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# DETERMINATION OF HEAVY METALS AND MACRO ELEMENTS CONCENTRATION IN PLANTAIN (*MUSA PARADISIACA)* SAP

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**Abstract: Heavy metal and macro-nutrients concentrations in *Musa paradisiaca* (plantain) sap from Ikot Osurua, Ikot Ekpene Local Government Area of Akwa Ibom State was carried out using standard analytical procedures. The result of the analysis revealed the following heavy metal; Cadmium (1.02±0.007mg/l), Chromium (0.89±0.002mg/L), Lead (0.003±0.005mg/L), Copper (6.51±0.002mg/L) and Zinc (0.28±0.007mg/L) while the macro-elements present were Potassium (6.005±0.969mg/L), Sodium (1.840±0.113mg/L), Calcium (4.505±0.559mg/L), Magnesium (1.965±0.021mg/L) and Phosphorus (1.655±0.035mg/L). The observed results showed that Chromium, Lead, and zinc were below OIV standard limit while cadmium and copper was higher than the OIV standard limit. Therefore standard measured system should be employed to reduce the concentration of cadmium and copper to be in line with OIV standard to avoid side effects on the consumers.**

**Key words: Heavy metals, Macro nutrients, *Musa paradisiaca* and Sap.**

## 1.0 INTRODUCTION

*Musa paradisiaca* sap, is commonly used as an alternative for managing diarrhoea. Diarrrhoea is an alteration in the normal bowel movement resulting in increase in the volume, frequency and passage of watery stool. Ethnobotannical researches suggest *Musa paradisiaca* sap as a solution.

Metals are natural constituents that exist in the ecosystem. They are substances with high electrical conductivity which voluntarily lose their electrons to form cations. Metals are found all over the earth including the atmosphere, earth crust, waterbodies, and can also accumulate in biological organisms including plants and animals. Among the 35 natural existing metals, 23 possess high specific density above 5g/cm$^3$ with atomic weight greater than 40 and are generally termed heavy metals (Duffus, 2002).

These metals generally termed heavy metals include: Antimony, tellurium, bismuth, tin, thallium, gold, arsenic, cerium, gallium, cadmium, chromium, cobalt, copper, iron, lead, mercury, manganese, nickel, platinum, silver, uranium, vanadium, and zinc (Lif, 2017).

Heavy metals have not only been known for their high density but most importantly for their adverse effects to the ecosystem and living organisms (Bradl, 2002).

Metals are quite essential to maintain various biochemical and physiological functions in living organism when in very low concentrations; however they become noxious when they exceed certain threshold concentrations. Although, it is acknowledged that heavy metals have many adverse health effects and last for a long period of time, heavy metal exposure continues and is increasing in many parts of the world. Heavy metals are significant environmental pollutants and their toxicity is a problem of increasing significance for ecological, ecological, evolutionary, nutritional and environmental reasons (Jaishankar*et al.*, 2013: Nagajyoti*et al.*, 2010). The most commonly found heavy metals in waste water include arsenic, cadmium, chromium, copper, lead, nickel, and zinc, all of which cause risks for human health and the environment (Lambert *et al.*, 2010). Heavy metals enter the surroundings by natural means and through human activities. Various sources of heavy metals include soil erosion, natural weathering of the earth's crust, mining, industrial effluents, urban runoff, sewage discharge, insect or disease control agents applied to crops, and many others (Morais*et al.*, 2012).

These heavy metals are common in our environment, diet and are actually necessary for good health in traced quantity, but large amounts of any many cause acute or chrome toxicity. It toxicity can result in damaging central nervous function, lower energy levels, and damage of blood composition, lungs, kidney, lever an vital organs. Long term exposure may result in slowly progressing physical, muscular and neurological degenerative

processes that mimic Alzheimer's disease, Parkinson's, muscular dystrophy and multiple sclerosis (John, 2002). Allegies are not uncommon and repeated long term contact with some heavy metals or other compound metals cause cancer. According to Konotal *et al,.*(2014) and Kocak *et al.,* (2005), heavy metals present in food in trace quantity; the existence is due to their role in the body metabolism. It has been established that whatever is taken as food might cause metabolic disturbance if it or does not contain the permissible upper and lower limits of heavy metals (John, 2002).

