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DEFIBRENATION AND TIME COURSE FERMENTATION IMPACT ON THE CYANIDE CONTENT OF INDUSTRIALLY AND LOCALLY PROCESSED GARI FOOD IN CROSS RIVER STATE OF NIGERIA

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ABSTRACT

The cyanide and fibre content of different samples of gari (industrially and locally processed) obtained from different locations were analyzed. From the results the cyanide content of the Obubra market sample was 3.25 ± 0.23 mg HCN/100g, compared to 4.46 ± 0.22 mg HCN/100g of the bitter variety TMX 30552 from Cross River Agricultural Development project (CRADP). The international institute for Tropical Agriculture (IITA) recommended variety, TMX 1425(2) had the lowest cyanide content with a value of 1.21 ± 0.06 mg HCN/100g. The cyanide content of the market sample survey was found not to approach toxic levels (2.75±o.08 to 4.46±0.02 mg HCN/100g) generally. The fibre content of the bitter variety was high with a value of 3.4 ± 0.02% weight. In contrast, the industrially processed Obubra gari had a rather low cyanide content of 1.84 ± 0.06 mg HCN/100g corresponding to a low fibre level of 1.90 ± 0.02% DM. The Better life variety (BLV) industrially processed at Ikot Nakanda was equally low in cyanide content (1.46± 0.14 HCNmg/100g) and fibre content (1.69±0.4 %DM).The effect of time course fermentation on the cyanide and fibre content of cassava raw grated Tubers (*M. Utilissima*) over 4-days showed that the cyanide content had a range of 34.50± 0.05-2.85±0.05 HCN/100g and 1.20 ± 0.01–2.40 DM respectively. Cyanide and fibre content of 34.50±0.05mg (HCN/100g) was obtained from both raw grated and fried cassava gari sample on the first day. A high content of fibre: 2.40±0.04% DM was obtained for the 4th day fermentation of the sample variety (*M. Utilissima*).

INTRODUCTION

There is a great concern about the levels of cyanide in many varieties of cassava products including gari. There is equally good evidence that some fibre depleted diets cause pathological effects (Umoh et al, 1985). These effects are manifested not only in the gastro-intestinal tracts but other anatomical structures such as the arteries, lower limb veins and gall bladder. Cyanide in cassava has been linked with tropical amploipia – (blindness that is common in West Africa) and Tropical Ataxia Neuropathy (TAN) – (Umoh *et al*, 1985).

Fibre contents in gari and feeds generally have been regarded as being of null nutritive value, but its importance in recent times has been appreciated both clinically and in animal husbandry. This paper reports some variations in the cyanide and fibre content of industrially (defibrenated) and locally processed gari samples across Cross River State of Nigeria.

The paper also will reflect the effect of time course fermentation on the cyanide and fibre content of raw grated cassava (M. Utilissima) and the final gari product for 4 days. The time rate of change of cyanide (dCN/dt) and fibre (df/dt) in this species of cassava product will be determined. The result will be used to highlight the levels of these components in cassava food(s) while suggesting improved procedural detoxification with recommended dietary fortification.

MATERIALS AND METHODS

The gari samples used in this study were obtained from different but specific locations in Cross River State. The market samples were purchased on market days mixed in bags, while the industrially processed samples were obtained from the factories directly at the packaging stage.

Cassava tuber *(M. Utilissima)* obtained from Ikot Effanga, Cross River State was grated into raw mesh, air fermented in Polythylene bag and fried to yield gari within 3 - 4 days interval. The reagents and chemicals used were of analytical grade.

Liberation of cyanide from samples through hydrolysis and subsequent determination of the isolate was by the method of (A.O.A.C) 1975. Fibre content in the samples was determined by acid digestion (A.O.A.C), 1975. Moisture content and percent dry matters (%DM) were also determined.

RESULTS

The results obtained from the course of this work are presented in tables 1, 2&3. Volume (ml) of silver nitrate was used to calculate the respective samples of cyanide content in mg/100g dry matter and ranges from 1.21 ± 0.06 to 4.46 ± 0.21 mg/100g dry matter. The fibre content of the respective samples in percent dry matter (%DM) is shown in table 1 and ranges from 1.69 ± 0.04 to 3.34 to ± 0.03 (%DM).

The cyanide content from *(M.utilissima)* raw grated and fried samples for 4 days fermentation is shown in table 2. This cassava species was selected based on the report by The-Koronye and Ngoddy (1985), report that its high cyanide content distracts mealy bug attack. The moisture content (%DM) and fibre (%DM) are presented in table 3 as well as the time rate of change of cyanide (dCN) content (raw grated and fried) and fiber content (*M.Utilissima*) in table 4.

