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Determination of heavy metals concentration in yam at two selected council ward in Kwande Local Government Area of Benue State

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RESEARCH ARTICLE

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Abstract: Determination of heavy metals concentration in yamat two selected council wards in Kwande Local Government Area of Benue State-Nigeria was conducted to investigate the safety of two among the most consumed food products in Nigeria. To achieve this critical investigation, a total of ten (10) samples were collected from each settlement in the two selected council wards in the Local Government Area. The samples were examined for heavy metals concentration using an Atomic Absorption Spectrometer (AAS). Zinc (Zn), Manganese (Mn), Lead (Pb), and Cadmium (Cd) were identified, and their respective concentrations were measured. Zinc ranged from 0.706 to 1.217 mg/l with an average value of 0.962mg/l. Copper has it values from 0.026 to o.313mg/l with an average of 0.154 mg/l. Manganese ranged from 0.426 to 1.816 mg/l with an average value of 0.758 mg/l. Lead from 0.052 to 0.291 mg/l with average value of 0.221 mg/l. Cadmium concentration also ranged from 0.040 to 0.084 mg/l with average value of 0.064 mg/l.

Keywords: *Heavy metals, radiation, yam, contamination*

INTRODUCTION

Heavy metals are generally referred to as those metals which possess a specific density of more than 5g/cm^3 and adversely affect the environment and living organisms [1]. Some of these metals include copper (Cu), chromium (Cr), fluorine (F), molybdenum (Mo), nickel (Ni), selenium (Se) or zinc (Zn), arsenic (As), cadmium (Cd), mercury (Hg) and lead (Pb), etc [2].

In agricultural practice, we understand plants acquire the necessary nutrients, such as Nitrogen (N), Phosphorus (P), and Potassium (K) from the environment. However, they may also accumulate unnecessary and toxic metals, such as Pb and Cd. Several plants have the ability to accumulate high metal concentrations [3]. Many researchers reported data for the transfer of heavy metals from soil to plants and vegetables through roots and shoots. Therefore, toxic metals such as As, Cd, and Pb can be taken up from cereal crops and transferred to their grains [4]. Toxic metals may be classified according to their capability of being transferred from soil to plants in mobile metals, such as Cd, and poorly mobile metals, such as Pb. This property may affect their bioaccumulation in plants [5].

The high level of environmental contamination by these metals is dangerous because their uptake by plants and subsequent accumulation in food crops consumed by humans and animals is deleterious to health. There are many known sources of harmful metals, including the earth, which releases them into food, air, and water, and anthropogenic activities, such as the application of fertilizer in agriculture, the use of pesticides and herbicides, and irrigation. Other sources are automobile emissions, paints, cigarette smoking, industries, and sewage and waste disposal [6].

METHODOLOGY

At each of the council wards, five (5) samples of yam were collected from the southern, northern, eastern, northern, and central part making a total of ten (10) samples collected, taken to the Chemistry Department, Faculty of Science Benue State University Makurdi. The collected samples were washed with distilled water to remove dirt, peeled to remove their coats, sliced into smaller size using a stainless steel knife, and dried for one week. The dried samples were grounded into powder using a mortar and pestle. Approximately 2g each of the grounded samples was weighed and placed in a 50ml beaker. 20ml of concentrated Nitric acid was added and shaken vigorously. The beaker was swirled gently and heated on an electric heating plate placed in a film held at a temperature of 120^{o}C till a clear solution was obtained. A drop wise addition of concentrated nitric acid was carried out to ensure that all the

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To rganic matter were digested. The digested samples were left to cool and then filtered through what man No. 42 filter paper.

The resulting solution were transferred into a 50ml graduated flask and made up to the mark with distilled water. The final processed samples were quantitative analyzed using buck scientific VGP 210 Flame Atomic Absorption Spectrophotometer. After every five sample analyzed using AAS, the first sample was repeated for quality check. Only when the results were within 10% earlier readings did the analyses proceed further. Samples were then analyzed further using the same Atomic Absorption spectrometer (AAS) 220 and were tabulated [7].

The table below shows the concentration of each selected heavy metals on yam at the study locations;

SAMPLE ID	Zn(mg/l)	Cu(mg/l)	Mn(mg/l)	Pb(mg/l)	Cd(mg/l)
AD1	0.706	0.313	0.841	0.244	0.078
AD2	1.217	0.157	1.816	0.218	0.068
AD3	1.164	0.143	0.426	0.284	0.046
AD4	1.145	0.026	0.758	0.250	0.044
AD5	1.200	0.040	0.620	0.052	0.084
AG1	0.706	0.203	0.593	0.291	0.082
AG2	1.098	0.075	0.443	0.164	0.040
AG3	0.935	0.111	0.825	0.246	0.073
AG4	0.733	0.294	0.647	0.244	0.048
AG5	0.815	0.179	0.620	0.225	0.084