*Musa paradisiaca* is also called plantain (English) as common name and in Efik is called Ukom, is native to south East Asia and India but is now extensively cultivated in the tropical and subtropical region. It belongs to the family *Musaceae* of the order *Zingiberales.* It is divided into several subspecies (Randy *et al.,* 2007). *Musa paradisiaca* is a herbaceous plant to up to 9m long. The pseudo stem (consisting of leaves and their fused based) of plantain grows up to 7-20 inches with a crown of large elongated oval deep-green leaves (up to 365cm in length and 61cm in width), with a prominent midrib. (Dutta *et al.* 1983).

Various parts of the plant have been claimed to be ethnopharmacologically relevant in the management of several aliments. For example, a cold infusion of the root is used to treat venereal diseases, anaemia, Scabies, Leprosy, and Skin diseases. The fruit is consumed as food and used as tonic, antihelminthic, depurative, diuretic, emollient, antiscorbutic, and aphrodisiac, while the leaf juice was reported to be used in the treatment of fresh wounds, cuts, insect and snake bites (Gill, 1992). The leaves have also been used for managing cold, bronchitis, and eye infections. The sap has also been claimed to be used as a remedy for diarrhoea, dysentery, hysteria, epilepsy and fever (Gill, 1992). The roots are administered in digestive disorders, dysentery and other aliments it also has anthelmintic property (Khare (p, 2007). The folkloric claims of *Musa paradisiaca* sap in managing diarrhea and other diseases is yet to be substantiated or refuted with scientific data. Therefore, this study aims at evaluating the cationic levels of the sap.

## 2.0 MATERIALS AND METHODS

The *Musa paradisiaca* (plantain) sap was collected from Ikot Otu village plantain plantation, Ikot Ekpene Local Government Area, Akwa Ibom State. it was transported to the chemistry laboratory in Akwa Ibom State Polytechnic, Ikot Osurua . The sap of *Musa paradisiaca* was obtained by slantingly cutting the internode of the plant and allowing the sap to flow freely into a clean sterilized conical flask. The sap was used within six hours of collection (Yakubu *et al*., 2015).

A known volume 100 mL of *Musa paradisiaca* sap was measured in a measuring cylinder into digestion flasks. Thereafter, 20ml of nitric acid was added into the sample and heated gently at a temperature of $130^0$C until the colour changed colourless. The digest was filtered with whatman filter paper and transferred into a plastic bottle for reading of the Absorbance concentration heavy metals and macro elements of interest directly with the aid of Atomic Absorption Spectrophotometer (AAS).

## 3.0 RESULTS AND DISCUSSION

The result of heavy metals and macro-nutrients concentration in *Musa paradisiaca* sap is presented in table 1- 2 and a bar chart showing their various concentrations is presented in figure 1 below.

**Table1: Heavy metals concentration in *Musa paradisiaca Sap***

| Parameters | Conc. mg/kg | OIV Standard (mg/L) |
|---|---|---|
| Cadmium (Cd) | 1.0205 ± 0.007 | 0.2 |
| Chromium (Cr) | 0.8955 ±0.002 | 0.05 |
| Lead (Pb) | 0.0035 ± 0.007 | 0.2 |
| Copper (Cu) | 6.512 ±0.0002 | 0.1-5 |
| Zinc (Zn) | 0.2895 ±0.007 | 5.0 |