There are differential changes in the amounts of cyanide and fibre as per change in the time period. The time rate of change of cyanide (dCN) and fibre (df) are calculated mathematically being the expression (dCN/dt), where dCN is the discrete change in the cyanide content in mg/100g and df, the change of fibre content in %DM while dt is the change in time period per hour. The graphical illustrations of these changes are shown in figures 1 and 2.

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TABLE 1: CYANIDE CONTENT IN mg/100g AND FIBRE CONTENT OF GARI SAMPLES FROM DIFFERENT SOURCES IN CROSS RIVER STATE .

SAMPLE	SOURCE	BRAND/COLOUR	MOISTURE PERCENT DRY MATTER	HCN (mg/100g)*	FIBRE CONTENT (%DM)
A	CPL Obubra	White	89.6 ± 0.6	1.84 ± 0.04	1.90± 0.02
B	Akamkpa (Market)	White	89.4±0.19	2.75±0.08	2.72±0.06
C	(Obubra)	Yellow	81.2±0.03	2.35±0.23	2.00±0.02
D	Calabar (Market)	Yellow	82.6±0.01	1.52±0.19	3.12±0.06
E	ADP (TMX 30552 (2)	Yellow	80.6±0.02	4.46±0.02	3.34±0.03
F	ADP (TMX 14254(2)	Yellow	88.7±0.05	1.21±0.06	2.84±0.02
G	Better Life (Ik.Nakanda) Akpabuyo	White	86.4±0.21	1.46±0.14	1.69±0.04

*** Means of three separate determinations ± S**

TABLE 2: CYANIDE CONTENT (mg/100g) AFTER 4 DAYS FERMENTATION OF CASSAVA (*M.Utilissimma*) RAW GRATED AND FRIED GARI.

DAY (FERMENTATION)	(*M.Utilissimma)*Sample	HCN (mg/100g)
1st	Raw	34. 50±0.05
	Fried	19.00±0.02
2nd	Raw	18. 80±0.11
	Fried	9.00±0.05
3rd	Raw	4. 40±0.05
	Fried	2.85±0.05
4th	Raw	2. 85±0.03
	Fried	1.80±0.04

- **Means of three separate Estimations ± SD**

TABLE 3: MOISTURE AND FIBRE CONTENT (%DM) OF CASSAVA GARI (*M.Utilissimma*) PRODUCED AFTER 4 DAYS FERMENTATION

DAY	MOISTURE CONTENT (%DM)*	FIBRE CONTENT (%DM)*
1st	81.80±0.02	1. 20±0.01
2nd	84.00±0.01	1. 40±0.02
3rd	86.00±0.02	1. 80±0.03
4th	90.50±0.03	2. 40±0.04

- **Mean of three separate determinations ± SD**

TABLE 4: THE EFFECT OF TIME (DURATION) OF FERMENTATION ON CYANIDE OF RAW GRATED AND FRIED CASSAVA AND FIBRE CONTENT (*M.Utilissima*) for 4 DAYS FERMENTATION

dt in (hours)	dCN in milligrams		dF (%DM) Gari
	Raw grated	Fried	
24	0.65	0.42	0.010
48	0.23	0.13	0.013
72	0.07	0.02	0.020

