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Assessment of heavy metals level in cassava flour sold in Anyigba Market Kogi State, Nigeria

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ABSTRACT

Kogi State, North Central Nigeria is a food basket state has several food items obtained from her rich agricultural soil which when harvested are transported to the markets raw or in processed form. Cassava flours processed locally and sold in Anyigba market were screened for mineral elements using atomic absorption spectrophotometer. Flour samples were obtained at random from different cassava flour sellers, processed and analyzed. Mineral elements analyzed for were K, Ca, Mg, Fe, Cu and Mn. Heavy metals Pb, Co and Cd were also determined. Potassium was analysed using flame photometer. Sample A has the highest level of K and Mg of 6.71µg/g and 4.84µg/g respectively while sample B showed the lowest level of K and Mg assayed 4.8µg/g and 1.18µg/g respectively. The heavy metals Pb, Co and Cd screened for were below detection limit. Mn was as low as 0.01µg/g in sample A and D. Results of the HCN showed that sample C have concentration value of 14.7ppm and D recorded 15.4ppm. These values were above WHO permissible limit cyanide concentration of 10.0ppm. Moisture and ash contents were also determined.

Keywords: Mineral, elements, cyanide, moisture.

INTRODUCTION

Cassava (*Manihot spp*) is the most staple food crop in tropical Africa. Its unique high adaptivity to a variety of ecological conditions has earned it the status of being the most important famine reserve crop [1]. Current trend in cassava production indicate that the production is increasing globally and that growing of cassava is expanding to semi arid areas [2].

Cassava is consumed either raw (i.e. boiled) or in a variety of processed forms known by different names depending on local customs and preferences [3]. Despite the high level of cassava production, Nigeria consumes virtually all that she produces. The household's consumption can be transformed into a number of products both for domestic and industrial uses [4].

There are two broad classifications of cassava's food forms, the food forms are fermented and unfermented cassava, and this classification is based on the processing technology. There are four major forms of cassava products; these are cassava meal, chips, flour and starch [5]. Cassava flour is gaining fast recognition as a good substitute for wheat flour in the bakery, biscuit and fast food industries [6].

The quality factors to be considered in the production of flour for human consumption are nutritional factors like mineral composition, chemical composition, and absence of mycotoxins, heavy metals, and residual cyanogens [7].

Cassava has about two hundred species but there are only two main species of nutritional and economic values. These species are M*anihot esculanta* crantz and *Manihot utilissima* phol [8]. Two species have also be identified on the basis of the cyanogenesis as bitter (*Manihot esculanta*) and sweet (*Manihot utilissima* phol) [7]. More than two-thirds of the total production of cassava is used as food for human, with lesser amounts being used for animal feed and industrial purposes [9]. Cassava can be processed into a number of products both traditionally and industrially. Among these products is cassava flour [10]. Processing cassava into dry form reduces the high moisture content, makes it more transportable, reduces volume, ensures stability, reduces cyanide content and makes it more palatable while improving on the quality of products [11]. The rate of cyanide reduction vary with the processing methods and ranges from 69.9 to 100 percent [3].

Cassava flour has major potential as an additive to or substitute for other types of flours in private households and in the food industry. Though cassava has low nutritional value, it remains an important stable food in tropical regions of Africa. Cassava can be used in private household to create a range of new dishes, including pasteries such as cookies, biscuits and rolls, doughnut, cakes, bread, flakes etc. Cassava flour is less expensive than imported wheat flour, enabling household users to occasionally surprise the family with some cookies or a cake at no extra cost [10].

Though cassava flour contains a list of mineral elements in trace amount which are of good use to the body may also contain a number of heavy metals. These heavy metals sometimes are accumulated in the cassava through the soil. Heavy metals are not good for the body; they could be very toxic when consumed in large quantity [12]. .

The objective of this study is to investigate the quality of cassava flour sold in Anyigba market in Kogi State of Nigeria with emphasis on the level of some mineral elements on the flour, presence of heavy metals and residual hydrogen cyanide.

MATERIALS AND METHODS

2.1. Sampling. Cassava flour were obtained from different seller in the market according to section of the market and grouped into four. Quartering was then carried out after proper mixing to obtain composite samples.

Sub-samples (1 kg, each) were taken at random from the composite sample (15 kg) and were processed for analysis by the wet-ashing method. The samples were first oven dried at 60 °C for 24 h. The dried samples were powdered in a mixer grinder taking care not to overheat the sample. 0.5 g of dried samples was digested with HNO_3 and $HClO_4$ in a 5:1 ratio until a transparent solution was obtained [13]. The digests were filtered and diluted to 25 ml, with distilled water

Analytical reagent grade chemicals were used. Atomic Absorption Spectrophotometer was used to determine mineral elements concentration while Flame Photometer was used to determine potassium after digestion following standard methods.

Hydrogen cyanide: Hydrogen cyanide was determined using picrate paper kits.[13] In this method 1.0g of each of the samples were weighed and poured in a flat bottom plastic bottle. Another set of samples with the same weight were weighed into a set of flat bottom plastic bottles containing enzyme and buffer (6.0); this was identified by a black spot sported on it. Then 5.0ml of distilled water was pipetted into each bottle containing the samples and immediately the yellow picrate paper was dropped into the bottles and covered; they were left to incubate for 21 hours in a dark cupboard.