**Table 2: Macro elements concentrations in *Musa paradisiaca Sap***

| Parameters | Concentration (mg/L) | OIV standard (mg/L) |
|---|---|---|
| Potassium (K) | 6.005±0.969 | 1500 |
| Sodium (Na) | 1.840±0.113 | 100 |
| Calcium (Ca) | 4.505±0.559 | 250 |
| Magnesium (Mg) | 1.965±0.021 | 150 |
| Phosphorus (P) | 1.655±0.035 | 1200 |

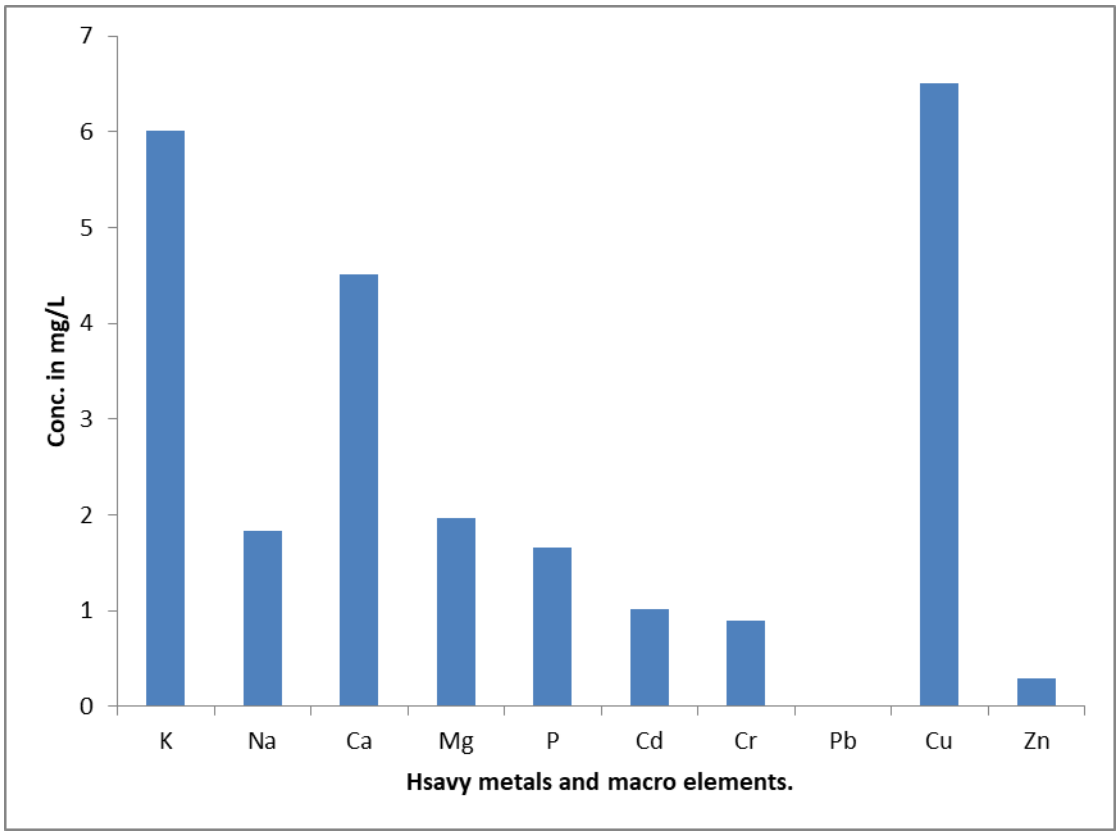


**Figure 1: A bar chart showing heavy metals and macro elements concentrations in *Musa paradisiaca* sap.**

Generally, the result showed that Cu > K > Ca > Mg > Na > P > Cd > Cr > Zn > Pb. (Fig. 1). This implies that Copper had the highest observed value followed by Cadmium while Lead recorded the least concentration for heavy metals while Potassium has the highest followed by Calcium and Lead has the least among the macro nutrients. The concentration of Cadmium (Cd) in *Musa paradisiaca* (Plantain) Sap after the analysis was found to be 1.0205± 0.0007mg/L. The result showed that the concentration of cadmium in the Sap was slightly above the OIV permissible limit value of 0.2mg/L. Cadmium is extremely toxic to the body, and it toxicity it can interacts with the essential nutrient in the body (Steenlan and Buffeta, 2000). Cadmium is not useful in the body. It is used in the industries for the production of paints pigments, alloys, coatings, batteries as well as plastics.

