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DETERMINATION OF HEAVY METAL CONCENTRATIONS OF FLUTED PUMPKIN FROM FARINGADA, TERMINUS AND CHOBE MARKETS IN JOS, PLATEAU STATE, NIGERIA

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Abstract

Fluted Pumpkin (Ugu-leaf) is a vegetable consumed in Nigeria as a result of the nutrients derived from it. The present study focuses on the determination of heavy metal concentrations of fluted pumpkins from Faringada, Chobe and Terminus markets in Jos. Two samples of fluted pumpkin were purchased from two retailers in Faringada, Chobe and Terminus markets. A total of six fluted pumpkin samples were air-dried and subjected to XRF analysis for heavy metals determination. The concentrations of heavy metals in fluted Pumpkin analyzed are: Mo (8.028 - 13.654 ppm), Zr (25.332 - 54.967 ppm), Sr (34.264 - 54.981 ppm), Rb (44.066 - 175.748 ppm), Pb (1.0 - 12.82 ppm), Zn (29.064 - 82.466 ppm), Fe (406.973 - 1817.989 ppm), Cu (26.171 - 48.444 ppm) and Nb (11.373 - 14.003 ppm) respectively. The concentrations of heavy metals detected (Mo, Zr, Sr, Rb, Pb, Zn, Fe, Cu and Nb) exceeded WHO tolerance limits and thus can be harmful to the consumer. These heavy metals detected in fluted pumpkin are carcinogenic, toxic and of detrimental effects to the health of consumers which may affect major human organs such as kidney and liver. It is therefore evident that mining activities in Jos have negative impact on the soil quality where fluted pumpkins are grown following the detection of heavy metals above the permissive limit.

Keywords: heavy, metals, Ugu-leaf, carcinogenic, harmful

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Introduction

Fluted pumpkins are planted in West Africa as vegetable and are known to be popularly eaten in southern Nigeria. Fluted pumpkin leaves are greenish leafy vegetables and grown in different areas. Ugu-leaves have high nutritional value and consist of essential elements and vitamins

which are required for the normal function of the body (Ikpe, 2013; Effiong *et al.*, 2009).

Fluted pumpkin are grown mainly for use in soup and herbal medicine, as the young shoots and leaves are known to have high amounts of K and Fe. The leaves, popularly used for anaemic patients, are known to consist of antioxidants and hepato-protective and antimicrobial

characteristics (Nwanna, 2008). Fluted pumpkin roots act as potent poisons to humans and utilized as rodenticide as well as an ordeal poison. The mixture of sliced fluted pumpkin leaf, coconut water and salt are used for treating convulsion in ethnomedicine (Eseyin *et al.*, 2005b). Extract from Fluted pumpkin leaf can be used in the treatment of liver problems and impaired defense immune systems (Eseyin *et al.*, 2005a).

Heavy metals are metallic elements that possess a high atomic weight and greater density (at least 5 times) than water. Heavy metals occur naturally as elements within the earthcrust (Tirasoglu *et al.*, 2006). Heavy metals are harmful to living organisms because they can easily accumulate in parts of the body, non-

biodegradable and toxic (Mansour, 2014; Singh *et al.*, 2010).

Plants can uptake metals from the environment when they are grown on or near contaminated soils and thus, accumulate in the edible parts of plants (Jordao *et al.*, 2006, Harmanescu *et al.*, 2011). There are limited investigations on heavy metals concentrations of fluted pumpkins from Jos while the present research aims at determining heavy metal concentrations of fluted pumpkins from three main markets within Jos metropolis. The study was carried out at FarinGada, Chobe and Terminus markets which are popularly known for selling fluted pumpkin (Ugu-leaf) in Jos. The study area is located within Jos Metropolis (Fig. 1).

Fig. 1: Location map of Jos Metropolis showing FarinGada, Terminus and Chobe markets

Materials and Method

A total of six fluted pumpkins (*Telferia occidentalis*) were purchased from two different retailers in each of FarinGada, Terminus and Chobe markets. The samples of fluted pumpkin were air-dried and pulverized into powdery form. The pulverized fluted pumpkin samples were subjected to X-ray Fluorescence analysis at Science Laboratory Technology Unit, University of Jos

Fluted pumpkin samples from the study area were analyzed using XRF spectroscopy for heavy metals concentration, the heavy metals identified include: Pb, Rb, Zn, Zr, Sr, Fe, Mn, Nb, Cu and Nb. The concentrations of heavy metals obtained from FarinGada, Terminus and Chobe markets were compared with WHO permissible limits (FAO/WHO, 2001) in plants

