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Cyanide and Heavy Metal Concentration of Fermented Cassava Flour (*Lafun)* Available in the Markets of Ogun and Oyo States of Nigeria

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Abstract**—**Fermented cassava flours *(lafun)* sold in Ogun and Oyo States of Nigeria were collected from 10 markets for a period of two months and analysed to determine their safety status. The presence of trace metals was due to high vehicular movement around the drying sites and markets. Cyanide and moisture contents of samples were also determined to assess the adequacy of fermentation and drying. The result showed that sample OWO was found to have the highest amount of 16.02±0.12mg/kg cyanide while the lowest was found in sample OJO with 10.51±0.10mg/kg. The results also indicated that sample TVE had the highest moisture content of 18.50±0.20% while sample OWO had the lowest amount of 12.46±0.47%. Copper and lead levels were found to be highest in TVE with values 28.10mg/kg and 1.1mg/kg respectively, while sample BTS had the lowest values of 20.6mg/kg and 0.05mg/kg respectively. High value of cyanide indicated inadequate fermentation.

Keywords**—**Cyanide, fermented, heavy metal, *lafun*.

I. Introduction

CASSAVA (*Manihot esculenta* Crantz) is grown throughout the tropic and could be regarded as the most important root crop, in terms of area cultivated and total production [1]. Nigeria is the largest producer of cassava in the world with about 45 million metric tonnes and its cassava transformation is the most advanced in Africa [2]. It is the most important root crop in Nigeria in terms of food security, employment creation and income generation for crop producing households [3]. It supplies about 70% of the daily calorie of over 50 million people in Nigeria. Edible part of fresh cassava root contains 32-35% carbohydrate, 2-3% protein, 75-80% moisture, 0.1% fat, 1.0% fibre and 0.70-2.50% ash [4]. In spite of the desirability of cassava for consumption as food and animal feed, it contains some toxic compounds such as cyanogenic glucosides, linamarin and lotaustralin which are highly toxic.

However, the toxicity of the cyanogens is as a result of inadequate processing [5]. Cyanogens are glycosides (compounds containing a sugar moiety linked to a non-glycon entity from which it can be separated by hydrolysis) whose hydrolyses result in the release of toxic hydrocyanic acids [6]

Lafun is fine flour obtained from the traditional fermentation of cassava. It is usually prepared as stiff porridge using boiling water, prior to being consumed with soup [7], [8]. The processing involves peeling, cutting, submerged fermentation, dewatering, sundrying and milling. One of the constraints in the commercialization of locally fermented cassava products is that the quality of the products varies from one processor to another as well as the processing batch [7].

The method of drying this product is by sun drying along the roadside for cost optimization. This has also resulted in pollution by trace metals from emission of vehicles due to high level vehicular movement. Heavy metals are potential environmental contaminants with the capability of finding their way into the food we eat and causing human health problems. They are given special attention throughout the world due to their ubiquitous nature and toxic effects even at very low concentrations [9].

This research is meant to assess the cyanide level and metal pollutant in fermented cassava flour from 10 locations around Ogun and Oyo states of Nigeria so as to establish their safety status.

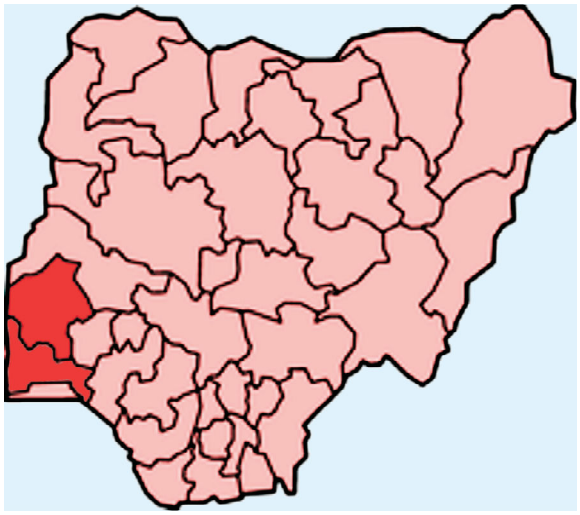

Fig. 1 Map of Nigeria showing the study states

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II. Materials and Methods

Fermented cassava flour samples were collected aseptically from the sellers in 10 locations in Ogun and Oyo States**.** The two states were selected being the major producers and consumers of this product. The samples after collection were labeled and taken to the laboratory for analysis.

