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Cyanide Content of Cassava Mash and Gari Flour and Influence of Water Activity (a_w) during Storage

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Cyanide occurs in many plants mainly in the form of cyanogenetic glycosides (Montgomery 1969). The lethal dose of HCN for man is in the order 0.5-3.5 mg/kg body weight (Wogan 1976). Diseases such as tropical ataxic neuropathy and goitre have been associated with cyanide intakes (Osuntokun 1968; Osuntokun 1969).

Cassava (Manihot) and gari flour obtained from cassava mash by fermentation and roasting, are major sources of energy for millions of people all over the world. Unfortunately, they contain toxic cyanides which are partly removed by processing. However, since the processing methods are highly unstandardized and have not yet been optimized to guarantee safe levels of cyanide in these foods at all times, regular analyses for cyanide levels are imperative. Although it is recognized that many factors influence the cyanide contents of cassava - based foods, it appears that there are no literature reports on the effects, if any, of water activity (a_w) on the cyanide contents of cassava mash and gari flour. Water activity is increasingly being recognized as a central factor affecting food composition, stability, safety and nutritive appeal. It is a measure of moisture availability for chemical reactions, microbial growth and activity (Troller and Christian 1978).

The present studies have therefore been directed at analyzing gari flour and the sweet and bitter varieties of cassava mash for cyanide levels. The influence of a_w on the cyanide contents of the varieties of cassava mash during a 12-wk storage, has also been investigated.

MATERIALS AND METHODS

The sweet and bitter varieties of cassava roots used

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in the studies were obtained from a local farm in Agbor-Obi, Nigeria while the lots of gari flour were purchased at five different markets, disignated A, B, C, D, E, in Benin City, Nigeria.

The cassava roots were subsequently peeled, washed with tap water, drained and grated. The grated cassava roots were designated cassava mash. Six hundred g triplicate samples, each, of the cassava mash and gari flour, were weighed into plastic plates and equilibrated to a_W 0.33, 0.94 and 0.97, respectively, in desiccators (Rockland 1960), and stored for 12 wks.

The samples were analyzed for cyanide contents before and after storage, on a weekly basis (Oyenuga and Amazigo 1957).

RESULTS AND DISCUSSION

The cyanide contents of gari flour obtained from 5 different markets in Benin City are shown in Table 1.

Table 1. Cyanide contents µg/g, dry wt. basis, of gari flour obtained from 5 different markets in Benin City, Nigeria.

Source	CN^- content (means $\pm$ SE 5 readings)
Market A	14.24 ± 1.03
Market B	18.79 ± 1.24
Market C	10.63 ± 2.11
Market D	22.08 ± 1.94
Market E	15.55 ± 1.69

Considerable variations in the cyanide content of the gari samples can be observed. The original glycoside content, maturity and agronomic practices associated with the cultivation of the cassava roots could have influenced the cyanide values. The processing methods may also be important. Especially among the traditional processors in Nigeria, there are clearly no standardized methods of production. Possibly, this leads to differences in the cyanide contents of the finished gari products. The levels of cyanide in the gari flour samples, as presented in Table 1, appear not to be unsafe (Wogan 1976). However, the possible toxic effects of long term intakes of even small amounts of cyanide need to be considered. This possibility, in co-

Table 2. Influence of water activity on the cyanide content (µg/g, dry wt. basis, means ± SE of 6 determinations) of cassava mash during a 12-wk storage.

No of wks in storage	a_w 0.97		a_w 0.94		a_w 0.33	
	A(Sweet type)	B(Bitter type)	A	B	A	B
0	81.00±2.12	162.34±2.01	81.00±2.12	162.34±2.01	81.00±2.12	162.34±2.01
1	67.71±3.12	137.43±3.8	68.10±12.12	138.97±3.24	69.43±2.12	140.06±1.84
2	55.59±1.10	115.38±1.80	58.38±1.27	117.39±1.72	59.61±0.09	121.11±3.36
3	45.25±0.09	95.12±3.00	47.37±1.60	99.11±1.60	50.23±1.27	104.10±1.53
4	35.62±2.12	76.74±1.65	37.85±1.27	83.18±2.61	42.63±0.90	89.60±2.25
5	27.00±1.27	63.33±1.57	29.67±0.90	69.31±1.42	36.77±2.12	80.06±2.25
6	19.24±1.10	51.04±4.00	22.31±1.10	59.56±2.32	31.62±2.12	66.86±2.43
7	15.27±2.12	39.89±1.44	15.94±1.27	51.10±1.28	27.27±1.10	57.55±1.96
8	11.68±1.27	32.42±1.40	12.62±2.12	43.06±1.19	23.46±2.12	48.69±2.08
9	11.23±2.12	25.47±1.33	11.97±1.10	35.97±1.96	20.20±2.12	41.86±0.93
10	8.95±2.12	19.09±1.28	9.23±2.12	29.65±1.10	16.95±1.27	35.42±0.93
11	7.71±2.12	13.13±1.24	7.94±2.12	23.84±1.77	14.30±0.90	29.92±0.88
12	4.96±2.12	7.61±1.20	7.44±1.27	18.61±0.97	11.90±2.12	24.90±0.84

njunction with doubts surrounding the efficacy of the unstandardized methods in detoxifying the cassava mash to safe levels all the time, call for continuous analyses for cyanide in gari flour.

Decreases in the cyanide content of the cassava mash during the 12-wk storage under various a_w can be observed in Table 2. The storage decreases which were statistically significant (Bhattacharyya and Johnson 1977) ($P = 0.01$) indicate that detoxification, via fermentation, occured during storage. In the fermentation process, starch is broken down and organic acids, such as formic and lactic acids are formed at the same time. Additionally, glycosides are hydrolyzed under the action of acid-catalyzed glycosidase (Umeh 1977) and this represents the detoxification proper.

The results presented in Table 2 also indicate that the a_w of 0.97 and 0.94, respectively, were more effective in lowering the cyanide content of the cassava mash than the a_w of 0.33. Clearly, if the breakdown of cyanogenetic glycosides into their corresponding glycones and aglycones is enzyme-catalyzed, then, elevated water activities may serve to stimulate the hydrolytic action of the glycosidases found in cassava mash, and lead to correspondingly lower levels of the residual glycosides in the mash. High water activities may also serve to increase the amorphous regions of the starch granules, thereby, exposing the glycosides therein to the action of the stimulated glycosidases. The practical implication of the results in Table 2 is that long fermentation periods, especially, under conditions of high water activities, may be effective in the substantial detoxification of cassava mash.

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