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E-mail: submit@mutagens.co.in
researchsubmission@hotmail.com

Research Paper

SOME HEAVY METALS ACCUMULATION IN MEDICINAL PLANTS USED IN OGHE COMMUNITY OF ENUGU STATE, NIGERIA AND THEIR HEALTH IMPLICATION

Ogbuanu C. C. [1, 2], Ehiri R. C. [2] and Ogah S. P. I. [2]

[1]Department of Industrial Chemistry, Enugu State University of Science and Technology, P. M. B. 01660 Enugu, Nigeria
[2]Department of Industrial Chemistry, Ebonyi State University, Abakaliki, P.M.B. 053 Abakaliki Nigeria.

Abstract

This study was carried out to evaluate the heavy metals risk involved on the use of medicinal plants from Oghe community of Enugu State, Nigeria. The plant samples Sabicea brevipes plant root used for treatment of erctile dysfunction in men were collected from four sample locations namely Oyofo, Neke, Akama and Iwollow Communities of Oghe in Ezeagu Local Government Area of Enugu State, Nigeria on July 10th, 2014 so as to assess its safety for consumption by the public. The roots were determined for lead, manganese, cadmium, zinc, copper and iron. Atomic absorption spectrophotometry was used for the analysis. The results showed the mean content of the heavy metals analyzed for - lead (0.6300), manganese (0.1795), cadmium (0.0189), zinc (18.3800), cupper (3.1900), and iron (129.3800). Generally, iron accumulation was the highest for all the four sample locations and far more above the Daily Dietary Intake (DDI). Lead, zinc, copper, cadmium and manganese were within or lower than the safety levels or Daily Dietary Intake for the four sample locations. Plants from sampling locations in Akama and Iwollow were higher in metal accumulation probably due to industrial activities and highway. When compared to the reference value from Daily Dietary Intake (DDI) for the heavy metals studied, iron is more than the safety levels or maximum permissible level for human consumption. Therefore, our results showed that heavy metals accumulation on medicinal plants (Sabicea brevipes plant root) were only safe for lead, manganese, cadmium, zinc, and cupper.

Key words: Heavy metals, *Sabicea brevipes*_root, Health Implications, Atomic absorption spectrophotometry.

INTRODUCTION

Heavy metals are the term used to describe metals with a density of at least five times that of water [17]. Living organisms require varying amounts of heavy metals. Iron, cobalt, copper, manganese, molybdenum, and zinc are required by humans. Excessive levels can be damaging to the organism. Other heavy metals such as mercury, arsenic, plutonium and lead are toxic and have no known vital or beneficial effect on organisms and their accumulation over time in the bodies of animals can cause serious illness [11,

15]. Certain elements that are normally toxic are, for certain organisms or under certain conditions, beneficial. Examples include molybdenum, tungsten and even cadmium [25, 26]. Chronic low-level intakes of heavy metals have damaging effect on human beings and other animals, since there is no good mechanism for their elimination. Metals such as lead, mercury, cadmium and copper are cumulative poisons. These metals cause environmental hazards and are reported to be exceptionally toxic [12].

Medicinal plants play a major role in the health care sector of developing nations for the management of diseases. The accumulation of heavy metals in environmental samples such as plants, sediments, soils, sewage, sluges, solid residues etc is a potential risk to human health due to their subsequent introduction into the food chain [21, 6, 30]. Concentration of heavy metals in the environment may rise to toxic levels through mining, industrial processing and use in numerous applications such as in anti knock in fuel, disposal of municipal and industrial wastes and agricultural fertilizer and pesticides [5, 24]. Plants growing in a heavy metal – polluted environment can bioaccumulate the toxic metal at high concentration causing serious health risk to human when consumed [30].

Human ingest trace metals to some extent in herbs grown in places subject to high human activities such as mining and quarrying with elevated levels, particularly in the air and soil [8]. Plant species and varieties vary in their capacity for heavy metals accumulation [19]. Vegetables take up metals by absorbing them from contaminated soil, as well as from deposits on parts of the vegetables exposed to the air from polluted environments [31]. The maximum tolerable levels of Cd, Pb, and Cu in plants are 5-30 mg/g, 30-300 mg/g and 20-100 mg/g respectively which are commonly referred to critical concentration in plants above which toxicity are likely to occur [3, 22].