The concentration of Chromium (Cr) in *Musa paradisiaca* Sap was found to be 0.8955± 0.002mg/L. The results showed that the concentration of chromium in the sap was higher than the standard which is 0.05mg/L. chromium as an heavy metal which form beneficial effect in the living system by promoting the ionization of

glucose as well as reducing the concentration of Serum cholesterol (Safyanayana and charkariani, 2014). When this occurs in high concentration, it leads to kidney damage while its deficiency causes the disturbance in carbohydrate, lipid and protein metabolism.

The concentration Lead (Pb) in *Musa paradisiaca* Sap was found to be 0.0035± 0.0007mg/L. The results showed that the concentration of Lead in the sap was lower than the OIV standard which is 0.2mg/L. lead metal is harmful to human when inhaled or ingested particularly to children under the age of five (5), acute exposure of Lead (Pb) causes encephalopathy (brain disfunction) Nauses, vomiting and chronic exposure causes anemia, foot drop, wrist drop (Palsy) and Nephropathy (Kidney disease). (Nolan,2003).

The concentration of Zinc (Zn) in the *Musa paradisiaca* Sap was found to be 0.2895± 0.0007mg/L. The result showed that the concentration of Zinc in sap was lower than the OIV standard which is 5.0mg/L. Zinc plays an important antioxidant role protecting the body against free radicals, this, higher concentration of Zinc causes impairment of growth and reproduction. Acute toxicity of Zinc from the ingestion of excessive amounts of Zinc salts either accidentally or deliberately occurs after the consumption of more than 500mg/L of Zinc sulphate (Ratten*et al.,* 2005).

The concentration of Copper (Cu) in the *Musa paradisiaca* Sap was found to be 6.512± 0.00002mg/L. The result showed that the concentration of copper (Cu) in the Sap was higher than the OIV permissible limit value of 0.1-5mg/L. Copper is an essential substance to human life but in high dose it can cause anemia, liver and kidney damage and intestinal irritation (Naanipre*et al.,* 1997).

However, the concentration of Potassium (K) was found to be (6.005±0.969mg/L) while the OIV standard is 1500mg/L. The observed result shows that the sample is below OIV standard. Potassium plays a key role in skeletal and smooth muscle contraction, making it important for normal digestive and muscular function. High potassium content is found to be useful in the prevention of high blood pleasure and muscle cramp (Ng and Fong, 2000).

Sodium (Na) was found to be (1.840±0.113mg/L) while the OIV standard is 100mg/L. This result shows that sample is below OIV standard but can be use as Sodium supplement. The body needs a small amount of sodium to help maintain normal blood pleasure and normal function of muscles and nerves. Sodium had a lower concentration which has supported the claim in previous findings (Stover and Simmonds, 1987; Welford *et al.,* 19988).

Calcium (Ca) content was found to be (4.505±0.559mg/L) while the OIV standard is 250mg/L. This result shows that the sample is below OIV standard but can still be used as Calcium supplement. Calcium is very important in the formation of strong bones and teeth, for growth, blood clotting, heart function and cell metabolism (Roth and Townsend, 2003; Rolfe *et al.,* 2009).

The concentration of Magnesium (Mg) was found to be (1.965±0.021mg/L) while the OIV standard is 150mg/L. This result shows that sample is below OIV standard but can still be used as Magnesium supplement. Magnesium helps to maintain normal nerves, muscle function support, healthy immune system, keep the heart beat steady and help bones remain strong. It is also a constituent of bones, teeth, enzymes cofactor (Kinases, etc) (Murray et al., 2000).