Results and Discussion

The values of heavy metal concentrations in fluted pumpkin samples from FarinGada, Terminus and Chobe markets are presented in Table 1 while the comparison of heavy metal concentrations of fluted pumpkin from FarinGada, Terminus and Chobe markets with WHO permissible limit are presented in Table 2. The distribution of heavy metals concentrations of fluted pumpkin from FarinGada market is shown in Figure 2 while Figure 3 shows the distribution of heavy metals concentrations of fluted pumpkin from Chobe market. The distribution of heavy metals concentrations of fluted pumpkin from terminus market is shown in Figure 4.

The value of molybdenum in fluted pumpkin ranges from 8.03 to 13.65 ppm and exceeded Occupational Safety and Health Administration (OSHA), 2013 value of 1.5 ppm. The value of Zr in the fluted pumpkin ranges from 25.33 to 54.97 ppm and exceeded OSHA (2013) permissible limit of 1.3 ppm. The concentration of Mn in fluted pumpkin ranges from 92.94 to 305.33ppm and exceeded the WHO permissible limit of 20 ppm. The value of Nb from fluted pumpkin ranges from 11.37 to 14.00ppm while Sr content in the fluted pumpkin ranges from 34.26 to 54.98 ppm and exceeded Environmental Protection Agency (EPA), 2004 limits of 4.0 ppm.

The values of Copper obtained in fluted pumpkins ranges from 26.17 to 48.44 ppm. The concentrations of Fe in the fluted pumpkins ranges from 406.97 to 1817.99 pm and exceeded WHO tolerance limit of 20 ppm. The lead concentrations from the fluted pumpkin ranges from 1.00 to 12.82pm and exceeded the WHO tolerance limit of 0.43 ppm. The values of Rb in fluted pumpkin ranges from 44.07 to 175.75 ppm and exceeded OSHA (2013) tolerance limit of 7.0ppm. Zinc concentrations in fluted pumpkins ranges from 29.06 to 82.47 ppm and exceeded WHO tolerance limit of 50 ppm except in FarinGada 1 and Terminus 2 samples (Table 2). The pH values of fluted pumpkin from FarinGada (5.26-5.30), Chobe (5.07-5.10) and Terminus (5.16-5.19) markets indicate mildly acidic conditions (Table 1)

Table 1: Heavy metal concentrations (ppm) of fluted pumpkin from three markets in Jos

Elements	FarinGada1	FarinGada2	Chobe 1	Chobe 2	Terminus 1	Terminus 2
Molybdenum (Mo)	11.06	8.19	10.17	8.03	9.26	13.65
Zirconium (Zr)	25.33	40.36	29.38	54.97	43.33	25.86
Strontium (Sr)	43.44	54.98	46.12	34.26	34.39	54.30
Rubidium (Rb)	151.14	112.67	175.75	72.10	44.07	96.46
Zinc (Zn)	46.33	52.11	81.91	59.27	82.47	29.06
Lead (Pb)	1.00	12.82	5.23	1.00	6.53	5.20
Copper (Cu)	26.64	32.18	35.28	48.44	43.40	26.17
Iron (Fe)	511.92	1817.99	514.74	1364.03	736.63	406.97
Manganese (Mn)	192.65	ND	257.78	92.94	ND	305.33
Niobium (Nb)	13.93	11.87	12.69	11.37	11.73	14.00
pH value	5.30	5.26	5.07	5.10	5.16	5.19

ND: Not Detected

Table 2: Comparison of FAO/WHO standard (2001) for vegetables with heavy metal concentrations (ppm) in fluted pumpkins from FarinGada, Chobe and Terminus markets

Heavy metals	FarinGada market	Chobe market	Terminus market	Permissible limits
Mo	8.19-11.06	8.03-10.17	9.26-13.65	1.5 (OSHA, 2013)
Zr	25.33-40.36	29.38-54.97	25.86-43.33	1.3 (OSHA, 2013)
Sr	43.44-54.98	34.26-46.12	34.39-54.30	4.0 (EPA, 2004)
Rb	112.67-151.14	72.10-175.75	44.07-96.46	7.0 (OSHA, 2013)
Zn	46.33-52.11	59.27-81.91	29.06-82.47	50 (WHO, 2001)
Cu	26.64-32.18	35.28-48.44	26.17-43.40	36 (WHO, 2001)
Fe	511.92-1817.99	514.74-1364.03	406.97-736.63	20 (WHO, 2001)
Pb	1.00-12.82	1.00-5.23	5.198-6.532	0.43 (WHO, 2001)

