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The Effect of Different Processing Methods on the Residual Cyanide of 'Gari'

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Abstract: The effect of different processing methods on the cyanide and residual cyanide content of gari (dry granule made from cassava and widely consumed in Nigeria) was investigated using gari from bitter variety of cassava. The processing methods investigated were 1 (unfermented with oil), 2 (unfermented without oil), 3 (fermented with oil), 4 (fermented without oil). The experimental design was a 2 x 2 factorial in a completely randomized design. The reference cyanide content of the cassava pulp determined immediately after grating was 437.4±15.2mg/kg. Results showed that the crude protein content of the fermented groups (Treatments 3 and 4) were higher than those of the unfermented groups (Treatments 1 & 2). The addition of palm oil increased the ether extract values of the groups with palm oil. Fermentation had a significant effect ($P < 0.01$) on the cyanide content of the gari. Cyanide content of the treatments at "garification" were 223.29±6.2; 203.16±11.7; 91.78±8.4 and 99.34±8.9mg/kg for treatments 1, 2, 3 and 4 respectively. The effect of palm oil addition on the cyanide content was not significant ($P > 0.05$). The residual cyanide content of the treatments after one week (7 days) of storage were 31.42±9.2; 33.6±2.6; 25.2±2.8 and 25.8±1.6mg/kg for treatments 1, 2, 3 and 4 respectively. These values were not significantly different ($P > 0.05$). It was concluded that fermentation was a veritable tool in gari production. Storage of gari for upward of 7 days further provides an enabling condition for the detoxification of cyanide from unfermented groups to safe levels.

Key words: Cassava, cyanide, gari, processing

Introduction

Cassava species *Manioc*, *Manihot esculenta* Crantz or *Manihot utillisima* Pohl is believed to have originated from Brazil and was introduced into West Africa by the Portuguese (Pierre Silvestre, 1989). Cassava may have been introduced into Nigeria over 300 years ago although its systematic cultivation was never generally accepted and practiced until the late 1990's. It became generally accepted and fully integrated into the farming systems of southern Nigeria a little over 150 years ago (RMRDC, 2004) . It is one of the most drought tolerant crops and can be successfully grown on marginal soils, giving reasonable yields where many other crops do not grow well. It is estimated that over 600 million people depend on cassava as staple food in Africa, Asia and Latin America. Cassava carbohydrate has a mean starch content of 20 percent amylose and 70 percent amylopectin. It is an important source of energy with a calorific value of 250Kcal/ha/day as compared with 200Kcal/ha/day for maize, 173Kcal/ha/day for rice, 114Kcal/ha/day for sorghum and 110Kcal/ha/day for wheat (RMRDC, 2004). Earlier investigation revealed that cassava root has the following proximate composition: starch; 86 percent, fats; 1 percent, protein; 2.6 percent , fibre ; 5.2 percent and Ash; 2.7 percent (Onyimonyi, 2002). It follows that the food value of cassava lies in its high starch content.

The most popular product from cassava in Nigeria is gari. Gari is a dry granule made from roots of cassava through a series of processing steps (Sanni, 1994). The granules are added to hot water and stirred to make a paste of varied consistency and consumed with soup or stews of various types by chewing or swallowed in morsels. It is a staple for many of the 374 ethnic groups in Nigeria (Akoroda, 1992). It is popularly referred to as the common man's bread (Meludu *et al*., 2001). The conventional method of producing gari involves peeling and grating the fresh roots. The grated pulp is normally allowed to ferment for two or three days. The pulp is then compressed to eliminate liquid, after which it is sieved and fried in heated pans. Often times palm oil is added either during the grating process or at the point of frying. The resultant gari is yellowish as distinct from white gari that results when no oil is added. In a recent study it was reported that fermentation significantly reduced the cyanide content of either the sweet or bitter variety of cassava (Asegbeloyin and Onyimonyi, 2005). The presence of cyanogenic glucosides (Linamarin and Lotaustralin) constitute a major limitation to the use of cassava as human food. These glucosides readily breakdown to give hydrocyanic acid. Whereas the effect of fermentation has proved efficient in reducing the total cyanide content from levels as high as 224.09±0.858ppm to 86.63±1.049ppm after 2 days (Asegbeloyin and Onyimonyi, 2005), the role of palm oil in reducing the total cyanide content of gari is not well understood. It is against this background of uncertainty that the present study was designed to investigate the effect of palm oil and fermentation on the cyanide content of gari.

