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HEAVY METAL LEVELS IN CASSAVA FLOUR SOLD IN OKURA, EJULE AND OJAPATA OF KOGI STATE, NIGERIA

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ABSTRACT

Cassava (Manihot esculenta) is a major source of carbohydrate and a staple food cultivated in Nigeria especially in Kogi State.Determination of heavy metals in cassava flour from major markets:(Okura ,Ejule and Ojapata) in Kogi East was done to ascertain the quality of cassava flour and its human exposure path.Lead, cadmium, iron and zinc contents were determined using Atomic Absorption Spectrophotometer (AAS).The results were analysed using Analysis of Variance (ANOVA), Duncan Multiple Range Test (DMRT) and Independent Sample t-test. Zn concentration in Ejule (Control) was as low as 0.002±0.000^{a}. Pd,Cd,Fe, and Zn screened were far below the WHO guideline values or permissible limit of metal in food.This implies that the metal toxicants present in the cassava flour is in such low concentrations that render the food non-toxic and edible.

Keywords: Heavy metals; pollution; cassava flour; human exposure.

INTRODUCTION

Cassava (*Manihot esculenta*) belong to the family of Euphorbiaceae.It is extensively cultivated in tropical and subtropical regions for its edible starchy tuberous root and is a major source of carbohydrates (Stephen, 1995). Pollution is the introduction of contaminants into an environment, soil, food, water e.t.c that causes instability, disorder, harm or discomfort to the ecosystem or living organisms (Gari, 2002).. Heavy metals are natural constituents of the Earth's crust, but human activities have drastically altered their geochemical cycles and biochemical balance (Giachetti *et al.*, 2006). High concentration of these metals in soil may cause long term risk to ecosystems and humans.

Ano *et al.*, (2007) reported that atmospheric deposition of heavy metals on cassava and soils along express road is higher than on cassava and soils in remote villages (non-road side environment) because of low vehicle emission in the remote villages. Alloway (1995) reported that plants accumulate considerable amount of heavy metals in root and leaves. Ugwu *et al.* (2011) reported high concentrations of lead, cadmium and nickel in cassava flour sundried along a major highway. Contamination of the environment by heavy metals is a major concern because of their toxicity (Wong, 2012). Heavy metals contamination in food (cassava) is becoming a serious problem around the world as it has gained momentum due to the increase in the use and processing of heavy metals during various activities to meet the

needs of the rapidly growing population (Odokuma, 2009).

Heavy metal toxicity has several health effects. Chronic long-term exposure of some heavy metals may cause cancer (Godwill *et al.*, 2019).

The findings obtained from this study will widen our knowledge on the danger of heavy metal pollution in our environment by providing information on its spread. It will also provide information on the danger of roadside selling of products a common practice among peasant traders. The accumulation of heavy metal in food (e.g cassava flour) has a great effect on the the body since heavy metals can damage and alter the functions of organs such as the brain, kidney, lungs and blood. It is of paramount importance that this study is carried out to check the presence of heavy metal and recommend a way of monitoring the consumption of food items contaminated with heavy metals.

The aim of this work is to investigate human exposure path through heavy metal concentration of cassava flour sold in Okura, Ejule and Ojapata of Kogi East.

The objectives of the study were to:

- Determine the concentration level of Lead (Pb), Iron (Fe), Zinc (Zn) and Cadmium (Cd).
- Determine and ascertain the quality of cassava flour sold in Okura, Ejule and Ojapata.

MATERIALS AND METHODS

Description of the Study Area

Ejule is located in Ofu between latitude 6˚ 95'N and longigitude 6˚ 83' 0" E. Okura is located in Dekina between latitude 7˚ 00' N and longitudes 7˚ 30'E while Ojapata is located in Ankpa between latitude 7˚ 37' N and longitudes 7˚ 30'N all of Kogi State.In 2014 the world bank in collaboration with federal government and Kogi State government commenced the implementation of FADAMA III – AF.Ojapata is currently a major cassava production hub in Nigeria.Ojapata has a cassava production cluster where they convert cassava peel or waste to wealth.Most of the people practice commerical and subsistence farming. They export cassava and produce for their immediate family.Kogi East inhabitants are predominantly farmers, traders, motorcycle riders and civil servants.

