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ABSORPTION OF HEAVY METALS BY SCENT LEAF (*Ocimum gratissimum L.)* GROWING AROUND UNICROSS DUMPSITE

Sam-Uket, Nwuyi Okori

Department of Animal and Environmental Biology

Faculty of Biological Sciences

University of Cross River State (UNICROSS)

Corresponding Email: nwuyiokori@yahoo.com

Abstract

The absorption of heavy metals by scent leaf (*Ocimum gratissimum L.*) growing around UNICROSS dumpsitewas investigated. The samples were obtained at random from three different locations in the dumpsite (Behind Microbiology Lab, Behind Plant Science and Biotechnology Lab, and behind Animal and Environmental Biology Lab) in UNICROSS. The plant samples were put in a poly-ethene bag and transported to Ministry of Science and Technology Uyo for analysis. The scent leaf (*O.gratissimum*) was digested and analyzed for heavy metals using Atomic Absorption Spectrometer (AAS). The result showed that the mean concentration of heavy metals in scent leaf from the three stations are as follows; Lead was 7.284 mg/L, calcium was 1.540 Mg/L, Chromium was 1.606 mg/L, Cobalt was 3.108 mg/L and Copper was 8.324 mg/L which were above the Federal Ministry of Environment permissible limit. The mean concentration of Iron and Arsenic was 0.303 mg/L and <0.001 which were within the FMENV permissible limit. The concentration of heavy metals in scent leaf can vary depending on various factors such as the soil quality, environmental pollution, and agricultural practices. To ensure the safety of using scent leaf, it's important to have it tested for heavy metal contamination, especially if it's grown in an area with potential pollution.

Keywords: Heavy metals, Scent leaf, environmental pollution, contamination, permissible limit.

1.0 Introduction

Vegetables constitute an important part of the human diet since they contain carbohydrates, proteins, vitamins, minerals as well as trace elements. The contamination of vegetables with heavy metals due to soil and atmospheric contamination poses a threat to its quality and safety. Dietary intake of heavy metals also poses risk to animals and human health. High concentrations of heavy metals (Cu, Cd and Pb) in fruits and vegetables were related to high prevalence of upper gastrointestinal cancer. Many anthropogenic sources such as waste incineration, industrial processes and most importantly, vehicular traffic emits heavy metals into the atmosphere. Regulations have been set up in many countries and for different industrial-set up to control the emission of heavy metals.

The uptake and bioaccumulation of heavy metals in vegetables are influenced by many factors such as climate, atmosphere depositions, the concentrations of heavy metals in soil, the nature of soil and the degree of maturity of the plants at harvest (Scott.*et al*.,1996, Voutsa. *et al*.,1996)

Heavy metals are hazardous contaminants in food and the environment and they are non-biodegradable having long biological half-lives (Heidarieh *et al*,2013).

Some plants are planted basically for medical use. For instance, scent leaf is a plant eaten by the UNICROSS community occupant and most times transported to the market for sales as vegetable and it is nutritionally important as a seasoning partly because of its aromatic flavor. It is also reported that they also use it in the care of a baby's umbilical cord because of its sterile action on the umbilical wound surface. Phytochemical evaluation of this plant has revealed its rich contents to include alkaloids, flavonoids, tannin, phytates and oligosaccharides. This could be the reason that they are seen as a cure of various ailments, (Sas-Nowosielska *et al*., 2008). It is also observed that in UNICROSS, the scent leaf is used as anti-malaria, mosquito repellent and anticonvulsant. The juice of this plant is used as anticonvulsant, smooth muscle relaxant, anti-catarrh and against headache. Oil produced from the plant has been proven to posses' antibacterial, antifungal and antiseptic, antibacterial activities.

However, human industrial activities such as the practice disposal of industrial wastes, automobiles exhaust, refuse burning and use of pesticides in agriculture, have contaminated the agricultural soils with heavy toxic metals such as Mercury (Hg), cobalt (Co), lead (Pb), Arsenic (As) cadmium (Cd) and chromium (Cu), which can potentially lead to the uptake and accumulation of these metals in the ~~medicinal~~ plants' parts. These are all source of possible health risk factors to the health of plants and animal. Research has shown that plants are crucial in humans getting contaminated by heavy metals via the soil because these heavy metals have the capacity to form concentrates in the normal ecological food chain. (Korfali *et al*., 2013)

2.0 Materials and method

2.1 Study socation

UNICROSS dumpsite near New Science Block 6(NSB 6) was selected for study location. Sampling was done at random from three different locations within UNICROSS dumpsite near NSB 6.

2.2 Collection of sample

Sample used for the study was scentleaf (*Ocimum gratissimum*). The sample was obtained at random from three different locations in UNICROSS dumpsite located at New Science Block 6(NSB 6). Station one was behind Microbiology Lab, station two was behind Plant Science and Biotechnology Lab and station three was behind Animal and

Environmental Biology Lab. The scent leaf was plucked from the stem. The used plant was selected because of the nutritional and medicinal purpose by the people in the sample area. The plant sample was washed clean using distilled water and to avoid sample contamination. All reusable laboratory wares were washed thoroughly and rinsed with distilled water.