After incubation, the plastic backing sheet was removed from the picrate paper and the picrate paper was immediately put into test tube containing 5.0ml of distilled water. The test tube was left for 30 minutes with frequent stirring. A blank was prepared. The absorbance of the solution in the test tube was taken at 510nm using a 6405uv/visible spectrophotometer against the blank.

The total cyanide content (ppm) = 396 x absorbance.

The moisture and ash content of the samples were determined [14]. In the determination of the ash content, 2.0g of the samples was ashed in a furnace at 500^0C.

$$Ash\% = \frac{Wt\,of\;ash}{Wt\,of\;sample} \times 100$$

2.2. Quality assurance

Appropriate quality assurance procedures and precautions were carried out to ensure reliability of the results. Samples were generally carefully handled to avoid contamination. Glassware was properly cleaned, and the reagents were of analytical grade. Double distilled deionised water was used throughout the study. Reagents blank determinations were used to correct the instrument readings. For validation of the analytical procedure, a recovery study was carried out by spiking and homogenizing several already analyzed samples with varied amounts of standard solutions of the metals.

RESULTS AND DISCUSSION

The mean values of moisture content in the cassava flour determined are presented in Table 1. The result obtained showed that the moisture content of cassava flour was within the range of 0.61 – 0.72%. Sample A had the lowest moisture content of 0.61% while sample D has the highest moisture content of 0.72%. Samples B and C have moisture content of 0.67% and 0.68% respectively. All samples are within the WHO permissible levels of 13% [14]. This means that cassava flour sold in Anyigba market meets up to standard in terms of moisture content and this means that they can be stored for a period of time prior to consumption when properly packed from moisture.

The quantity of inorganic residue (ash) remaining Table 2. shows that sample A has the lowest percentage ash content of 1.03% followed by sample B with 1.04%. Sample C and E showed the percentage ash of 1.47 and 1.26% respectively.

The residual hydrogen cyanide content in the flour sample determined is shown in Table 3. The results revealed that samples C and D have higher concentration of cyanide 14.7ppm and 15.4ppm respectively. These values were above the WHO permissible limit of cassava flour of 10ppm. Sample B have the lowest hydrogen cyanide concentration level of 7.92ppm. The high level of HCN in C and D signifies that proper fermentation did not take place and going by WHO standard, sample C and D cassava flour may be of great health risk and may not be good for consumption with respect to hydrogen cyanide.

Analysed mineral element concentration is presented in Table 4. The mineral elements examined are Mg, Ca, Fe, K, Cu, and Mn. Heavy metals determined are Pb, Co, and Cd. Results showed that K level was highest in sample A which is 6.71 μgg^{-1}. Sample D recorded a similar concentration of 6.14μgg^{-1}. Samples B and C showed potassium value of 4.80 μgg^{-1} and 5.64 µg/g respectively. Calcium concentration is lowest in sample B with value of 1.18µg/g and highest concentration of 1.53μgg^{-1} in sample C. The results of Magnesium concentration showed similarity as calcium concentrations. Samples A, 1.96 μgg^{-1}, B, 1.37μgg^{-1}, C, 1.74 μgg^{-1} and D, 1.71 μgg^{-1}. Iron concentration level ranges from 0.06μgg^{-1} to 1.2 μgg^{-1}. Sample A showed the lowest concentration of 0.06μgg^{-1}, while sample C value was 1.27µg/g. For all samples analysed, copper showed the lowest concentration. Samples A and D have concentration of 0.01 μgg^{-1} in each case and was below detection limit for samples B and C.

Similarly, Mn, Pb and Cd were below detection limit in all samples examined. This makes the cassava flour suitable for consumptions. Lead and cadmium are important elements to be considered in terms of food-chain contamination. Presence of these metals even in low quantity in food poses health risk.

Table 1. Showing moisture content in mean (%)

Samples	Mean (%)
A	0.61 ± 0.11
B	0.67 ± 0.11
C	0.68 ± 0.17
D	0.72 ± 0.10
E	0.70 ± 0.11

Table 2: Ash content of cassava flour (%)

Samples	Ash content in %
A	1.03
B	1.04
C	1.47
D	1.64
E	1.26

Table 3: The results of residual hydrogen cyanide in cassava flour

Samples	Total cyanide content (ppm)
A	7.92
B	4.75
C	14.7
D	15.4

Table 4: Concentration of metals in cassava flour (µg/g)

Minerals	Sample A	Sample B	Sample C	Sample D
K	6.71	4.84	5.64	6.14
Ca	1.42	1.18	1.53	1.36
Mg	1.96	1.37	1.74	1.71
Fe	0.66	1.12	1.27	1.01
Cu	0.01	BDL	BDL	0.01
Mn	BDL	BDL	BDL	BDL
Pb	BDL	BDL	BDL	BDL
Co	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL

BDL: Below Detection Limit.

CONCLUSION

The moisture and ash content of cassava flour obtained from Anyigba market for this analysis were within the permissible level when compared with the WHO standard.

The flour contains some minerals which are essential for the body. These elements are K, Ca, Mg and Fe. Though present in low concentration, they play vital roles in the body system. The non detection of heavy metals such as Co, Pb and Cd makes the flour good material for food and food related products.

The presence of high hydrogen cyanide concentration in sample C and D which are above WHO permissible level could make these samples dangerous to the body system. This high concentration of HCN could be avoided if proper fermentation is allowed to take place before the flour is processed.

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