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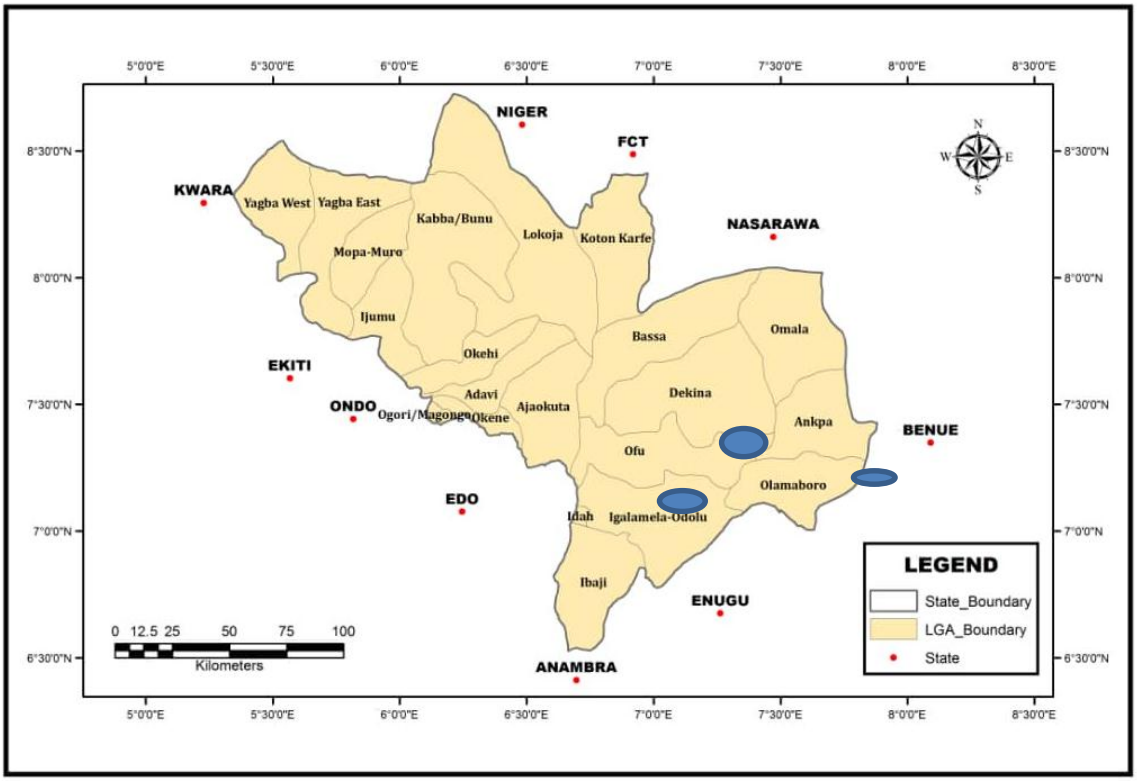

Figure 3.1 Map of Kogi Showing the LGAs where the markets are located

Source: Geospatial Analysis Mapping and Environmental Research Solution, 2018

Sample collection

Cassava flours were obtained from three (3) different towns in three (3) Local Government area in Kogi East. Okura in Dekina, Ojapata in Ankpa and Ejule in Ofu. The control was obtained from Okura, the other two samples were obtained from Ojapata and Ejule.

Digestion and metal analysis

The samples were taken to the laboratory in a clean polythene bag. Two(2) grams of each sample of cassava flour were weighed and taken to the furnace for ashing after which it was diluted with 0.1 mole of HCl. Two (2) grams of each sample which was a pulverized sample were laced in a crucible for digestion and ignited in a muffle furnace at 55˚C for 6 hours. The resulting ash was dissolved in 10ml of 10% HNO_3 and heated slowly for 20 minutes. After heating, it was filtered using Whatman filter, and deionized water was added to make up to 50ml in a volumetric flask. Heavy metal was determined using Atomic Absorption Spectrophotometer (Varian Company USA). Concentrations of the heavy metals were read directly from the AAS meter in (mg/kg) (AOAC, 1995).

