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Heavy Metals In Tapioca Locally Processed By Sun-Drying Method Along Enugu-Abakaliki Highway In Ezilo, Ebonyi State, Nigeria

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Abstract: *Samples of flakes of cassava (Manihot esculenta) popularly known as tapioca from the same source were divided into two and one group was processed by sun-drying along Ezillo Road side while the other by in-door spreading served as control. Atomic Absorption Spectrophotometer model AGP 210 Bulk scientific was used to determine the levels of heavy metals in the tapioca samples. The result (in ppm) revealed the following concentration: Zn (11.13 ± 0.08); Cd (2.50 ± 0.03); As (0.15 ± 0.01); Pb (0.53 ± 0.02) and Cr (3.00 ± 0.04) for sundried tapioca while that of the results (in ppm) of the control (indoor tapioca) were Zn (13.38 ± 0.11); Cd (0.06 ± 0.01); As (0.13 ± 0.01) ; Pb (0.35 ± 0.01) and Cr (1.75 ± 0.03). The levels of heavy metals in samples of sundried tapioca were generally higher than those processed in-doors. Statistical analysis revealed there was no significant difference (p > 0.05) in the mean concentration of Zn, As and Cr in sundried samples when compared with the control, while the levels of Pb and Cd that were significantly (p<0.05). All the metals except Zn exceeded the World Health Organization Maximum Limit (WHO ML). Consumption of tapioca contaminated with toxic metal has adverse effect on human health.*

Keywords: *Tapioca, Cassava, Heavy Metals, Sun-drying and Ezillo*

I. Introduction

Tapioca comes from cassava root (*Manihot esculenta*). Cassava *(Manihot esculenta),* a woody shrub of the Euphorbiaceae (spurge family) native to South America, is extensively cultivated as an annual crop in tropical and subtropical regions for its edible starchy tuberous root, a major source of carbohydrates. With the exception of sugar canes, cassava is the largest source of carbohydrates for meals in the world [1]. World production of cassava root was estimated to be 184 million tonnes in 2002, rising to 230 million tonnes in 2008 [2]. The majority of production in 2002 was in Africa where 99.1 million tonnes were grown, 51.5 million tonnes were grown in Asia and 33.2 million tonnes in Latin America and the Caribbean. No continent depends as much on root and tuber crops in feeding its population as does Africa. In the humid and subhumid areas of tropical Africa, it is either a primary staple food or a secondary co-staple. Nigeria is the world's largest producer of cassava. It is classified as sweet or bitter, depending on the level of toxic cyanogenic glucosides. Farmers often prefer the bitter varieties because they deter pests, animals, and thieves [3]. Cassava plays a particularly important role in agriculture in developing countries (especially in sub-Saharan Africa) because it does well on poor soils and with low rainfall, and because it is a perennial that can be harvested as required. Its wide harvesting window allows it to act as a famine reserve and is invaluable in managing labour schedules. It also offers flexibility to resource-poor farmers because it serves as either subsistence or a cash crop [4]. Two major challenges associated with cassava post harvest system are perishability of the fresh tuber and presence of cyanogenic compounds. The cassava root is long and tapered, with a firm homogeneous flesh encased in a detachable rind, about 1mm thick, rough and brown on the outside. Cassava roots are very rich in starch, and contain significant amounts of calcium (50 mg/l00g), phosphorus (40 mg/l00g) and vitamin C (25 mg/l00g). However, they are poor in protein and other nutrients. In contrast, cassava leaves are a good source of protein, but lack the amino acid lysine and methionine [5]. Inadequately processed cassava tubers are potential health hazards. Effective processing essentially involves: peeling of the back of cassava and cook it, allow to cool, or tuber disintegration in water to remove cyanogenic compound this process also help to remove some toxic element of the root, then slice it thin and spread and the most commonly used is sun drying. Most recently, drying along the highway has become a very common practice in Nigeria [6]. However road-side soils have been shown to contaminate the dried items as a result of winds and vehicular motion along the high ways [7]. The extent of contamination of road-side food by heavy metals has also been shown to depend on the volume of traffic and nearness to the high way [8].

Environmental pollutants include heavy metals, which in the past were defined based on their atomic weight, as a group of metals with density higher than 5.0g/cm^3 but in more recent times, the definition is based on their chemical properties and toxicity [9]. Unlike other pollutants, heavy metals are non-biodegradable and they have the tendency to bioaccumulate and biomagnify from one trophic level to another [10]. Presence of heavy metals in the soil even in trace concentration causes serious problem to all organisms as they form integral part of the food chain [11]. Heavy metals exposure cause serious adverse health effect including reduced growth and development, cancer, organ damage and in extreme case death [12]. This work was aimed at assessing the level of Pb, Cr, Cd, Zn and As, in sun-dried and indoor processed tapioca and to compare the concentration of different heavy metals in the tapioca with WHO standard for metals in edible food.