2.3 Analysis of sample in the laboratory

The samples analysis for heavy metals was done in Ministry of Science and Technology laboratory Uyo, Akwa Ibom State, Nigeria.

Sample Analysis Beakers and flasks, Solar thermos elemental atomic absorption spectrophotometer (Flame AAS), Burner, Hollow cathode lamps, Graphical display and recorder, Pipette (micro liter with disposal tips), Pressure reducing valves, Glassware, Volumetric flask of suitable precision and accuracy. Air, Acetylene, Metal free water, Stock metal solution, Potassium chloride solution, Aluminium nitrate solution, Hydrogen tetraoxosulphate (vi) acid (H_2SO_4), Trioxonitrate (v) acid (HNO_3), Perchloric acid ($HCLO_4$). A total volume of 100ml of H_2SO_4, HNO_3, and HCIO in the ratio of 40%: 40%: 20% was mixed together. A portion (1g) of the sample was weighed into a conical flask; 2ml of the mixed acid was taken to each of the sample in the conical flask. It was digested in a fume cupboard with hot plate until white fumes appeared. After that, it cooled and was filtered into 100ml volumetric flask and made up to mark with distilled water (Luevano *et al.*, 2014). This technique operates on Beer-Lambert's law which states that Absorbance is directly proportional to concentration. Hence, absorption spectrometry is used to evaluate the concentrations of analyte in a sample; it requires standards with known analyte concentrations. The light source is a lamp with a cathode of the same element being determined since each element has a characteristic wavelength that is readily absorbed. An AAS consists of an atomizer burner to convert the element in the solution to free atoms in an acetylene flame, a monochromatic to disperse and isolate emitted and a photomultiplier to detect and amplify the light transitory through the monochromatic into its component wavelength. The photomultiplier then receives only the isolated resonance wavelength and absorption of its light by the sample. After proper lamp for the test element has been inserted, the intensity of the light is measured by passing through the unrestricted flame. Then the sample is introduced into the flame and the concentration of the elements in the sample is determined by the increase in light intensity.

2.4 Statistical analysis

The sample of the study was analyzed using the Statistical Programme for Social Science (SPSS). A t–test was used to determine difference between the means of the various sample using $p < 0.05$ level of significance.

3.0 Result and discussion

Table 1: Table showing the concentration of heavy metals in scent leaf collected behind Microbiology lab

Elements	**Concentration**	**FMENV permissive limit**
Lead	7.512	0.05
Calcium	1.605	0.5-1.5
Iron	0.314	0.1-1.0
Chromium	1.803	0.003
Cobalt	3.113	-
Copper	8.732	-
Arsenic	<0.001	<0.001

Table 2. Table showing the concentration of heavy metals in scent leaf Behind Plant Science and Biotechnology lab

Elements	**Concentration**	**FMENV permissive limit**
Lead	6.912	0.05
Calcium	1.504	0.5-1.5
Iron	0.285	0.1-1.0
Chromium	1.604	0.003
Cobalt	3.111	-
Copper	8.116	-
Arsenic	<0.001	<0.001

Table 3: Table showing the concentration of heavy metals in scent leaf in station 3(Behind Animal and Environmental Biology lab) and the permissive FMENV limit.

Elements	**Concentration**	**FMENV permissive limit**
Lead	7.425	0.05
Calcium	1.511	0.5-1.5
Iron	0.311	0.1-1.0
Chromium	1.411	0.003
Cobalt	3.101	-
Copper	8.124	-
Arsenic	<0.001	<0.001

Table 4: Table showing the mean, Md, Std deviation, degree of freedom, t-value & significance of scent-leaf in the elements

Elements	T	Df	Sig (2-tailed	Mean	Mean difference	Std deviation	Limit
Lead	-140.07	2	3.624	7.284	7.234	0.180	0.05
Calcium	-171.11	2	0.770	1.540	0.040	0.032	0.5-1.5
Iron	0.131	2	0.150	0.303	-0.697	0.008	0.1-1.0
Chromium	0.337	2	0.804	1.606	1.603	0.584	0.003
Cobalt	0.001	2	1.552	3.108	3.108	0.002	-
Copper	-141.08	2	4.121	8.324	8.324	0.204	-
Arsenic	<0.001	2	<0.001	<0.001	<0.001	<0.001	<0.001

The table above shows the mean concentration, standard deviation and difference between the concentration mean and recommended permissible limit by FMENV of lead (Pb), calcium (Ca), Iron (Fe), chromium (Cr), Cobalt (Co), copper (Cu) and Arsenic (As) in scent leaf in mg/L. The table shows that the average amount of Pb, Ca, Fe, Cr, Co, Cu, and As in scent leaf was 7.284 mg/L. in Pb, in Ca its 1.540 mg/L, in Fe its 0.303 mg/L, in Cr 1.606mg/L, in Co its 3.108 mg/L, in Cu its 8.324 mg/L, in As its <0.001 mg/L. With observed standard deviation of 0.180, 0.032, 0.008, 0.584, 0.002, 0.204 and <0.001 respectively.