Statistical Analysis

Analysis of Variance (ANOVA) was used to compare the heavy metal concentration in each sample (cassava flour). Duncan Multiple Range Test (DMRT) was used to separate the means in case they are significantly different. T-test was used to determine the variability of the mean level of pollutant between the two sources of the major experimental samples of Ejule and Ojapata.

RESULTS

Concentration of heavy metals (mg/kg) in cassava flour

The concentration of heavy metal in the cassava flour is presented in table 1 below. There is significant differences (P<0.05) in the Zn content of the Samples compared wito Okura (Control).Ejule is significantly higher than Okura (control). While Ojapata is not significantly (P>0.05) different from the Okura (control). Cd content is significantly different (P<0.05) in the Ejule and Ojapata compared to Okura (Control). Ejule and Ojapata are significantly higher than Okura (control). Fe content is significantly different (P<0.05) in the of the two other location compared to Okura (Control). Ejule and Ojapata are significantly higher than Okura (Control). Also, there is a significant difference (P<0.05) in the Pb of the Samples compared to the control.

Table 1: Concentration of Heavy metals (mg/kg) in cassava flour

Samples	Zn	Cd	Fe	Pb
Okura(Control)	0.002±0.000^{a}	0.011±0.001^{a}	0.881±0.001^{a}	0.001±0.000^{a}
Ejule	0.003±0.000^{b}	0.013±0.000^{c}	1.101±0.001^{c}	0.002±0.000^{b}
Ojapata	0.002±0.001^{a}	0.012±0.001^{ab}	0.949±0.001^{b}	0.001±0.000^{a}

Values are Mean ± SD, Values with different superscript letter down the column are significantly different at p <0.05 using Duncan Multiple range test (DMRT)