Figure. 2: Heavy metals concentration of fluted pumpkins from FarinGada market

Figure. 3: Heavy metals concentration of fluted pumpkins from Chobe market

Figure. 4: Heavy metals concentration of fluted pumpkins from Terminus market

The zinc values of fluted pumpkin from FarinGada (46.33-52.11 ppm), Chobe (59.27-81.91 ppm) and Terminus (29.06-82.47 ppm) markets are similar with zinc value reported by Orubite *et al.* (2015) on fluted pumpkin leaf in Umuebulu Community of River State. Nnamonu *et al.* (2015) reported lower values of Fe (54.7 ± 21.9 ppm) and Cu (5.03 ± 1.1 ppm) in fluted pumpkin from Makurdi area than the values of Fe (406.97-1817.99 ppm) and Cu

(26.17-48.44 ppm) obtained from fluted pumpkin in Jos markets.

The concentrations of Cu, Zn and Mn obtained from fluted pumpkins in Jos markets were higher than WHO/FAO permissible limit and significantly higher than the values reported by Olajire-Gbaye and Folusho (2018) on fluted pumpkin from farms and markets within Akure metropolis where Cu, Zn and Mn values of

fluted pumpkin were lower than WHO/FAO tolerance limit.

Chukwuemeka *et al.* (2015) investigated heavy metals concentration of fluted pumpkin from Niger Delta area where Mn (7.75 ± 3.76 ppm), Fe (5.96 ± 4.07 ppm), Zn (0.11 ± 0.07 ppm), Pb (0.09 ± 0.15 ppm) and Ni (0.03 ± 0.06 ppm) values were reported. The values of heavy metals reported by Chukwuemeka *et al.* (2015) were significantly lower than Fe, Mn, Zn, Cu and Pb values obtained from the fluted pumpkin in Jos markets (Table 1)

Enemugwem *et al.* (2016) reported on heavy metal compositions of fluted pumpkin from Tai Express road and Bori market, Ogoniland, Rivers State. Pumpkin samples from Tai Expressway had Pb value of 2.27 ppm and Cu value of 17.74 ppm while pumpkin leaves from Bori market had Cu value of 2.95 ppm and Pb value of < 0.01 ppm. These values reported by Enemugwem *et al.* (2016) from Ogoniland were lower than the values of Cu (26.17-48.44 ppm) and Pb (1.00-12.82 ppm) obtained from fluted pumpkin in Jos markets.

Mustapha *et al.* (2019) carried out research on fluted pumpkin leaf bought from Samaru market, Sabon Gari L.G.A of Kaduna State. The mean concentrations of Fe (275.670 ppm), Zn (12.830 ppm) and Pb (0.040 ppm) from Samaru market (Mustapha *et al.*, 2019) were lower than Fe (406.97-1817.99 ppm), Zn (29.06 -82.47 ppm) and Pb (1.00-12.82 ppm) obtained from fluted pumpkin in Jos markets

Matthews-Amune *et al.* (2018) investigated fluted pumpkin from two farmlands in Bwari, Abuja. The Cu for Farm A (0.187 ± 0.0005 ppm) and Farm B (0.189 ± 0.0002 ppm); Pb values for Farm A (0.00 ± 0.0001 ppm) and Farm B (0.00 ± 0.0002 ppm); Fe for Farm A (9.400 ± 0.0004 ppm) and Farm B (8.901 ± 0.0004 ppm); and Zn for Farm A (0.732 ± 0.0002 ppm) and Farm B (1.169 ± 0.0003 ppm) were significantly lower than Cu (26.17-48.44 ppm), Pb (1.00-12.82 ppm), Fe (406.97-1817.99 ppm) and Zn (29.06 -82.47 ppm) values obtained from fluted pumpkins in Jos markets (Table 1)

The consumption of plants is one of the major sources of heavy metal toxicity to humans (Intawonge and Dean, 2006). The consumption of plants contaminated with heavy metal may lead to various diseases (Duruibe *et al.*, 2007). Heavy metals can accumulate in the liver and kidney of humans if ingested from contaminated plants which may cause electronic imbalance and leads to nervous, kidney, cardiovascular and bone diseases (Jarup, 2003). High concentrations of heavy metals ingested from plants can damage central and peripheral nervous systems, bloods, lungs and liver (Adaramodu *et al.*, 2012; Ogwuegbu and Mahanga, 2005).