Also, the table compared the average value of Pb, Ca, Fe, Cr, Co, Cu and As with the allowable FMENV permissible limit recommended by FMENV.

The table shows that the mean difference for scent leaf for Pb, is 7.234, Ca is 0.040, for Fe is – 0.697, for Cr is 1.603, for Co is 3.108, for Cu is 8.324 and Arsenic is <0.001 respectively when compared with the allowable permissible limit for pb is 0.05, Ca is 0.5-1.5, Fe is 0.1-1.0, Cr is 0.003, Co and cu is zero while As is <0.001.

The scent leaf sample shows that in Pb p = 3.642 at p <0.05. This shows that the sample's mean was not significantly different. In Ca p = 0.770 at <0.05. This show that the sample means was significantly different. In Fe p =0.150 at P <0.05. This shows that the samples mean was not significantly different. In Cr p = 0.804 at p < 0.05. This shows that the samples mean was not significantly different. In Co P = 1.552 at p <0.05. This shows that the samples mean was not significantly different. In Cu p = 4.126 at P < 0.05. This shows that the samples mean was not significantly different. In As P = <0.001 at P <0.05. This shows that the mean of the sample is significantly different.

Heavy metals implicated with contamination of scent leaf were Pb, Ca, Fe, Co, Cr and As across Nigeria and this study has presented a picture of Heavy metals contamination of scent leaf within UNICROSS dumpsite near NSB 6. The levels of these heavy metals are however above the approved FMENV approved limits while some are within the limit. This raises concern about the toxic effects of heavy metals in body as continuous ingestion of scent leaf whose heavy metals accumulation is still within tolerable range raises danger of potential toxicity in events of prolongs and cumulative ingestion overtime. Sources of heavy metals found in scent leaf include anthropogenic activities such as: Land reclamation from refuse dumpsites, using heavily polluted effluent waters for irrigation, emissions from vehicles close to roads, agricultural activities involving use of heavy metals such as pesticides, other industrial emissions which may be influenced by direction of winds and water currents (Shinggu *et al., 2010,* Chiroma *et al., 2007)*

Cutting down on the use of fossil fuel in vehicles and reducing the number of vehicles on roads are options to reduce HMs accumulation in farm crops close to Roads with heavy vehicular loads and waste. Also planting scent leaf in soils less than 20 meters form dumpsite should be discouraged as levels of HMs in n such soils are generally high. More enlightenment and awareness should be created to discourage farming close to dumpsites as such soils often appear more fertile, with better proximity and hence more tempting compared to distant site (olajumoke *et al.,*2020)

While many studies reported high heavy metals concentration in scent leaf studied, they were however within tolerable limits. This should not be seen as a normal trend but a possible transition stage of these elemental accumulations and is bound to increase overtime.

I also agree with the views of researcher who recommended a regular screening of these vegetable and soils to detect abnormal accumulation early, and also to deploy measures to halt and slow down the process of accumulation.

Heavy metals toxicity in human tissues is associated with several diseases and these includes: Alzheimer's disease and multiple sclerosis which have been closely linked with high levels of Pb in the blood of affected patients (Lee *et al.,* 2012). Cardiovascular disease (Hypertension, stroke) is associated with arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu) causing hyperglycemia and dyslipidemia leading to diabetes mellitus and may also cause endocrine disruption (yang et al ,202) Neurodegenerative diseases associated with As, Pb (Karri *et al*.,2020).

Ar, Cr are grouped under class 1 carcinogens by international Agency for Research on cancer; cancers associated with heavy metals include; Hepatocellular carcinoma caused by Pb, As (Kim *et al.,* 2015), gastric cancers caused by Lead, chromium and arsenic (yuan et al., 2016), thyroid Cancers (vigneri *et al.,* 2017) Lung cancer (Mahurpawar M. 2015). Breast cancer is caused by Lead, arsenic when they cross the brain barrier and cause various Neurodegenerative conditions (Agnihotri *et al.* 2019).

4.0 Conclusion

The study above showed the presence of the selected heavy metals in scent leaf (*Ocimum gratissimum).* Furthermore, the concentration of lead (Pb) in scentleaf is above the allowable limit. Excess intake of Lead may not be appropriate for human intake because it could lead to food poisoning. Calcium (Ca), iron (Fe), chromium (Cr), cobalt (Co), Copper (Cu), are also above the allowable limit. The excess intake of calcium (Ca) may increase the risk of some conditions like kidney stones, prostate cancer and constipation. The excess intake of iron (Fe) can cause gastrointestinal effects. The excess intake of chromium causes stomach problems, low blood sugar and kidney or live damage. Cobalt excess intake by human can lead to heart muscle disease. Copper intake by human in excess can lead to result in liver damage and gastro intestinal.

Finally, Arsenic is the same with the allowable permissible limit.

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