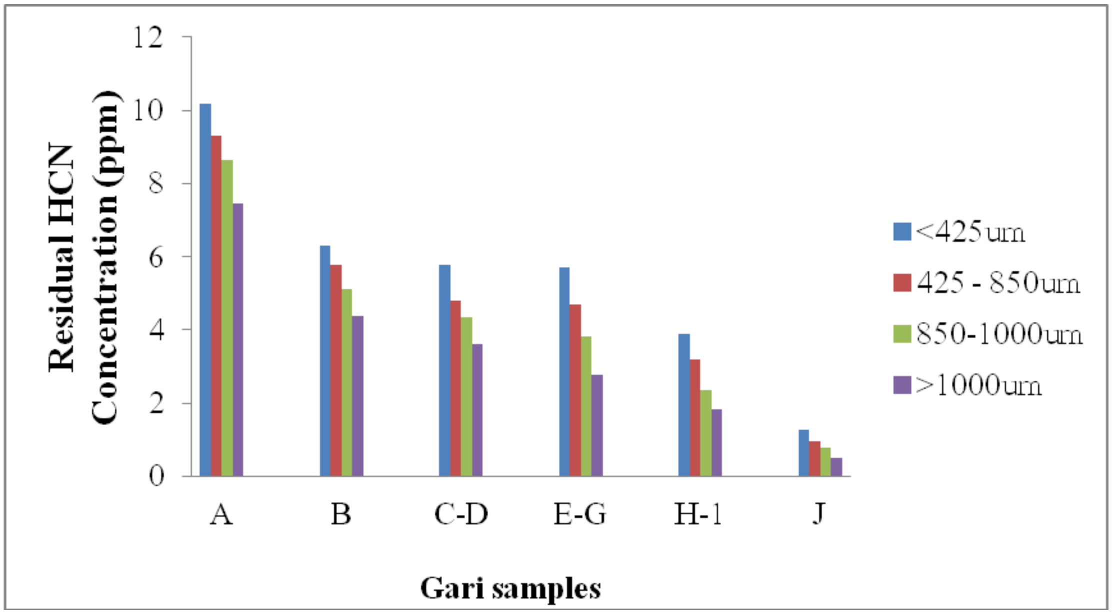

Figure 1: Mean residual cyanide content of gari samples in Centre 1

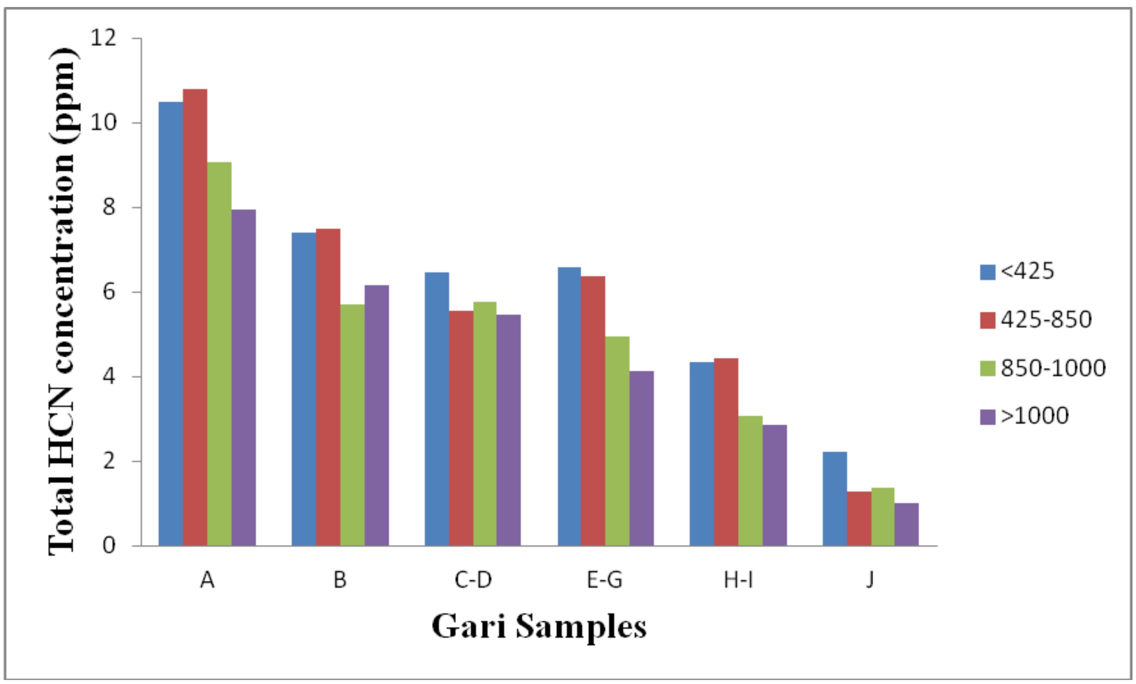

Figure 2: Mean total cyanide content of gari samples in Centre 1

In Centre 2, the cassava pulp of all samples collected were only fermented for a day before frying and palm oil was added to samples K and L. Gari samples in which palm oil was added had a mean residual HCN content of 7.20ppm, 6.61ppm, 5.98ppm and 4.50ppm with a particle size of <425µm, 425-859µm, 850-1000µm and >1000µm respectively as shown in figure 3. This showed a significant decrease in cyanide content compared with the sample which palm oil was not added which had a mean HCN content of 13.73ppm, 13.32ppm, 11.53ppm and 10.14ppm with a particle size of <425µm, 425-850µm, 850-1000µm and >1000µm respectively. The low level of hydrocyanic acid in the yellow gari could be due to the sequestration of the cyanide by palm oil components (fat) into a complex compound and therefore unavailable for detection using quantitative measurement. A Study by Emoyan *et al.*, 2012 also showed that gari mixed with red palm oil had low cyanide content.