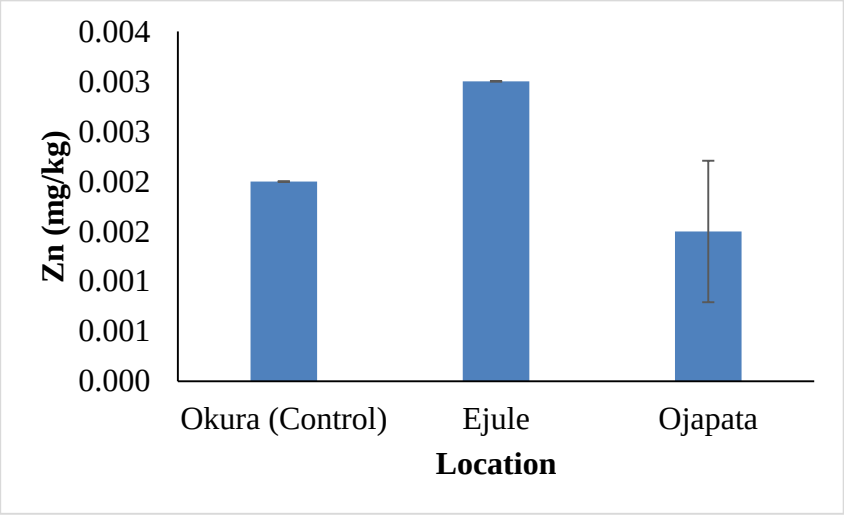

Figure 1: Zinc concentration of cassava flour

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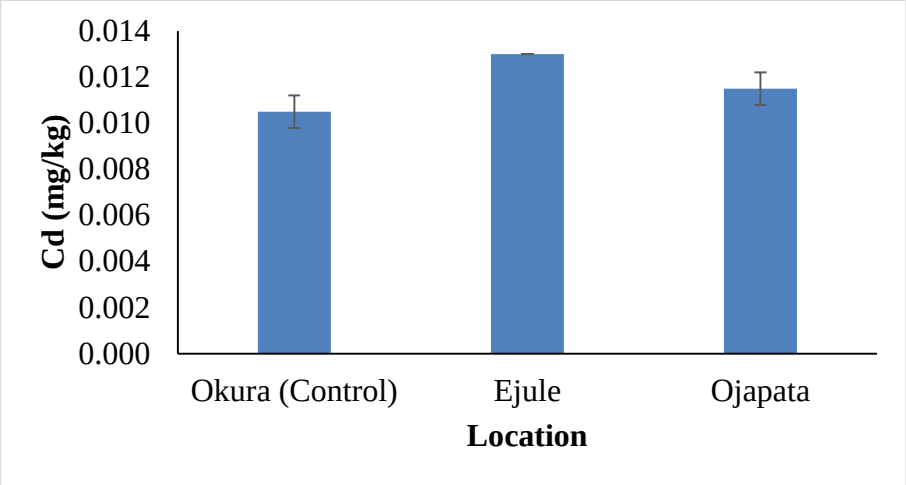

Figure 2 : Cadmium concentrations in cassava flour

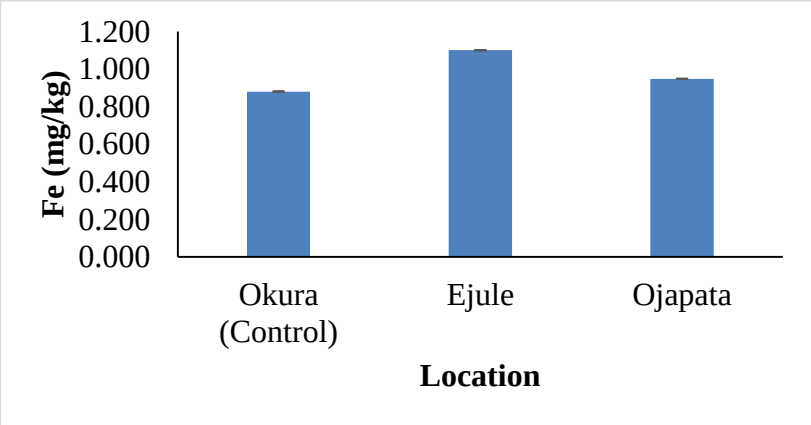

Figure 3: Iron concentrations in cassava flour

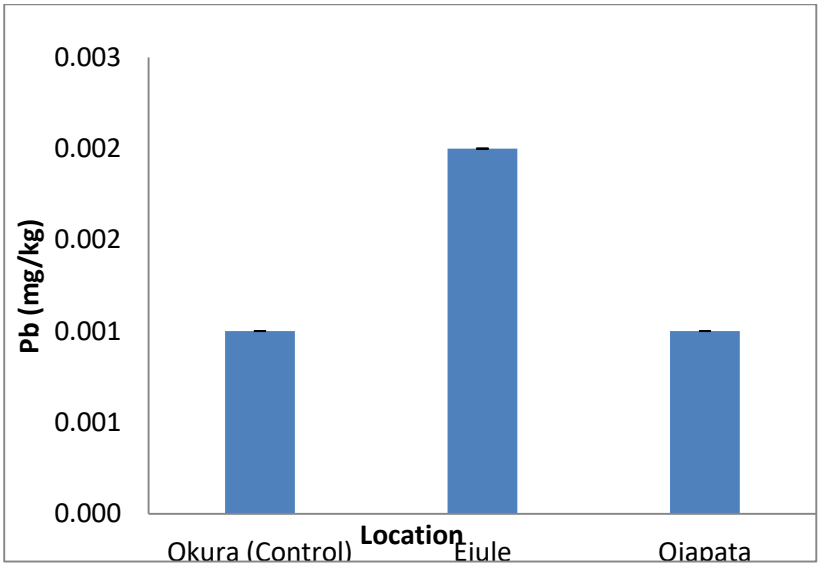

Figure 4: Lead concentrations in cassava flour

Table 2 shows the difference in the concentration level (mg/kg) of the sampled cassava flour For Zn, Ejule is not significantly different to Ojapata. In Cd there is not significantly different to Ojapata. For Fe, Ejule and Ojapata is not significantly different. In Pb, Ejule and Ojapata are not applicable.