The concentration of Phosphorus (P) was found to be (1.655±0.035mg/L)while the OIV standard is 1200mg/L. This result shows that the sample is below OIV standard but can be used as Phosphorus supplement. Phosphorus is used for several biological processes such as; bone mineralization, energy production, cell signaling and regulation of acid-base homeostasis. Phosphorus availability stimulates early growth and hastens maturity in plants (Sharma *et al.,* 2008).

## 4.0 CONCLUSION

The analysis of heavy metal and trace nutrient concentrations in *Musa paradisiaca sap* is an important step in ensuring human and environmental health. The presence of these metals in plantain sap is directly due to the soil erosion, natural weathering of the earth's crust, mining, industrial effluents, urban runoff, sewage discharge, insect or disease control agents applied to crops and many others. The metals present in the plant sap also have a direct influence on the quality of food chain, plant growth which depends on cycle nutrient.

Some of these metals are essential for plants growth as well as cofactors for enzymes and metabolic yields, such metals include iron, Zinc, Chromium and Cobalt. On the contrary, Lead and Cadmium are among the most abundant heavy metals and are particularly toxic even at an ultra-traced amount. They are associated with cardiovascular diseases, kidney and nervous disorders as well as anemia.

The heavy metals and macro nutrients that were found to be present in the sap were Cadmium (Cd), Chromium (Cr), Lead (Pb), Copper (Cu), Zinc (Zn) Calcium (Ca), Potassium (K), phosphorus (P), Magnesium (Mg) and Sodium (Na) Conclusively, from the analysis, it was observed that the concentration of some heavy metals in the sap it some were higher than the OIV permissible limit while some were lower than the OIV permissible limit. Therefore, the appropriate measures and purification system should be employed before the consumption of the sap.

## 5.0 REFERENCE

Bradi, H. (2002) editor. Heavy metals in the environment: Origin, interaction and Remediation. London: *Academic Press*: Vol.6.

Chatter Jee, R. (2002). Environmental toxicity Cambridge: *Cambridge University press*. P. 40.

Constantine, David (2008). "*Musaserapionis*". Musa: an annotated list of the species of Musa.

Debaandya M, Namarata S. (2010). Banana and its by product utilization: An overview.*Journal of scientific and industrial research*, 323-329.

Duffs, J. H. (2002). Heavy metals — A meaningless term.*Pure and Applied Chemistry*, 74(5): 793-807.

Ghani A. (2003). Chemical constitutients and uses. *Medicinal plants of Bangladseh,* 2nd ed. Pp. 315.

Gill, L. S.(1992). Ethnomedical uses of plants in Nigeria. *Uniben press*, Benin, Nigeria.

GRIN (2009). "Genus: Musa L." Taxonomy for plants. National Germplasm Resources Laboratory. Belts ville, Maryland, USDA, ARS, National Genetic Resources Program.

Jaishankar M, Mathew BB, Shah MS, Gowda KRS (2014). Biosorption of few heavy metal lons using Agricultural wastes. *Journal of environment pollution on Human Health*, 2(1): 1-6.

John, H. (2002). Distribution of heavy metals in fluredpumple in (TelferiaOceentalis) leaves planted at different distances away from the traffic congested highway. *Highways intern. J. Adv. Biotechnology Research* 2(2): 250-256.

Khare CP. (2007). Indian Medicinal Plants. Springer Science + Business Media, 426.

Krishna AK, Mohan KR (2016). Distribution, correlation, ecological and health risk assessment in surface soils around an industrial area, Hyderabad, India. Environment and Earth Science. pg 75: 411

Lambert M, Leven BA, Green RM. (2000). New methods of cleaning up heavy metals in soils and water, Environmental secience and technology briefs for citizens, Manhattan, KS: Kansa State University.