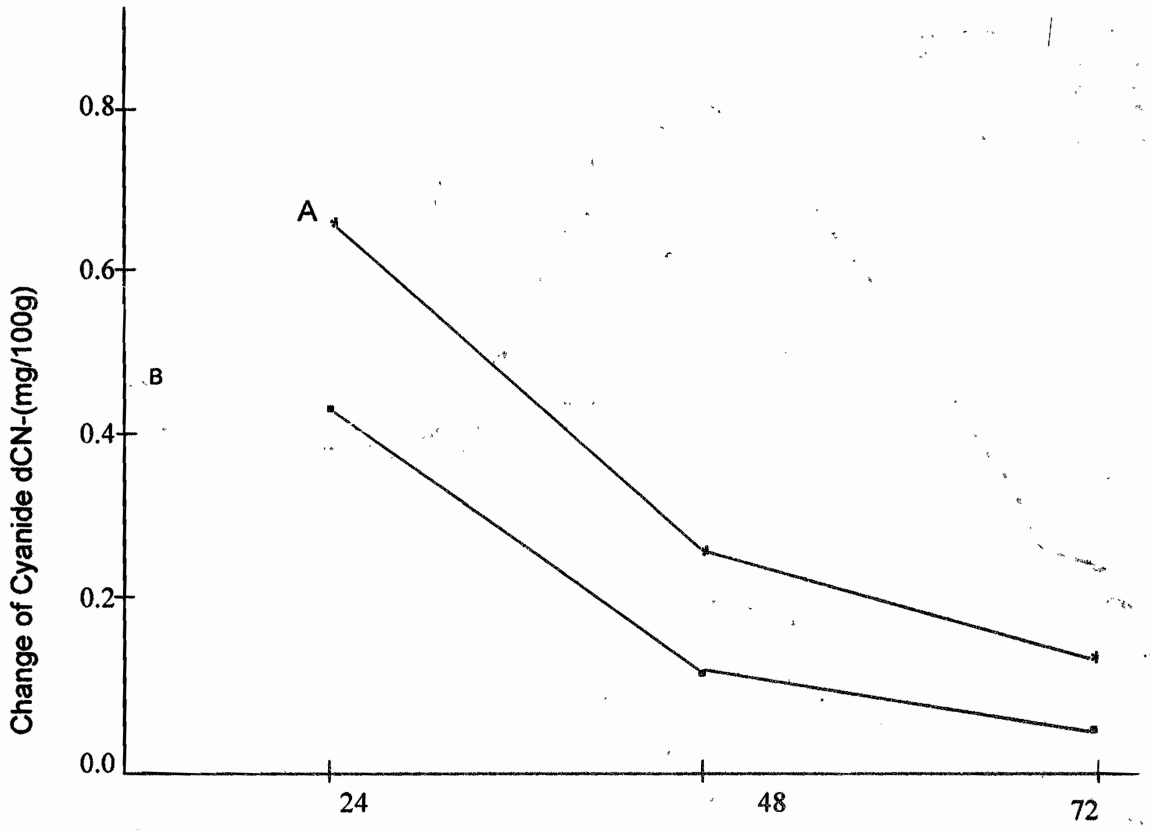

Fig. 1: Discrete: Time rate of change of Cyanide (dCN-) and dt for the raw grated (A) and Fried (B) gari sample (*M. Utilissima*): from table 4.

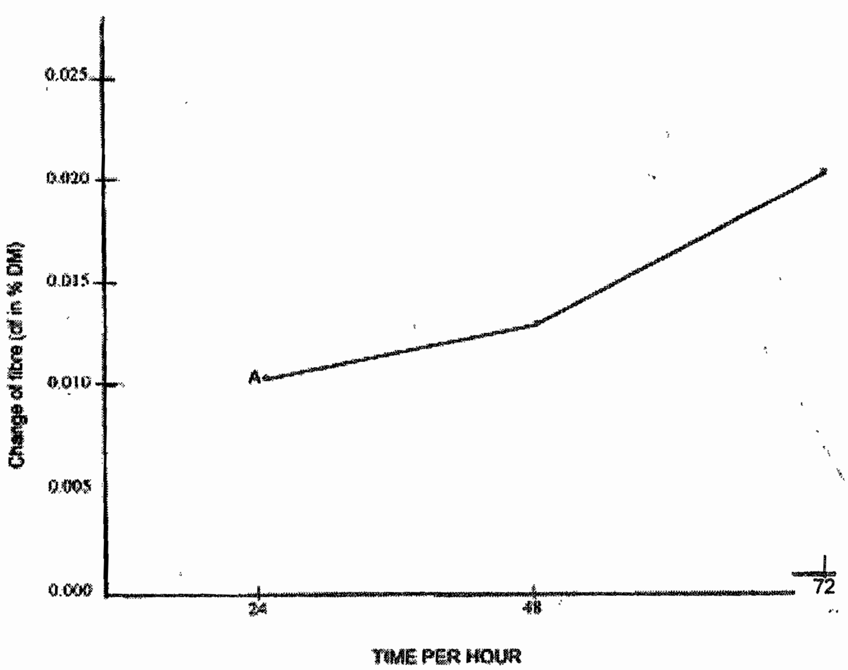

Fig. 2: Non-Discrete: Time rate of change of fibre content (df) for the given period of time for the fried sample (*M. Utillissima)*

DISCUSSION

Two important chemical components – cyanide and fibre have been reported in cassava (Akinrele, 1976; The-Koranye Ngoddy, 1985). The former, a cynogenic glycoside (*Linamarin*) with other related compounds may pose as toxicant(s) when improperly processed food of cassava product is eaten.