II. Materials And Method

Sample Collection and Processing

Samples of tapioca used in this work were collected on 7th April 2014 from tapioca processed by sun-drying method which was spread outdoor along Enugu- Abakaliki, highway in Ezillo, Ebonyi State, Nigeria and also from those spread within a room which serves as control. The tapioca samples was collected and stored into a sample bottles which were earlier washed with distilled water and sulfur free soap and rinsed with % ml of 0.1m HNO_3. They were labeled as Sample A (Ezilo Roadside tapioca) and Sample B (Indoor tapioca). 2g of each of the tapioca samples were dry ashed. Charring of the samples prior to muffling was accomplished using an open flame. Dry ashing was done by placing the samples in an open inert vessel and destroying the combustible (organic) by thermal decomposition using a muffle furnace. Magnesium nitrate was added as an ashing aid. This was done inside a muffle furnace at a temperature of 60^0C allow to ash. It was removed and allowed to cool, the ash was now reconstituted with 15ml of 6m HCl and HNO_3 and was heat about 10-15 minutes and they were filtered into the volumetric flasks which were made up to 250ml. Prepared samples were analyzed for lead (Pb), Cadmium (Cd) Chromium (Cr), Zinc (Zn) using AAS AGP 210 Bulk Scientific model. Samples solution was aspirated after the equipment was switched at wave length for each metal such as Cd (228.9 nm), Zn (213.9 nm), Cr (357.9 nm) and Pb (283.3 nm). Arsenic was determined using colorimetric method.

III. Result

Table 1 presents the mean concentrations of the heavy metals in tapioca and the World health Organization Maximum Limit (WHO ML).

Sample	Metals	Mean concentration	WHO ML
A	Zn	11.13 ± 0.08	100
B	Zn	13.38 ± 0.11	
A	Cd	2.50 ± 0.03	0.1
B	Cd	0.06 ± 0.01	
A	As	0.15 ± 0.01	0.1
B	As	0.13 ± 0.01	
A	Pb	0.53 ± 0.02	0.3
B	Pb	0.35 ± 0.01	
A	Cr	3.00 ± 0.04	0.05
B	Cr	1.75 ± 0.03	

IV. Discussion

Zinc: Only Zn in both samples was found to be within the WHO ML. Among all the studied metals, Zn is the least toxic and it is an essential element in the human diet as it is required to maintain the proper functions of the immune system, normal brain activity and is fundamental in the growth and development of the foetus [13]. Zinc deficiency in the diet may be more detrimental to human health than excess Zinc in the diet [14]. Zinc shortage causes birth defect and anaemia, stomach cramps and vomiting and Skin irritation etc.

Cadmium: Cadmium in indoor processed tapioca was below WHO ML (0.1 ppm) while sundried tapioca (2.5 ppm) was significantly high and exceeded. This could be as a result of cd from exhaust fumes of vehicles plying the road during the sun-drying process. Food substances containing excess Cd are known to result to bone fracture, cancer, diarrhea, stomach pains, severe vomiting, reproductive failure and damage of CNS and DNA [15].

Arsenic: Arsenic in both sundried (0.15 ppm) and indoor (0.13 ppm) tapioca exceeded the World Health Organization Maximum Limit (WHO ML = 0.1ppm). consumption of tapioca with high level of As will certainly result to health consequences such as kidney and liver damage, gastrointestinal effect, peripheral neuropathy, skin lesion, lung cancer and death [16].

Lead: Lead in both samples of indoor processed tapioca (0.35 ppm) and sun-dried tapioca (0.53 ppm) were above WHO ML (0.3 ppm). Soil samples from Ebonyi State especially Enyigba and Abakaliki axes are known to contain high level of Pb and as a result, cassava grown in Ezillo may absorb high quantity of lead [17]. Higher level of Pb observed in sundried tapioca could be as a result of accumulation of dust particles on the tapioca by wind blowing out soil particles created by vehicles speeding along the highway [18]. Consumption of tapioca with high concentration of Pb can cause musculoskeletal, renal, ocular, immunological, neurological, reproductive, and developmental effects [19].

Chromium: Chromium in both samples of indoor processed tapioca (1.75 ppm) and sun-dried tapioca (3.00 ppm) were significantly above WHO ML (0.05 ppm). Chromium is an essential trace metal but high concentration in edible food materials could be disastrous to human health.Chromuim toxicity in human includes kidney and liver damage, skin rashes, stomach upset and ulcer, respiratory problems and lung cancer and alteration of genetic materials [20].

V. Conclusion

This study reveals that there is a high level of contamination in roadside tapioca due to the vehicular densities than the home made. The concentrations of all the studied heavy metals were higher in tapioca processed by sun-drying along highway express road at Ezillo. This obviously means that the roadside sun-dried tapioca was contaminated from the exhaust from vehicles plying the highway. Based on this, it is fair to conclude that though sun-drying tapioca on roadside is a faster process than indoor drying process, however, sun-dried tapioca is not safe for human consumption because of its high levels of heavy metals which may adversely affect human health.

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