Table 1: Measured concentration of heavy metals on yam

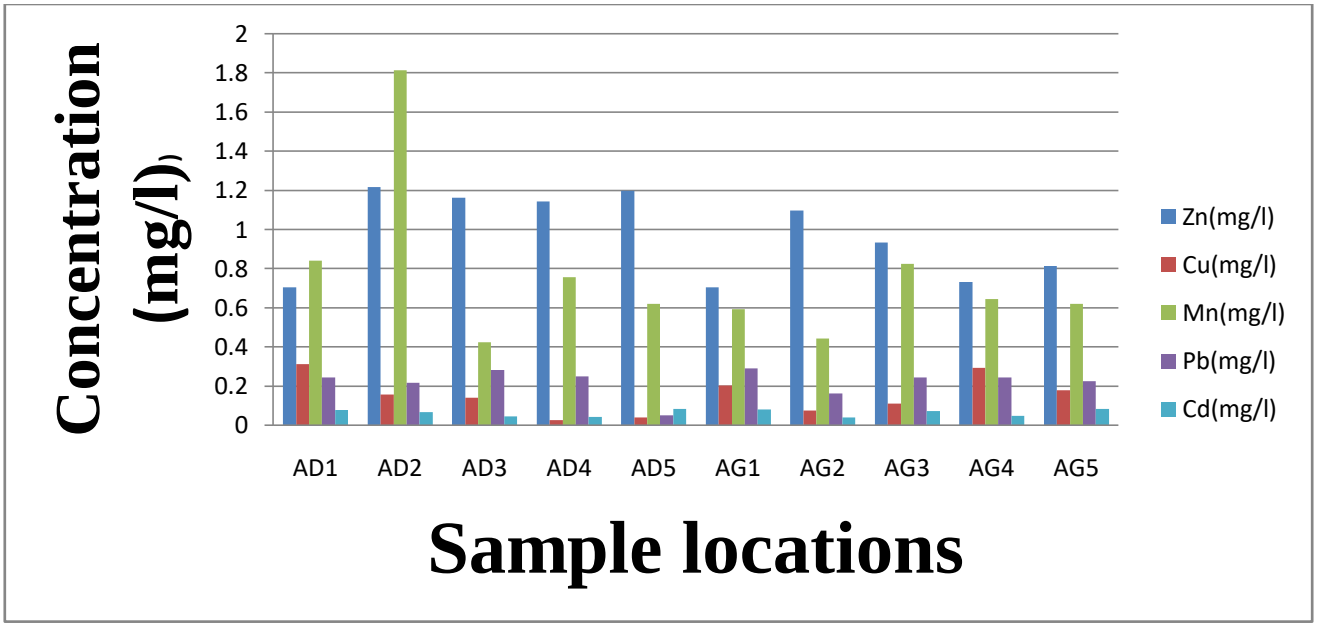

Figure 1: Concentration level of heavy metals and the samples

They are about fifty (50) heavy metals, of which twenty are considered been toxic and radioactive. But for the purpose of this work, five of the radioactive heavy metals were selected considering their level of toxicity and radioactivity, they include;

(a) Zinc (Zn)
(b) Copper (Cu)
(c) Manganese (Mn)
(d) Lead (Pb)
(e) Cadmium (Cd) [8]

Table 1 showed the actual concentration of heavy metals in yam sample with Zinc ranging from 0.706 to 1.217 mg/l with an average value of 0.971 mg/l with the least values in AD1 and AG1 and has its highest value in AD3. Zinc has all its values greater than the acceptable value by NSFQ (0.003 mg/l), WHO (0.003 mg/l) and USEPA (0.005mg/l). The high value of Zinc in this crop could be attributed to the passage of ground waters that enters the environment from several sources including mine drainage, industrial and municipal wastes, urban runoff, and mainly from the erosion of soil particles containing Zinc. Diarrhea, emotional disorders, weight loss, infections due to cell-medicated immune dysfunction, hypogonadism in males, neurosensory disorders, and problems with the healing of ulcers are likely risks associated with the use of such crops [9].

Copper has it values in all the sample locations lower than the recommended value set by NSFQ (1mg/l) and (2mg/l) by the WHO and with average value of 0.154 mg/l. This could be attributed to low contamination from soil through leaching and the use of fertilizers and fungicides. Health risk associated with excess intake of copper includes kidney and stomach damage, vomiting, and loss of strength. Manganese ranges from 0.426 to 1.816 mg/l with average value of 0.758 mg/l. All the values were higher than the standard set by WHO (0.4 mg/l), USEPA (0.005mg/l) and NSFQ (0.2 mg/l) [10]. Consuming such crops for a long period of time can adversely affect human memory, and attention in adult and in children under one year, it can result to poor learning and behavior [11].

Lead has it values ranging from 0.052 to 0.291 mg/l with average value of 0.221 mg/l with the least value in AD5 and has it highest value in AD3. Lead has all its values greater than the reference value by WHO (0.01 mg/l) and NSFQ (0.01 mg/l). The high value of lead in this crop can be as a result of metal smelting, battery manufacturing and other factories that use lead. This lead gets into the air and then mixes with the soil. Exposure to high level of lead can cause anemia, weakness, kidney and brain damage [12, 13].