Materials and Methods

Cassava roots of the bitter variety were collected from a farm in the Crop Science Department of the Faculty of Agriculture, University of Nigeria, Nsukka. The roots were washed, peeled and grated using a cassava grating machine in Nsukka town. The cyanide content of the pulp was immediately determined and used as the reference unit according to the method of AOAC, 1990. The resulting cassava root mash was divided into 4 groups of 2kg each. Palm oil was added into 2 groups at the rate of 10g/kg and thoroughly mixed. Each group was replicated twice. The 4 groups were assigned to four treatments as follows:-

Treatment	Processing Method
1	Unfermented with oil
2	Unfermented without oil
3	Fermented with oil
4	Fermented without oil

The unfermented group were pressed immediately using a hydraulic press. The dried mash were sieved using a screener of about 2 to 3mm and subsequently fried using aluminium pots over fire. The fermented groups were allowed to ferment for 2 days before frying. The gari from the four treatment were further subjected to storage at ambient temperature for a week after which the residual cyanide was measured.

Determination of relevant parameters: The cyanide content of the resulting gari from the different treatments and their proximate composition where determined by methods of AOAC, 1990.

Statistical design: The design used was a 2x2 factorial arrangement in a Completely Randomized Design [CRD] as outlined by Steel and Torrie, 1980. Significantly different means were separated according to the method of Duncan, 1955.

Results and Discussion

The effect of processing on the proximate composition and cyanide content at 'garification' and cyanide content after 1 weeks of storage is as presented in Table 1 and 2 respectively. Results showed that the crude protein content of the fermented groups (Treatments 3 and 4) were higher than those of the unfermented group. Similarly, the ether extract of the treatments with oil (Treatments 1 and 3) were higher than those of treatments without oil. Earlier investigation revealed that when cassava peels were put in a jute sack and allowed to ferment for two days the crude protein of the fermented peels increased from 5.25 to 7.5 percent

Table 1: Proximate Composition of Gari from the Four Treatments

Parameters (%)	Treatments			
	1	2	3	4
Moisture	5.20	4.98	5.10	4.87
Crude Protein	1.96	2.03	2.57	2.65
Crude Fibre	2.10	2.07	2.15	2.01
Ash	0.50	0.53	0.50	0.51
Ether extract	5.16	3.50	5.50	3.50
Nitrogen Free Extract	85.04	84.18	84.18	86.48

(Onyimonyi, 2002). The present finding further supports this earlier observation. The increase in the ether extract fraction of the treatments with palm oil must have arose because of the palm oil added to them. The ether extract fraction has been referred to as the fat portion of the sample. It contains organic acids, oils, pigments, alcohols and the fat soluble vitamins. It follows that an addition of palm oil to a sample will invariably increase its ether extract. This explains the increase in the ether extract fraction of treatments 1 and 3.

Result also revealed a reduction in cyanide content of the four treatments when compared to the reference cyanide content of the fresh pulp (437±15.2mg/kg). Treatments 1 and 2 (the unfermented group) have cyanide values of 223.29±6.2 and 203.16±11.7mg/kg which differed significantly ($P < 0.01$) from the values of 91.78±8.4 and 97.34±6.9mg/kg observed for the gari from the fermented group (treatments 3 and 4) respectively. The percentage of HCN loss from the pulp followed the same trend. Highest percentage loss of HCN was recorded for the fermented groups. However after one week of storage the HCN content of the gari of the treatments were 31.42±9.2; 33.6±2.6; 25.2±2.8 and 25.8±1.6mg/kg for treatments 1, 2, 3 and 4 respectively these values did not differ significantly ($P > 0.05$). There was no significant interaction between fermentation and the addition of palm oil to the cyanide content of the gari from the different treatments.