A. Hydrogen Cyanide Determination

This was carried out using the method described by [10]. 2g of each of sample was made into paste in 20 mL of distilled water in a corked conical flask overnight after which extraction took place. The extract was filtered and the filtrate was used for the analysis. 1 ml of this was put in a test tube, followed by the addition of 4mL alkaline picrate solution. This was heated in water at 90^0C for 5min. After the colour development, the absorbance values of each sample was determined at 490nm using the spectrophotometer (AAS 6200 SHIMADZU). The actual amount of cyanide was extrapolated from the standard cyanide curve. A blank reagent from 4mL picrate solution and 1mL distilled water was also prepared to standardise the spectrophotometer before measuring the absorbance.

B. Moisture Content Determination

The moisture content of the samples was determined by the standard method of [11]. 5.0 g of each of the sample was weighed into already weighed petri dishes and put inside a preset oven at 105^0C for 4hr, followed by drying in dessicator until constant weights were obtained. The difference in weight was used to obtain the moisture content. All analyses were carried out in triplicates. The percentage moisture was calculated as

$$\text{Moisture content MC } (\%) = \frac{\text{Weight loss}}{\text{Original weight}} X100\%$$

C. Trace Metal Determination

5.0 g of each sample was weighed out into a platinum foil and dried. The dried samples and the ashes produced were digested with 20 mls of 1.1 (v/v) HNO_3 and HCL acids in 100 mL beaker. The digests were filtered and the filtrates were diluted using de-ionized water to 100 mls and 2 mls aliquots was used for the heavy metals determination with the aid of flame atomic absorption spectrophotometer (Buck Scientific, model 210 VGP, USA) using aqueous calibration standards prepared from stock standard solution of the respective elements [12].

III. Results and Discussion

Fig. 1 shows the results of the cyanide content of the samples. It was observed that the value ranged from 10.51±0.13mg/kg to 16.02±0.12mg/kg with sample OWO having the highest amount and sample OJO having the lowest amount. All the samples have cyanide content above the 10mg/kg recommended values of [13], [14]. This can be attributed to the short period of fermentation sometimes employed by the processors. HCN is responsible for tissue hypoxia. Chronic exposure of HCN causes neurological, respiratory cardiovascular and thyroid defects. Symptoms of this may be seen less than one minute following ingestion of cyanide [15], [16]. The results of the moisture content of the samples were shown in Fig. 2. It was observed that this ranged between 12.46±0.47% and 18.50±0.2% with OWO having the lowest amount and TVE having the highest amount. These values were higher than that stipulated by [17], but similar to that obtained by [8], [18]. It was observed that the fermented cassava flour sold in these markets is always exposed without any package in opened bowls. Since the collected samples were subjected to the same conditions, the high level of water content could be explained by the environmental humidity in this part of Nigeria. This may encourage the growth of mould thereby limiting the shelf life of the product and safety status especially if the mould is toxigenic.