Cadmium concentration also ranges from 0.040 to 0.084 mg/l with average value of 0.064 mg/l. Cadmium has all its values greater than the reference value by NSFQ (0.003), WHO (0.003mg/l) and USEPA(0.003 mg/l) [14]. The high value of cadmium in this crop can be as a result of the use of fertilizers and fungicides by the farmers in these areas. Kidney and liver malfunctioning and cancer are likely risks associated with the use of such crops [9, 13].

CONCLUSION

Considering WHO, USNRC, USEPA and NSFQ acceptable standard of radiation level and concentration of heavy metals in food stuffs and the analytical result as presented above, the radiation level in yam is high in AD1, AD5, AG3, AG4, AG5 and low in AD2, AD3, AD4, AG1, and AG2, while the radiation level in cassava is low in all the sample locations except in AD1.

Heavy metal concentration in yam has as well revealed the measure of the concentration of metals on the soil of Adikpo Township and Agbaikyan council ward. Records showed high levels of Zn, Mn, Pb, and Cd and only the level of Cu is within the recommended standard. For the fact that this crop is commonly and widely consumed by humans, the high levels of these heavy metals may likely pose a severe health risk to human life and even animals.

Continue consumption of this crop might foster the accumulation of the same heavy metals in the body, especially in the locations AD1, AD5, AG3, AG4, and AG5. The result revealed that yam from AD2, AD3, AD4, AG1, and AG2 are very safe for consumption. It's advised to use more of organic fertilizer and less of inorganic fertilizers for the safety of the food products. Also, the use of herbicide should be minimized for these are some of the most possible avenues through which these heavy metals can easily contaminate our crops.

REFERENCE

1. Myung Chea Jung (2008) Heavy metal concentration in soils and factors affecting metal uptake by plants in the vicinity of a Korean Cu-W mine. MDPI Journal, issn 1424-8220.
2. Kinuthia, G.K., Ngure, V., Beti, D. et al. Levels of heavy metels in water and soil samples from open drainage channels in Nairobi Kenya. Community health implication. Sci Rep 10, 8434 (2020).
3. M. E. Watanabe, (1997) "Phytoremediation on the brink of commercialization," *Environmental Science & Technology*, vol. 31, pp. 82A–187A, 1997.View at: Google Scholar.
4. X. F. Hu, Y. Jiang, Y. Shu, X. Hu, L. Liu, and F. Luo, (2014) "Effects of mining wastewater discharges on heavy metal pollution and soil enzyme activity of the paddy fields," *Journal of Geochemical Exploration*, vol. 147, part B, pp. 139–150, 2014.View at: Publisher Site | Google Scholar
5. Sekara, M. Poniedziałek, J. Ciura, and E. Jedrszczyk, (2015) "Cadmium and lead accumulation and distribution in the organs of nine crops: implications for phytoremediation," *Polish Journal of Environmental Studies*, vol. 14, no. 4, pp. 509–516, 2005.
6. Adah, C.A., and Abah, J., et al., (2013). Soils Availability and Uptake of Some Heavy metals by Three sample vegetables Commonly Cultivated along the south Bank of

River Benue, Makurdi, Nigeria, International Journal of Environmental and Bioenergy, 8(2):56-67.

7. Koréneková B, Skalická M &Nad P (2002). Concentration of some heavy metals in cattle reared in the vicinity of metallurgic industry. VeterinarskiArhiv., 72(5): 259- 267.
8. Daniel B & Edward AK (1995). Environmental Science, Earth as a Living Planet. JohnWiley and Sons, Inc. New York: Pp 278-279.
9. Shen X, Chi Y, Xiong K (2019) The effects of heavy metal contamination on humans and animals in vicinity of zinc smiting facility. Plos one (10): e0207423.doi:10.1371/journal.pone.0207423
10. USEPA. 2007. Concepts, Methods and Data Sources for Cumulative Health Risk Assessment of Multiple Chemicals, Exposures and Effects: A Resource Document, EPA/600/R- 06/013F.
11. David Sylvester Kacholi, MinatiSahu (2018). Level and health risk of heavy metals in soil, water and vegetables of dare s salaam, Tanzania, Journal of chemistry, vol, 2018, 9 page
12. Mangset E.W, Christopher L.D, Solomon A. O, Ike E.E, Mallam S.P, and OnojaR. A.(2014) Gross Alpha and Beta Radio Activity Concentrations and Concentrations and Estimated Committed Effective dose to the General Public Due to Intake of Groundwater in Mining Areas of Plateau State, North Central Nigeria Advances in Physics Theories and Applications. Vol.38, 2014.
13. WHO (1998) Guideline for drinking water quality 2nd edition. Addendum to volume 2: Health criteria and other supporting information, WHO/EOS/98.1, Geneva, Switzerland, pp 283.
14. USEPA (US Environmental Protection Agency) (2015) Regulated food contaminants. Online database.