Cyanide in cassava could be bond, free or volatile (Cooke and Maduagwu, 1985) each of these forms of cyanide respond differently to processing and storage. The relatively high cyanide content of the gari from the unfermented products may result from the high proportion of bond cyanide in the pulp before they were fried. On the other hand, the fermented products which had enough time had the opportunity for their bond cyanide to be hydrolyzed and thus distributed to different forms and the volatile HCN content removed during frying. Also the enzyme linamarase had more time to hydrolyze the bond cyanide in the product. It has been reported earlier that the importance of fermentation in cassava processing is based on its ability to reduce the cyanogenic glucosides to relatively insignificant levels. The biochemistry and microbiology of the fermentation process is only superficially understood, but it is believed that some cyanidrophilic/cyanide tolerant. micro-organisms effect the breakdown of the cyanogenic

Table 2: Effect of Processing Methods on the Cyanide Content of Gari and the Residual Cyanide Content after one Week of Storage

Parameters		Treatments			
		1	2	3	4
HCN content of gari (mg/kg)		223.29^{a}±6.2	203.16^{a}±11.7	91.78^{b}±8.4	97.34^{b}±6.9
HCN loss from pulp (mg/kg)		214.11±5.7	234.40±12.4	345.62±7.7	340.06±11.2
% of HCN loss from pulp		48.95	53.55	79.02	77.74
HCN content of gari after 1week (mg/kg)		31.42±9.2	33.6±2.6	25.2±2.8	25.8±1.6
Cyanides content of fresh pulp (mg/kg)	437.4±15.2				

^{ab} Row means with different superscripts are significantly different (P<0.01)

glucoside (Tewe, 1983). When cyanogenic glucoside is exposed to linamarase, it is cleaved to produce hydrogen cyanide which evaporates or pressed out during cassava processing. It follows that all factors that are important in increasing the rate of enzymatically controlled reactions such as temperature, pH, surface area etc are relevant in fermentation. The present findings agree with these reports.

The benefit of adding palm oil to gari is not well documented. Omole and Onwudiwe (1982) observed that when rabbits were fed diets containing up to 50 percent of cassava peel meal supplemented with palm oil, their serum thiocyanate levels remain unaltered. Fomuyan *et al.* (1981) observed that the rate of hydrolysis of cyanogenic glucoside in cassava to produce the toxic hydrogen cyanide is greatly reduced in the presence of palm oil. From the results of the presence study, palm oil addition to gari did not have any significant effect on the level of cyanide. Rather fermentation was the main factor responsible for the drastic reduction of cyanide content. Also when the unfermented groups were stored for upwards of a week (7 days) their cyanide level became reduced to a level comparable to that of the gari from the fermented groups. The beneficial effect of palm oil addition to gari will therefore lie on its *in vivo* potential in detoxifying cyanide. There is evidence in literature that fats and oils decrease the rate of passage of materials in the gastro-intestinal tract (Duke and Evanson, 1972). The merit of palm oil addition may be as a result of its ability to increase the retention time of the cassava based diet in the highly acidic stomach thus allowing enough time for detoxification process by hydrogen chloride. This agrees with the views of Gozalo and Jerry (1980).

Conclusion: The result of the present study has shown that fermentation is a veritable tool in reducing the cyanide content of gari to appreciable safe levels. The practice whereby cassava is processed into gari the same day it was harvested most be discouraged. Regulatory Authorities in Nigeria such as the National Agency for Food Drugs and Administration Control (NAFDAC), Standard Organization of Nigeria (SON) and other Farmers Association should carry out awareness campaigns to educate the public on the danger of this unwholesome practice.

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