Labe *et al.*, (2018) reported the occurrence of barites as vein mineralization and the associated gangue minerals include galena, sphalerite, copper sulphide, quartz and iron oxide which might be sources of Pb, Zn, Cu, Si and Fe in the soils where these fluted pumpkins are grown. According to Gyang and Ashano (2010), extensive quantities of mine wastes have been generated by the several mining operations in Jos.

The contaminations of agricultural soils in Jos and environs could be associated with mining, industrial and agricultural activities which indicate anthropogenic sources while weathering, leaching and dispersion of underlying mineralization could be a possible source of soil contaminations indicating geogenic sources. The contaminations of soils have negatively impacted on the soil quality where fluted pumpkins are grown and have being the main sources of heavy metals values obtained in the fluted pumpkin. This indicates that the sources of heavy metals in the fluted pumpkins could be attributed to soil contaminations from geogenic and/or anthropogenic sources.

Conclusion

The concentrations of iron in the fluted pumpkin ranges from 406.97 to 1817.99 ppm and exceeded WHO tolerance limit of 20 ppm while the lead concentrations of fluted pumpkin ranges from 1.00 to 12.82 ppm and exceeded the WHO tolerance limit of 0.43 ppm

The values of heavy metals such as Zr, Sr, Rb, Pb, Zn, Fe, Mn and Cu in the fluted pumpkin exceeded the tolerance limits and thus are toxic, carcinogenic and of detrimental effects to the health of the consumers.

The contaminations of soils from mining, industrial and agricultural activities have negatively impacted on the soil quality where fluted pumpkins are grown as indicated by the accumulation of heavy metals in the fluted pumpkin

References

Adaramodu, A.A., Osuntogun, A.O. and Ehi-Eromosele, C.O. (2012). Heavy Metal concentration of surface dust present in E-Waste components: The Westminster Electronic Market, Lagos Case Study. *Resources and Environment*, 2(2): 9-13

Chukwuemeka, A. N., Godwin J. U. and Alfreda O. N. (2015). Investigations of Heavy Metals Concentrations in Leaves of *Telfairia occidentalis* Hook. F. (Fluted Pumpkin) in Nigeria. *Polish Journal of Environmental Studies*, 24 (4): 1733-1742.

Duruibe, J.O., Ogwuegbu, M.O.C. and Egwurugwu, J.N. (2007). Heavy Metal pollution and human biotoxic effects. *International Journal of Physical Sciences*, 2 (5): 112-118

Effiong, G.S., Ogban, P.I., Ibia, T.O. and Adam, A.A. (2009). Evaluation of nutrient supplying potentials of fluted pumpkin (*Telfairia occidentalis*, Hook, F.) and okra (*Abelmoschus esculentus*) (L.) Moench. *Academic Journal of Plant Science*, 2(3): 209 - 214.

Enemugwem, R.I., Baridagara, S.C., Miikueyobe togenu, F.B., Godwin, C., S. and Attah, J. (2016). Heavy metal levels in fluted pumpkin leaves (*telfairia occidentalis*) obtained from tai express way (tai lga) and bori market (khana lga) in Ogoni land, Rivers State, Nigeria. *Nigerian International Journal of Scientific & Engineering Research*, 7 (11): 2229-5518

Environmental Protection Agency, (2004). Agency for Toxic Substances and Disease Registry Toxicological profile for strontium. Atlanta, GA: U.S. Department of Health and Human Services. Public Health Service

Eseyin, A.O., Igboasoiiyi, C.A., Mbagwu, H., Umoh, E. and Ekpe, F.J. (2005a). Studies on the effects of an alcohol extract of the leaves of *Telfairia occidentalis* on alloxan induced diabetic rats. *Global Journal of Pure and Applied Sciences*, 11: 77-79.

Eseyin, O.A., Igboasoiiyi, A.C., Oforah, E., Ching, P. and Okoli, B.C. (2005b). Effects of extracts of *Telfairia occidentalis* leaves on some biochemical parameters in rat. *Global Journal of Pure and Applied Sciences*, 11: 85-87.

Food and Agricultural Organization/World Health Organization (2001). Food additives and contaminants. *Joint FAO/WHO Food Standards Programme Alinorm*, (01/12A), 1-289.

