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# PROXIMATE ANALYSIS AND LEVELS OF SOME HEAVY METALS IN CASSAVA FLOUR PROCESSED BY ROADSIDE DRYING ALONG ABUJA-LOKOJA HIGHWAY, NIGERIA

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## ABSTRACT
This study was carried out to evaluate heavy metal concentration and proximate composition of cassava flour processed by roadside drying technique. Thirty samples were collected from processing points along Abuja-Lokoja highway at Abaji, Yangoji, Kwali and Sheda towns. Heavy metal levels were determined using flame atomic absorption spectrophotometer and the proximate composition of the samples determined using standard analytical methods. Proximate analysis revealed 87.44% (carbohydrate), 1.26% (fat), 0.96% (protein) and 0.60 % (fibre) in the control sample, which were not significantly different ($p > 0.05$) from the test samples. The levels of the selected heavy metals decreased in the following order Abaji (28.55%) > Kwali (27.53%) > Yangoji (20.29%) > Sheda (18.84%) with the control as 4.80 %. The concentration of metals were in the following decreasing order; Pb>Fe>Cu > Cr >Mn >Zn >Ni >Cd >Co. Significantly higher metal concentrations were recorded in the roadside samples when compared to the control. High correlation coefficients were found among most elemental pairs which indicated possible pollution from a single source. Elevated levels of highly toxic non-biogenic heavy metals pollutants observed in this study can cause serious health implications to the consumers of cassava flour processed by roadside drying technique in these localities.

***Key Words**: Abuja-Lokoja, Cassava Flour, Road Side, Pollution, Proximate Composition*

## INTRODUCTION
Cassava (*Manihot esculenta,* Crantz) is an all-season crop of the tropics and ranks among the top ten food crops in the world (FAO, 2002). Today, Africa is the largest producer of cassava referred as the 'bread of the tropics' with Nigeria leading with nineteen percent of global market share. It holds the position as a primary food security crop in Africa due to its resistance to drought and disease, flexible planting, harvest cycles and tolerance of low-quality soils (Adams, 2009).
The cassava tuber contains 30% to 40% dry matter with about 90% starch or sugar, while the crude protein content is 2 to 4% (Adeshinwa *et al*., 2011). Tubers are poor in protein and other nutrients but cassava leaves are good sources of protein (Ravindran, 1992). The tubers contain significant amounts of vitamins, particularly vitamin C, thiamine, riboflavin, niacin, calcium and phosphorous (FAO, 2002). Cassava based dishes are widely consumed wherever the plant is cultivated (Frederick, 2008) and used worldwide in animal feeds for livestock (Eruvbetine *et al*., 2003 and Adeshinwa *et al*., 2011).
Two of the major constraints to the development of cassava post-harvest systems include perishability of the fresh tubers and presence of cyanogenic compounds. Inadequately processed cassava tubers are potential health hazards. Effective processing, essentially involves tuber disintegration in water to remove the cyanogenic compounds followed by drying of raw food items after harvest to remove residual water after the fermentation process. The most commonly employed means is sun-drying. In the recent past, road side drying along the highways has become a very common practice in Nigeria. However, Roadside soils have been shown to contaminate the dried items as a result of winds and vehicular motion along the highways (Obanijesu and Olajide, 2009).The extent of contamination of roadside food by heavy metals has also been shown to depend on the volume of traffic and nearness to the highway (WHO, 1992)

The analysis of processed cassava flour has revealed the presence of poisonous metals such as lead, arsenic and cadmiuim. (Aribike and Akinpelu, 2000) Low levels of Cd (RDA; 0.00 mg/day) and Pb (RDA; 0.00 mg/day) in biological systems have been reported to cause various human organs disorders, which are sometimes irreversible (Ogunkola and Agboola, 2004). Excessive intake of biogenic trace metals such as Fe (RDA; 6-15 mg/day) and Zn (RDA; 12-15 mg/day) could also result in complications ranging from gastro-intestinal irritation, vomiting to tissue damages and skin pigmentation (Nelson and Cox, 2000; Robert *et al.*, 2000) while the excessive intake of Mn (RDA; 2-5 mg/day) have been implicated in Parkinson's disease (Nelson and Cox, 2000).
In recognition of the fact that the Abuja-Lokoja highway carries the largest traffic volume in Nigeria, this work was aimed at assessing the levels of Pb, Cr, Fe, Mn, Zn, Cd, Ni and Co as well as the proximate composition of cassava processed by roadside drying technique on the highway. The result of the study is expected to provide the nutritive composition and levels of toxic heavy metals in the cassava in order to assist its consumers to know the value and possible dangers associated with its consumption.