Lif, Qir ZZ, Zhang JD. (2017). Investigation, pollution mapping and stimulative leakage health risk assessment for heavy metals and metalloids in ground water from a typical brownfield, middle China. *International Journal of Environmental Research and public Health*, 14(7): 768.

Magajyoti, P. C, Lee, K. D., Screekanth TVM (2010). Heavy Metals, occurrence and toxicity for plans a review environ chem Lett, 8(3): 199-216.

Morais S, Costa F G, Pereira ML. (2012). Heavy Metals on human health in: Environmental Health emerging issues and practice, pp, 227-246.

Mumataz Johan, Warsi MK, FehmeedaKhatoon. (2010). Concentration influence on anti-microbial activity of banana blossom extract incorporated chitosan-ployethylene glycol (cs-PEG) blended film. *Journal of chemical chemistry and Pharmacentical Research*, 2(5): 373-378.

Narayan, N. P, S. S Purohit, K. S. Arun, and K. Arun. (2003). Hand Book of medicinal plants. A complete source Book, Agrobios, Jodhpur, India.

NaturajLoganayaki, Dharmar R., Stellamuthu M. (2010). Antioxidant capacity and phenolic content of different solvent extracts from plantain and mustai (Riveahypocraterifomis). *Food science and biotechnology* 19(5): 1251-1258.

Nolan, K. (2003). Copper toxicity Syndrome Journal of or thomuecular psychiatry. *Journal of Biological Science* 12: 270-282.

Okorondu SI, Akujobi (O, Nwachukwu IN, (2012). Antifungal properties of Musa Paradisiaca (Plantain) peel and stalk extracts. International Journal of Biological and chemical Science, 6(4): 1527-1534.

Ploetz, R. C., Kepler, A. K, Daniells, J. and Nelson, S. C. (2007). "Banana and plantain: An overview with emphasis on pacific Island cultivars", in Elevitch.

Prasobh GR, Revikumar KG, (2014). A study on the use of Musa species in the management of renal calculi. Asian journal of pharmaceutical and clinical research, 7(3): 123-125.

Safyanaranyana, U. and chakrapani, U. (2014). Biochemistry, 4th ed. India: Thomas Press Ltd, Pp. 414-422.

Shram P, Dubey R S. (2005). Lead toxicity in plants. Brazilian Journal of Plant Physiology, 17(1): 35-52.

Steenlan, K. and Boffertta, P. (2000). Lead and cancer in Humans: where are we now? *American Journal of industrial medicine*, 38: 295-299.

Surbhi Gupta *et al.,* (2001) Der Pharmacia Sinica, 2(4): 74.

Suruchi, K and Khanna, P. (2011). Assessment of heavy metals contamination in different Vegetables growth in the around Urban areas. Research Journal of Environ. Toxicology, 5: 162-179.

Thirumala K, Janarthan M, Firasat AM, (2013). The aqueous extract of stem core of Musa Paradisiaca against ethylene glycol and ammonium chloride induced urolithiasis. International Journal of research in pharmacy and biotechnology, 1(6)|: 866-868.

Thurmer K, Williams E, Reuth-Rubey J. (2002). Autocatalytic oxidation of lead crystallite surfaces. Science, 297(5589): 2033-2035.

Valmajor, Ramon V., Jamaluddin, S.H., Silayoi, B., Kusumo, S., Danh, L. D, Pascua, O. C. and Espino, R. R. C. (2000). Banana cultivar names and synonyms in southeast Asia, Los Banos, Philippines: International network for improvement of Banana and plantain – Asia and the Pacific office, ISBN 978-971-91751-2-4.

Yakubu, M.T., Nurudeen,G.O., Salimon,S.S., Yakubu,M.O., Jimoh,O.R., Nafiu,O.M., Akanji,M.A., Oladiji,T.A and Willams, F.E,(2015). Antidiarrhoea Activity of Musa paradisiaca Sap in Wistar Rats. Evidence-Bases Complementary and Alternative Medicine https//doi.org/10.1155/2015/683726