Gyang, J.D. and Ashano, E.C. (2010). Effects of Mining on Water Quality and the Environment: A Case Study of Parts of the Jos Plateau, North Central Nigeria. *The Pacific Journal of Science and Technology*, 11(1): 631-639

Harmanescu, M., Alda, L. M., Bordean, D.M., Gogoasa, I. and Gergen, I. (2011). Heavy metals health risk assessment for population via consumption of vegetables grown in old mining area; a case study: Banat County, Romania. *Chemistry Central Journal*, 5: 64-72

Ikpe, C. (2013). How pumpkin leaves prevent premature ageing, <http://www.vanguardngrnews.com> (2013). Accessed 5 June 2013.

Intawonge, M. and Dean, J. R. (2006). In vitro testing for assessing oral bioaccessibility of trace metals in soil and food samples. *Trends in Analytical Chemistry*, 25: 876-885

Jarup, L. (2003). Hazards of Heavy metals contamination. *British Medical Bulletin*, 68(1): 167-182

- Jordao, C.P., Nascentres, C.C., Cecon, P.R., Fontes, R.L.F. and Pereira, J.L. (2006). Heavy metal availability in soil amended with composted urban solid wastes. *Environmental Monitoring and Assessment*, 112: 309-326
- Labe, N.A., Ogunleye, P.O., Ibrahim, A.A., Fajulugbe, T. and Gbadema, S.T., (2018). Review of the occurrence and structural controls of Barytes resources of Nigeria. *Journal of Degraded and Mining Lands Management*, 5(3): 1207-1216.
- Mansour, S. A. (2014). Monitoring and Health Risk Assessment of Heavy Metal Contamination in Food. Practical Food Safety: Contemporary issue and future Direction. In Bhat R. and Gómez-López (eds). Published by John Wiley & Sons Ltd. pp. 235-255
- Matthews-Amune, C.O., Yisa, B.N. and Ukachukwu, C.V. (2018). Concentration of Pb, Fe, Zn, Cu and Cd in soil, Vegetable and Irrigation water in Bwari Abuja, Nigeria. *Journal of Applied Sciences and Environmental Management*, 22 (9): 1-14
- Mustapha, A.F., Abdullateef, J. and Moses, T.Y. (2019). Health Risk Assessment of Heavy Metals in Samples of some Edible Vegetable Leaves sold in Samaru Market Nigerian *Journal of Pharmaceutical and Applied Science Research*, 8 (2): 67-78.
- Nnamonu, L. A., Ogidi, O. A. and Eneji, I. S. (2015). Analysis of heavy metals content of fluted pumpkin (*Telfairia occidentalis*) leaves cultivated on the south bank of river Benue, Nigeria. *Food Science and Quality Management*, 39: 1-8
- Nwanna, E.E. (2008). "Antioxidant and Hepatoprotective properties of *Telfairia occidentalis* (fluted pumpkin) leaf" Thesis and Dissertations (*Biochemistry*), 56p
- Ogwuegbu, M.O. and Mahanga, W. (2005). Investigation of lead concentration in the blood of people in the Copperbelt Province of Zambia. *Journal of Environment*, 1: 66-75
- Olajire-Gbaye, O.O. and Folusho, O. (2018). Bioaccumulation potential of heavy metals in Leaves of *Amaranthus hybridus* L. and *Telfaria occidentalis* Hook. f. from selected vegetable Farms within Akure metropolis. *Journal of Stored Products Research*, 47(1): 8-12
- OSHA (2013). Occupational Safety and Health Administration: Zirconium and Molybdenum. U.S. Department of Labor. New Jersey Department of Health and Senior Services, pp.1-6
- Orubite, K.O., Ogunka-Nnoka, C.U. and Okpokwu, K.K. (2015). Heavy metal concentrations in soil, fluted pumpkin leaf and surface water in Umuebulu Community in Rivers State, Nigeria. *European Journal of Basic and Applied Sciences*, 2(1): 46-52.
- Singh, N., Hui, Y.H., Evranuz, E.O, Siddiq, M. and Ahmed, J. (2010). Handbook of Vegetables and Vegetable Processing. John Wiley & Sons. pp. 192-352.
- Tirasoglu E., Sogut O., Apaydin G., Aylikci V. and Damla N (2006). Elemental Concentration analysis in Some plant Samples by EDXRF at Trabzon. *Journal of Quantitative Spectroscopy and Radiative Transfer*, 102: 396-401