Sabicea brevipes, locally known in Ezeagu Local Government Area of Enugu State as 'susu', is a plant species used for the management of erectile dysfunction. It is an erect or climbing shrub, growing 0.6096 – 1.2192 meters in height. The plant produces fruits between the months of July and August. The fruits are small, red and juicy and are eaten by the people in Sierra Leon and Eastern Nigeria mostly. The leaves are ovale, 12cm long and 30.5cm broad. They are long at the apex and round at the base [16].

The objective of this study is to evaluate the levels of some heavy metals accumulation in the roots of *Sabicea Brevipes* plants grown in Oghe community of Enugu State so as to obtain a comprehensive picture of heavy metal accumulation in medicinal plants.

MATERIALS AND METHODS

The study was carried out between 10th July 2014 and August 2015. **Reagents:** Analytical (Analar) grade reagents and distilled water were used throughout the experiment.

SAMPLE COLLECTION:

Fresh roots of *Sabicea brevipes* were collected from the four sample locations namely Oyofo, Akama, Neke, and Iwollo of Oghe Community in Ezeagu L.G.A. of Enugu State, Nigeria.

SAMPLE DIGESTION:

Five gram powdered plant material was taken in the silica crucible and heated in a muffle furnace at 500^{o}C till there was no evolution of smoke and maintained in that temperature for 4 hours and later cooled. The cooled ashed sample was dissolved in

10mL aqua-regia and heated to dryness without baking for 1 hour. The digest was dissolved with distilled water and the volume made up to 50mL with distilled water [20, 9].

HEAVY METAL ANALYSIS:

The sample digests were analyzed for their heavy metals content using the Buck Scientific Atomic Absorption Spectrophotomer 205, in duplicates for lead, manganese, cadmium, zinc, copper and iron.

RESULTS AND DISCUSSION

The results of the accumulation of heavy metals in the root of *Sabicea brevipes* plat root for the four sample locations are shown in Table I. Lead accumulation was highest in Akama (0.6600ppm) followed by Oyofo (0.6500 ppm) probably due to the Premier Cashew Industry that is close to the two sample locations. Neke (0.06100ppm) showed the least accumulation followed by Iwollow (0.6300ppm). This also may be due to emission from vehicles and as well as wastes pollution from different operations. High concentration of lead in the body causes anemia (reduction in hemoglobin levels), pale skin, decreased hand grip strength, abdominal pain severe constipation, nausea, paralysis of the wrist joint, increases chance of miscarriage or birth defects and erythropoiscs. The central nervous system becomes severely damaged at blood lead concentration starting from 40 mcg/dL and 70 mcg/dL [14, 15, 10]

In this study manganese ranges from 0.1780ppm to 0.1797 ppm in the four sample location with Oyofo showing the highest accumulation 0.1797 ppm, followed by Iwollow (0.1796 ppm), Akama (0.1776ppm) and Neke (0.1770ppm). Thus the concentration level of manganese is well below the DDI and hence acceptable, hence it will neither affect the plant growth nor cause human toxicity. Manganese is also an essential element for plants and animals. Critical manganese concentration in plant is in the range of 300-500mg/kg [18]. At high levels manganese causes damage to the brain, liver, kidneys the developing fetus, respiratory tract and Parkinson. The National Research Council has recommended a safe and adequate daily intake level of manganese from 0.3 to 1mg/kg, beyond 5mg/kg is toxic [28].

Cadmium is a toxic metal having no functions in animal or plants. It stays in the kidney resulting in high blood pressure and kidney disease and is very difficult to remove by excretion. Cadmium directly damages nerve cells. It inhibits the release of acetylcholine and activates cholinesterase enzyme, resulting in a tendency for hyperactivity of the nervous system [4]. The lowest level of cadmium that can cause yield reduction is between 5-30 mg/kg.