## MATERIALS AND METHODS

### *Sample Collection and Preparation*

A total of 30 dried cassava samples (0.2kg each) made up of 24 randomly collected from roadside drying point at Abaji, Yangoji, Kwali and Sheda towns along Abuja-Lokoja highway (four per location) and six other fresh cassava root samples obtained at farms situated close to these locations as control. The control samples were peeled, washed, soaked in distilled water for complete fermentation and dried in the open laboratory. All test and control samples were ground into fine powder using wooden mortar and pestle and sieved to obtain homogenized particles. The prepared samples were then stored in black polythene bags and used for further analysis.

### *Digestion of Sample*

To one gram (1.0gm) of each sample was added 20cm$^3$ $HNO_3/H_2O_2$ (2:1 ratio) mixtures in a 100 cm$^3$ beaker. The mixture was placed on a hot plate and the temperature maintained at 130$^o$c for four hours. After cooling, the solution was filtered through whatman No.1 filter paper to remove the insoluble particles and made up to a final volume of 25ml with distilled deionized water in a standard flask. The same method was used to prepare the blank using only the acid mixture. The resulting solutions were analyzed using Buck Scientific VGP 210 Flame Atomic Absorption Spectrophotometer and the levels of the metals extrapolated from calibration graphs generated using standard metal solutions. The procedures employed in these determinations were as contained in the manufacturer's manual for the equipment.

### *Proximate Analysis*

The samples were analysed for the crude protein (CP), fibre (CF), carbohydrate, ash and fat (CFT) using standard analytical methods (AOAC, 1990).

### *Statistical Analysis*

All data are expressed as the mean of six replicates $\pm$ standard error of mean (S.E.M). Statistical evaluation of data was performed by Graph pad prism version 5.02 using One Way Analysis of Variance (ANOVA), followed by Dunett's post hoc test for multiple comparison. Inter-elemental association was also evaluated by Spearman's rank correlation coefficient ($\rho$).

## RESULTS AND DISCUSSION

Results of the proximate analysis of the samples were found to range between 85.47± 1.25 – 82.29±0.10 (Carbohydrate); 1.10±0.22 – 1.14 ±0.23% (Protein) 94.42 ±1.30 – 97.25± 0.84% (NFE) and 1665.26± 6.47 – 1732 ±19.50 kg/GK (Gross Energy). The above values were within the levels obtained for the control samples; showing that the nutritive status of the roadside dried samples were not affected by the processing technique employed.
The metal concentrations were higher in most test samples and this may be attributed to contamination during the drying process as shown in Figure 1. Comparing the metal levels in the samples the following

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order was observed; Pb > Fe > Cu > Cr > Mn > Zn > Ni > Cd > Co while a different order was obtained for the control samples: Pb > Fe> Ni > Cr > Zn > Cu > Cd > Co > Mn. The trend for the control may be the natural order resulting factors such as soil conditions and absorption by plants during cultivation at the different locations (Nelson ad Cox, 2000).