Most factory gari undergo defibrenation before final packaging and this may reduce the cyanide levels. An extensive industrial processing of cassava into gari as is reported, not only reduces the cyanide content but also removes fibre – which is low in cassava meal (Eka, 1986). Fibre constitutes an important component in food since high fibre diet leads to increased faecal excretion of nitrogenous compounds including fat/oil (Lipids). The detoxification of cyanide by the use of palm oil is a different aspect entirely. According to the standard organization of Nigeria (SON), 2mg/100g of cyanide is the acceptable level in Nigerian gari.

In this study, we have found out that the cyanide in gari from market samples ranges from 1.46 ± 0.14 to 3.25 ± 0.32mg HCN/100gm. The result of the cyanide level for the bitter variety tends to agree with that of (Eka, 1986), which was reported to be 4.6 ± 0.2mg/100gm and fibre of 1.40 ± 0.2% D.M

The cyanide levels of the industrially processed gari from cassava processing Ltd. (C.P.L) Obubra had a low value relative to other samples in the market (locally processed). This low value of cyanide may be attributed to the 3 days fermentation period allowed in the factory coupled with high temperature during frying. It is pertinent to note that the factory gari is defibrenated and this as well reduces substantial amount of the cyanide remaining after frying.

The bitter variety ADP [(TMX 30552 (2)] had the lowest level of moisture 80.6 ±0.02% DM, indicating a high moisture content. It would appear that some of the cyanide in this sample may have been trapped in the moisture and account for the high cyanide content of 4.4±0.21mg/100gm. The moisture content of gari from different source obtained in this study tend to agree with those of oyenuga, (1968)

The results of the fibre levels range form 1.90 ± 0.02% D.M. in C.P.L Obubra to 3.34% DM in the bitter variety. The fibre levels of the industrially processed gari were low relative to other samples, but comparable with those of oyenuga (1968). In the mechanized, industrial process, a sieving system is in place to separate fibre from the flour-thereby removing some amount of the cyanide from the total flour.

From the results of the fermentation, about 50% and 92% of cyanide is liberated from the raw and fried cassava *(M. Utilissima)*- on the 1st and 4th days respectively. This supports the finding of (Eka, 1986) that 3 -4 days of fermentation was ideal for fermenting cassava food(s).

The time rate of change (dt) of cyanide (dCN) and Fibre (df) show differential amount of both components during cassava processing. This mathematically novel approach indicates how much cyanide is lost and fibre gained during fermentation, and could be a useful index in cassava processing. As the cyanide decreases there is concomitant increase in the fibre with increase in fermentation time, dCN/dt and df/dt. This can be explained as a reflection of the chemical fact that during fermentation, there is reduction on the amount of other components such as carbohydrates, cyanide and water, so that after frying, cassava flour is left with more fibre and other products which may be of nutritive value (Sidwell, 1967; Adewusi, *et al.*, 1999). Fermentation also enhances micronutrient bio availability and aids in degrading antinutritional factors (Achinewhu, *et al.*, 1998)

The improvement of the nutrient value of cassava gari (rich in energy but poor in proteins and lipids) is a subject of intense interest. Although fermentation and processing of cassava into gari slightly increase proteins and lipids Eka (1986), this in itself does not yield an adequate balanced diet, considering the high scale consumption of gari food stuff in Nigeria. This therefore calls for a process of dietary fortification in cassava gari foods.

According to FAO/WHO (1965) protein requirements in food concentrates should contain essential amino acid pattern of mixtures rich in lysine, threonine, tryptophan and sulphur amino acids of methionine and cystine. These amino acids can be considered important in fortification of cassava food(s). Single cell protein as fortification in low protein gari diet is hereby suggested. Seeley *et al*, (1950) found that dried yeast of single cell protein (SCP) when added to breads at a concentration not exceeding 3% and fed to rats resulted in an increase in daily weight gain over control. In another research development, fish protein concentrate (FPC) has been used in supplementing wheat flour (Sidwell, 1967).

And studies undertaken on high protein gari-like dry product showed that the products water absorption and swell ling characteristics were lower than those of protein- free gari (Akinyele and Fasaye, 1988).A mixture of 10% fish protein concentration (FCP) and 90% wheat flour in cookies showed a PER of 3.0 compared to 3.4 for casein.

CONCLUSION

In conclusion, it has been shown that cyanide levels in gari samples in Cross River State fall within the range of acceptable edible limits. The fibre contents of the industrially processed gari is far below expected usefulness and hence the need for fibre fortification from cereals and grains.

Whereas Cassava processed into gari food(s) results in the elimination of over 90% of the cyanide and a minimal increase in fibre and protein it becomes necessary that dietary fortification with essential amino acids of proteins be recommended for the improvement of Cassava based diet.

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