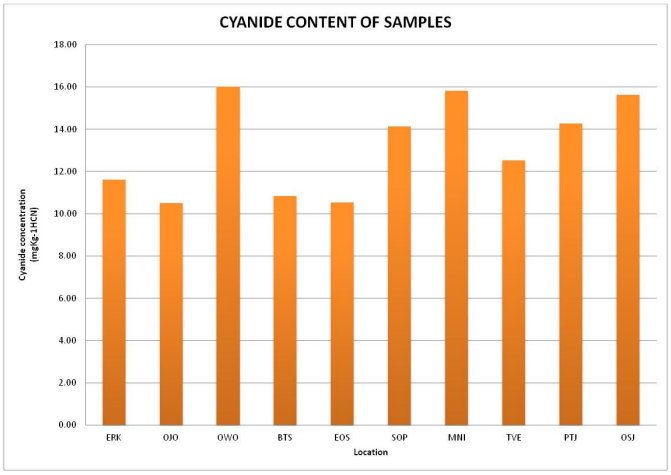

Fig. 1 Cyanide composition of fermented cassava flour samples

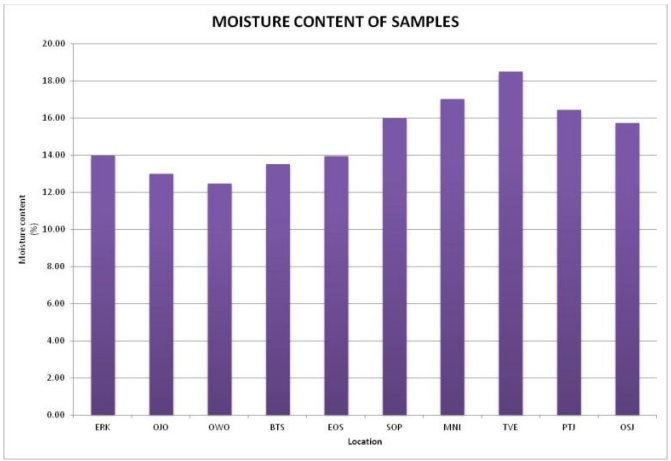

Fig. 2 Moisture content of fermented cassava flour samples

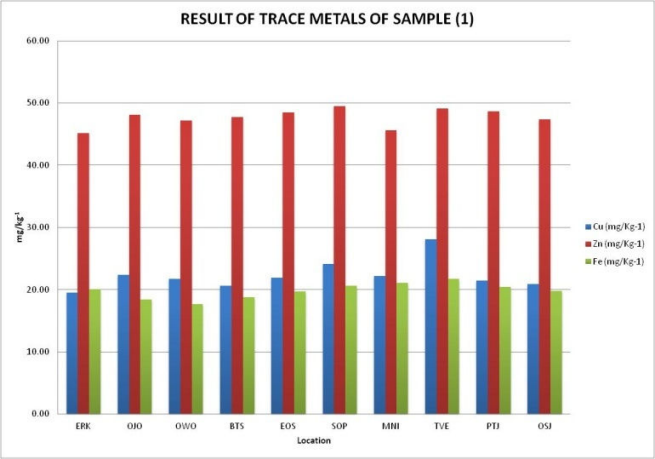

Fig. 3 Result of trace metals of samples

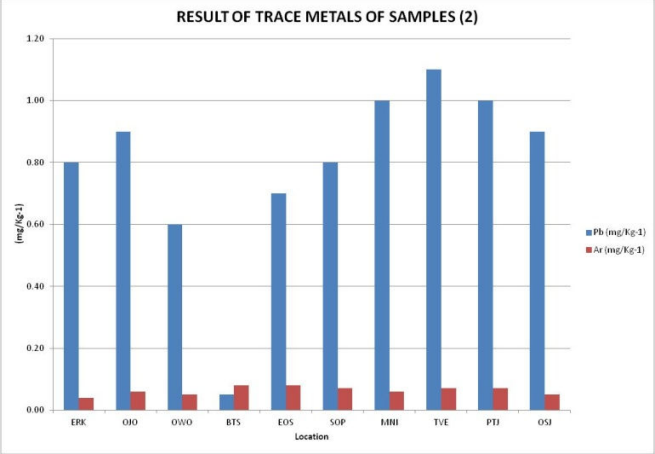

Fig. 4 Result of trace metals of samples

Fig. 3 and 4 show the results of the trace metals analysed. Cu, Zn and Fe are nutritionally essential metals. They are referred to as trace elements and are commonly found naturally in foodstuffs. Iron is an essential trace element required by all forms of life. In man it is required for the synthesis of haem proteins and in many enzyme systems. Various groups (male, female, children, pregnant, lactating) differ in requirement for iron, iron deficiency is one of the most common nutritional deficiencies in children, women of child bearing age, and pregnant women. It rarely occurs in adult men, except in cases of chronic bleeding. However, these metals are toxic when taken in excess of requirements [19].

Fig. 3 revealed that all the samples except ERK had values of Cu greater than the recommended values which is 10.0mg/Kg [20]. Meanwhile, the results of the Zinc (Zn) was lower than the recommended maximum values of 50.mg/kg [21].

Fig. 4 shows the results of lead (Pb) and arsenic (As) that were determined. Except for TVE which is slightly higher in Pb, all others were found to be lower than the recommended value of 1.0mg/kg [3], [23]. The permissible level of As is between 0.5-1.0mg/Kg body weight [24] while Mg was not determined in all the samples. Excessive content of these metals in food is associated with a number of diseases, especially of the cardiovascular, renal, nervous and skeletal systems. These heavy metals are also implicated in carcinogenesis, mutagenesis and teratogenesis [25], [20].

The result therefore showed that the levels of the trace metals from emission of vehicles were not high enough to cause toxicity in these locations.

IV. Conclusion

The study shows that the chemical composition of the product from the study areas needs to be given adequate attention so as to prevent toxicity.

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