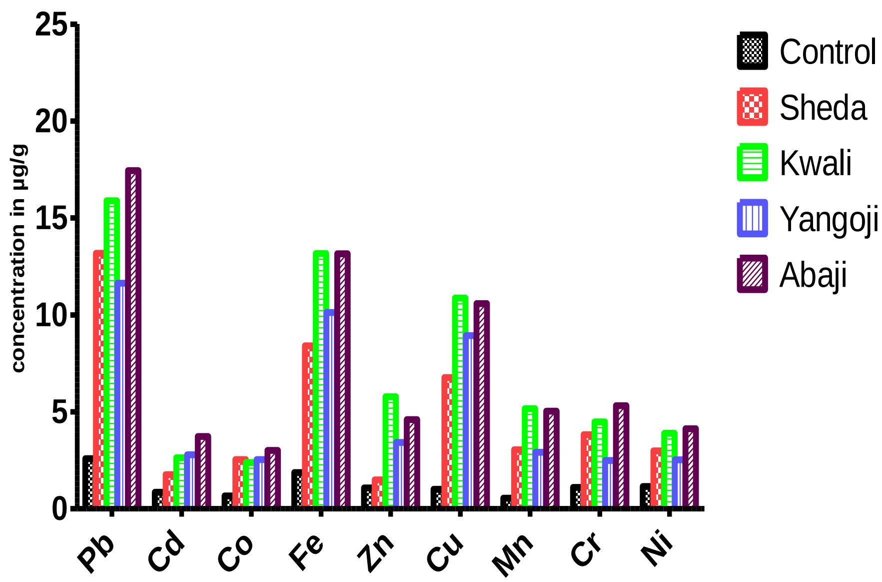


**Figure 1: The levels of the metals in the control and test samples from different sampling points.**

Statistical analysis revealed there was no significant ($p > 0.05$) difference in Fe, Cu, Mn, levels in test samples when compared with each other, while the levels of Zn and Cd that were significantly ($p<0.05$)
Lower in test samples from Sheda. Significantly lower levels of Pb (11.63 ±0.63mg/gm), Ni (2.52± 1.50mg/gm) and Cr (2.50 ±0.58mg/gm) were also observed in Yangoji samples when compared with other test samples, except for Ni which was much lower in the Sheda samples. The Co levels were not significantly ($p > 0.05$) different among all test samples analyzed. Pb (17.44± 3.63mg/gm) concentration was highest in all test samples collected in Abaji compared with the others. This can be attributed to the heavy vehicular traffic coupled with presence of link roads with trailer parks in the town. The closely related high level Pb (15.89± 2.53mg/gm) found in the Kwali samples can also be attributed to the bulging local industrial activities such as welding, smelting, automobile repairs garages in addition to the vehicular movement. Apart from Pb, Fe and Cu also predominate the bulk of heavy metals found in all samples analyzed. Levels of Cu were ten times higher in roadside sample from Abaji town when compared with control. Inter-elemental associations evaluated by Spearman's rank correlation coefficient $\rho$ revealed a strong to perfect positive relationships among all metals analyzed with ($\rho =$ 0.7-1.0, $p< 0.05$), Pb/Ni, Pb/Cr, Fe/Cu, Fe/Zn, Cu/Zn .
Nigeria crude oil is known to have 0.003-42.31mg/kg of these transition metals (Cr, Mn, Fe, Co, and Ni) and that most fuel sold in Nigeria contain elevated levels of metals in this order; Pb>Fe>Cr>Zn>Cu>Mn (Osibanjo *et al.*, 2007). The elevated levels of these metals found in the test samples must have resulted from contamination from emissions from the large traffic volume on this highway. Strong correlations of this nature signify that each paired elements have common contamination source (Mmolowa *et al.,* 2011) probably from vehicular emissions in this study.

**CONCLUSION**

The results have shown the presence of heavy metals at elevated levels in the cassava flour processed by roadside drying technique as observed in these studies, particularly in areas where vehicular densities are

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high. Much of the heavy metals were found in the roadside test sample in the following decreasing order; Abaji (28.55 %)> Kwali (27.53 %)> Yangoji (20.29%) > Sheda (18.84 %) > Control (4.8%). The observed values correlated well with the high traffic density at Abaji and Kwali town, which are local government headquarters. Strong correlation coefficient among elemental pairs indicates that the metal levels are probably from a single source. These increased levels of highly toxic non-biogenic heavy metals in samples call for concern on health implications of the consumption of cassava flour processed by roadside drying technique as these are transported for sale in other parts of Nigeria and beyond.

## REFERENCES

**Adams RM (2009).** *Occupational Skin Disease*, Edited by Adams 2$^{nd}$, RM Philadelphia WB Saunders 26-31.

**Adesehinwa OK, Obi1 OO, Makanjuola BA, Oluwole OO and Adesina MA (2011).** *African Journal of Biotechnology* **10**(14) 2791-2796.

**Aribike DS and Akinpelu A (2000).** Lead Deposition in Nigeria. *Chemical and Engineering Journal* 1-9.

**Eruvbetine D, Tajudeen ID, Adeosun AT and Olojede AA (2003).** Cassava *(M. esculenta)* leaf and tuber concentrate in diets for broiler chickens. *Bioresources Technology* **86** 277-281.

**FAO (Food and Agriculture Organization) (2002).** *FAOSTAT Statistics Database*. Available at: http://aps.fao.org [Accessed 6 September 2012].

**Frederick DO (2008).** Hog and Hominy: *Soul Food from Africa to America* (Columbia University Press) 1-2.

**Mmolawa KB, Likuku AS and Gaboutloeloe GK (2011).** Assessment of heavy metal pollution in soils along major roadside areas in Botswana. *African Journal of Environmental Science and Technology* **5**(3) 186-196.

**Nelson LN and Cox MM (2000).** *Lehninger Principles of Biochemistry* 4th edition, WH Freeman and Company (New York) 31–64.

**Obanijesu EO and Olajide JO (2009).** Trace Metal Pollution Study on Cassava Flour's Roadside Drying Technique in Nigeria. In: *AppropriateTechnologies for Environmental Protection in the Developing World*, edited by EK Yanful (Springer Science and Business Media) **B** V0.

**Ogunkola SA and Agboola OB (2004).** Environmental impact of waste and its consequences. *Chemical Engineering Journal* 44.

**Osibanjo O, Kakulu SE and Ajayi SO (2007).** Determination of Trace Metals in Crude Oils and its Heavy Fractions. *Journal of Applied Analytical Chemistry* **127** 939.

**Ravindran V (1992).** Preparation of cassava leaf products and their use as animal feeds. *FAO Animal Production and Health Paper* (Rome, Italy - Food and Agriculture Organization of the United Nations) **95** 111–125.

**WHO (World Health Organization) (1992).** Urban Air Pollution Consequences. *Chemical and Engineering Journal* **44**.