The concentration of cadmium detected in *Sabicea brevipes* plant root for the four simple locations was very much lower than the Daily Dietary Intake (DDI) level. This may be due to a very low level of cadmium in the available soil for plant growth [21].

Highest concentration of zinc was in Neke (18. 4100 ppm) while lowest concentration was observed in Iwollow (18.3400 ppm). Among all the metals, Zinc (Zn) is of the least toxic and an essential element in the human diet as it is required to maintain the proper functioning of the immune system. It is also important for normal brain activity and is fundamental requirement in the growth and development of the foetus. Zinc deficiency in the diet may be more detrimental to human health than too much zinc in the diet. Although the average daily intake of zinc is 7-16.3 mg per day, the recommended dietary allowance for it is 15mg per day for men and 12mg per day for

women [2]. On the contrary, higher concentration of zinc may cause vomiting, renal damage, cramps etc. The acceptable limit of zinc for human consumption is 150mg/kg.

The result also revealed that copper was found highest in Akama (3.2100 ppm) while lowest concentration was observed in Neke (3.1600 ppm). The common sources for copper in soils are pesticides, fertilizers, industrial waste and sewage sludge. Critical concentrations for copper in plants are between 20 and 100 mg/kg. The acceptable limit for human consumption of cooper (Cu) is 10mg/kg [13]. When Cu exceeds its safe level, it causes hypertension, sporadic, fever, uremia etc. The consumption of *Sabicea brevipes* from the four sample locations will not pose any health problem.

In this investigation, the value for Fe was found to be too high, which is evidence that the soil is rich in iron. The concentration of iron (Fe) content was highest in Neke (129.5000 ppm) while it was found lowest (129.2600 ppm) in Akama *Sabicea brevipes* plant roots. Iron is another essential element for plant and animal growth. Its deficiency can cause various types of diseases; however, its high concentration also affects plant growth. Iron is an essential element in production of Red Blood Cells (RBCs). Low intake of Fe may cause anemia, tiredness and pallid physique while high intake may result to hepatic megaly, cardiac infraction and nephric malfunction. The acceptable limit for human consumption of iron is 8-11 mg/day [2].

Table 1: Heavy Metal Concentration (PPM) in roots of Sabicea brevipes from four different locations

Element	*Oyofo*	Neke	Akama	Iwollo	Range	Mean	SD	RSD %	DDI
Pb	0.6500	0.6100	0.6600	0.6300	0.6100 – 0.660	0.6400	0.0222	3.4641	0.001-1.767
Mn	0.1797	0.1770	0.1776	0.1796	0.1780 – 0.1797	0.1795	0.0004	0.0020	2 – 5
Cd	0.0189	0.0189	0.0189	0.0190	0.0186 – 0.0190	0.0189	0.0005	0.0003	0.002 – 0.880
Zn	18.3600	18.4100	18.4000	18.3400	18.3400 – 18.4100	18.3800	0.0330	0.1780	8 – 15
Cu	3.1900	3.1600	3.2100	2.1800	3.1600 – 3.2100	3.1900	0.0208	0.0653	1.2 – 4.8
Fe	129.3800	129.5000	129.2600	129.3600	129.2600 – 129.5000	129.3800	0.0985	0.0761	12 – 30

DDI from [7,23,1,29].

DDI: Daily Dietary Intake
ND: Not detected
SD: Standard deviation
RSD: Coefficient of variation

CONCLUSION

The main aim of the study is to generate data that will create awareness among the public regarding health effects of toxic metals and about the precautionary use of plants grown in contaminated areas. It is clear from findings that plants grown in metal contaminated areas have greater risk of heavy metals uptake above the permissible limit. The findings of this study revealed that the *Sabicea brevipes* plant root used for the management of erectile dysfunction in men is safe for human consumption. And probably that the medicinal plants grown and sourced from these locations are free from heavy metals contamination. it can be concluded that plant growing in the four sample locations are not contaminated with the heavy metals investigated.

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