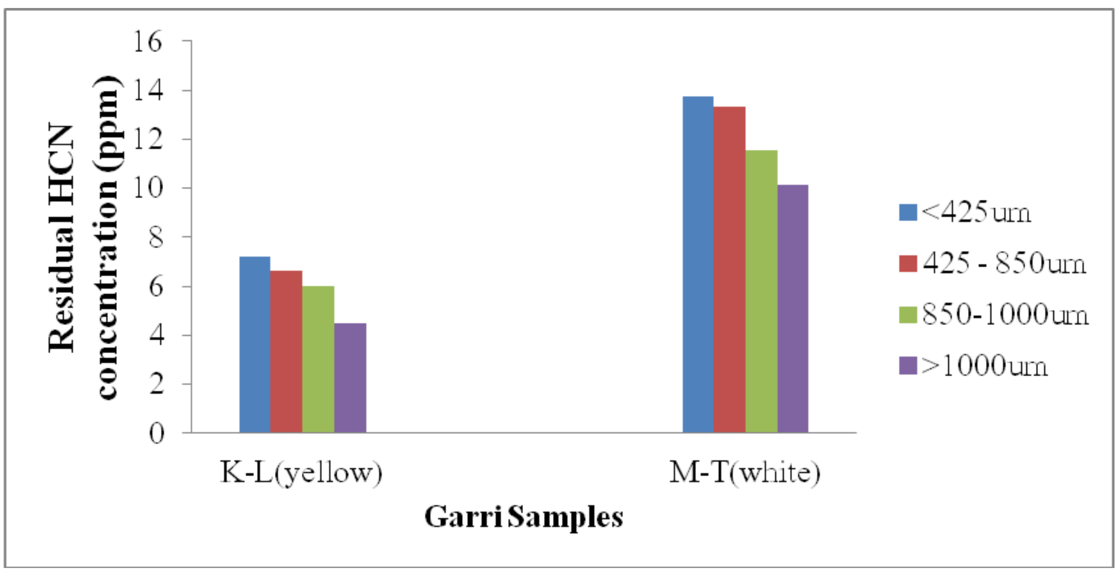

Figure 3: Mean residual HCN Content of gari samples in Centre 2

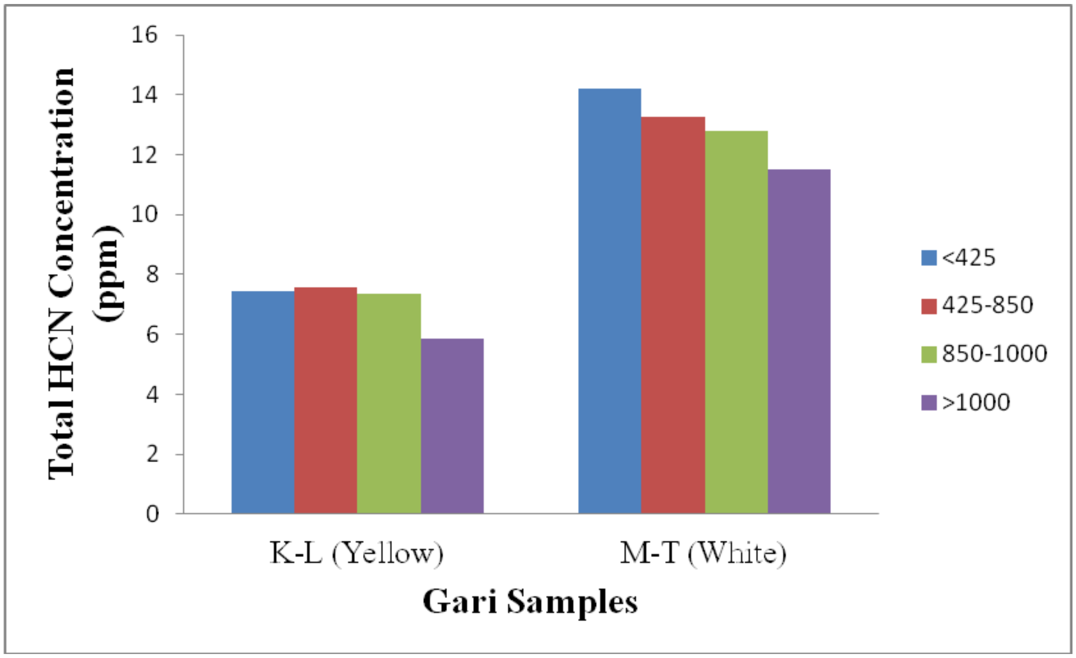

Figure 4: Mean Total HCN Content of gari samples in Centre 2

Gari comprise of different particle sizes. This finding shows that there is a strong relationship between particle size of gari and the corresponding cyanide content. In all samples, the residual cyanide content decreased with increased particle size. The relationship is in line with a study carried out by Maduagwu, (1979). The gari samples, however, showed a haphazard relationship between total cyanide content and increased particle size.

CONCLUSION AND RECOMMENDATION

The residual cyanide content showed a decrease with increasing particle size, however, the total cyanide showed a haphazard trend and this could be due to the fact that the enzymatic activity on the bound cyanide varies. The cyanide content of the gari produced in Centre 2 was above the WHO limit of 10ppm and the consumption of this product could lead to chronic toxicity which could affect consumers after a period of time. The cyanide contents of gari in Centre 1 were however safe for human consumption because the cassava tubers were well processed. It is however recommended that there should be adequate awareness for the need to process cassava tubers properly to ensure safe consumption of the final product and the common practice of using mixed varieties of cassava tubers for gari processing should be discouraged. And more research can be channeled to determine factors involved in the reduction of residual HCN content in gari as the particle size increase.

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