Table 2: Significant Difference in the Concentration levels (mg/kg) in cassava flours

	Ejule	Ojapata	p-value	Remarks
Zn	0.003 ± 0.000^{a}	0.002 ± 0.001^{a}	0.095	NS
Cd	0.013 ± 0.000^{a}	0.012 ± 0.001^{a}	0.095	NS
Fe	1.101 ± 0.001^{b}	0.949 ± 0.001^{a}	0.000*	S
Pb	0.002 ± 0.000^{a}	0.001 ± 0.000^{a}	-	NA

Values are Mean ± SD, Using Independent Sample t-test, * ($P<0.05$)
Note: Values with different superscript alphabet are significantly different ($P<0.05$)
KEY: NS- Not Significant S- Significant NA- Not Applicable

DISCUSSION

This study confirmed the presence of of Zinc (Zn), Cadmium (Cd), Iron (Fe) and Lead (Pb) in the cassava flour obtained from the studied locations.The results of heavy metals obtained in the present study were below the FAO/ WHO guideline values or permissible limit of metal in food. (Codex Alimentarius Commission, 2001). This implies that the metal toxicants present in the cassava flour are in such a low concentration that renders the food non-toxic and edible. The result obtained from this study relates to the findings of Sawyerr *et al*. (2018) whose findings are also below the permissible limit. However the result contradicts the finding of Emurotu *et al*. (2012) where similar heavy metals were below the detection limit.

Metal toxicity in plants has been reported by various authors (Tangahu *et al.,* 2011; Manara 2012) Heavy metal pollutants are stable in the environment, but highly toxic to biological organisms (Tangahu *et al.*, 2011; Flora *et al*., 2008). Among the heavy metals, Mercury, lead, nickel, chromium are most dangerous. Heavy metals released by cement factories (Kumar *et al.,* 2011) is responsible for causing various biochemical changes which also include cytotoxic and mutagenic effects such as chromosomal aberrations,stickiness,chromosomal bridge, chromosome fragmentation, vagrant chromosomes, DNA fragmentation etc. in various plants as well as in humans.

Heavy metals are significant environmental pollutants and their toxicity is a problem of increasing significance for ecological, evolutionary, nutritional and environmental reasons (Jaishankar *et al.*, 2013; Nagajyoti *et al*., 2010). According to Morais *et al*. (2012), sources of heavy metals includes soil erosion, mining, natural weathering of the earth's crust, industrial effluents, sewage discharge etc. According to Najeeb *et al.* (2014) plant with high lead concentration fasten the production of reactive oxygen species (ROS) causing lipid membrane damage that ultimately leads to damage of chlorophyll and photosynthesis

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processes and suppresses the overall growth of the plant.

Lead poisoning was considered to be a classic disease and the signs that were seen in children and adults were mainly pertaining to the central nervous system and gastrointestinal tract (Markowitz, 2000) lead poisoning can also occur from drinking water, the pipe that carry the water may be made of lead and its compound which can contaminate the water (Brochin *et al.*, 2008).

According to the Environmental Protection Agency (EPA), lead is considered a carcinogen. Toxicity of lead also called lead poisoning can be either acute or chronic. Acute exposure can cause loss of appetite, headache, hypertension, etc. Chronic exposure of lead can result to mental retardation, birth defect, paralysis, weight loss and may even cause death (Martin & Griswold, 2009).

CONCLUSION

The results obtained from the study show that the mean concentration levels of lead, cadmium, zinc and iron in cassava flour samples are below the FAO and World Health Organization (WHO) guideline or permissible safe levels of metals in food. This shows that metals are present in the cassava flour in such low concentrations that render the food non-toxic and will not cause any harm.

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