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Assessment of Heavy Metals in selected Medicinal Plants in Bayelsa State, Nigeria

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ABSTRACT

Background: The study evaluated the concentration of some toxic heavy metals in medicinal plants used widely in traditional medicine in Bayelsa State. The leaves of six medicinal plants (*Stachytarpheta jamaicensis, Justicia secunda, Cleome viscosa*, *Ipomoea aquatica, Ipomoea cairica* and *Solenostemon monostachyus*) growing their natural habitats were collected and analyzed for seven heavy metals.

Methods: The concentrations of the heavy metals (Cadmium, Lead, Arsenic, Chromium, Zinc and Mercury) were determined using standard procedures and Varian Spectra A100 Atomic Absorption Spectrophotometer.

Results: The results indicate the plants had differential accumulation of the heavy metals that were mostly within the permissible concentration thresholds set by the WHO. Lead significantly accumulated in all the plant species.

Conclusion: The need for constant monitoring, and collection of medicinal plants from an unpolluted area or areas with minimal contamination is essential and highlighted.

Keywords: Bayelsa State, Bioaccumulation, Heavy metals,Medicinal plants, Metal toxicity

1. INTRODUCTION

Medicinal plants are a wide array of plants that are predominantly herbs with a significant number of therapeutic phytochemicals that help to combat human illnesses [1]; and play a vital role in many health care systems both in rural and urban communities [2]. Also, they are used in drug formulations and development, and have being in useful to humans from the ancient times to the present day especially in developing countries [3].About 80% and 60%of the population living developing and developed areas respectively use many medicinal plants to treat various diseases [2], and several plant parts are useful for treating many ailments because they are considered safer and cheaper alternatives to conventional medicines.Rapid industrialization, urbanization and anthropogenic activities contribute to heavy metal in the biosphere [4]. The environmental and health impacts of heavy metals are a serious concern [5]. They are counted as a serious threat due to their bioaccumulation, toxicity, long term persistence and aggregation behavior.Heavy metals implicated in human toxicity such as Lead, Mercury, Arsenic and Cadmium continuously enters into the food chain. Furthermore, medicinal plants have been cited as a potential source of heavy metal toxicity to both man and animals [6]. Hence, constant assessments of medicinal plants the raw materials of herbal remedies for heavy metals are recommended by the World Health Organization [7]. Based on the aforementioned and the general notion that medicinal plants are safe and devoid of toxicity, the study assessed the accumulation of heavy metals in six medicinal plants in Bayelsa State. The plants are known and used widely for their medicinal importance in traditional medicine in the state.

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Biological Materials

Solenostemon monostachyus, Stachytarpheta jamaicensis, Justicia secunda, Cleome viscosa, *Ipomoea aquatica, Ipomoea cairica*

2.1.2 Equipment and Apparatus

Hand gloves, facemasks, paper tape, paper towel, sterile blade, sterile Petri dish, cotton wool, hand wash, hand sanitizer, foil paper, marker, syringes and needles, collection tubes, micropipette, spatula, forceps, test tube rack, gas

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lighter, Ziploc bag, Whatman filter paper, conical flask, glass rod, crucible, funnel, beakers, analytical weighing balance, atomic absorption spectrophotometer, fume cupboard.

2.1.3 Chemicals and Reagents

De-ionized water, distilled water, nitric acid, hydrogen chloride, ethanol (100% and 70%), polytetraflouroethylene (PTFE), hydrogen peroxide.De-ionized water, nitric acid, hydrogen chloride, ethanol (100% and 70%), polytetraflouroethylene (PTFE), hydrogen peroxide.

2. Methods

2.2.1 Sample Collection and Preparation

Glass wares used were washed with detergent and tap water then soaked in 5% nitric acid for twenty four (24) hours, followed by washing and rinsing with deionized water prior analysis. The samples were prepared and analyzed in triplicates. Plant samples (Table 1) were randomly collected from various sites placed in Ziploc plastic bags and labeled. Samples were washed thoroughly with water and cut into pieces using a stainless steel knife. The sections were pulverized into powdery forms using a stainless steel blade blender. 0.5g of the sample was weighed into a previously acid washed labeled 100ml polytetraflouroethylene (PTFE) Teflon bombs. 6ml of concentrated nitric acid (HNO3, 65%), and 1ml of hydrogen peroxide (H_2O_2, 30%) was added to each sample in a fume chamber. The samples were then loaded on the microwave carousel. The vessel caps were secured tightly using a wrench. The complete assembly was microwaved and irradiated for 25minutes.

Table 1: Medicinal Plants collected in the Study and their Collection Localities

Sample	Site	GPS Reading
Solenostemon monostachyus	Orlando Spot Road, Opolo, Yenagoa	4·80198°″N 6.31969°″E.
Justicia secunda	Orlando Spot Road, Opolo, Yenagoa Local Government Area	4.95037°″N 6.34107°″E.
Stachytarpheta jamaicensis	Orlando Spot Road, Opolo, Yenagoa Local Government Area	4.4223418°″N 6.1944472°″E
Cleome viscose	Otuaba Community, Ogbia Local Government Area	4.4223418°″N 6.1944472″E
Ipomoea aquatica	Near First Baptist Church, Bassambiri	4.321285 °″N 6.242236° ″E
Ipomoea cairica	Beside Faculty Building 1 Federal University Otuoke	4.2212171″N 6.2930176°″E

2.2.2 Determination of Heavy Metals

The AOAC [8] method was used for analysis of heavy metals. The digest in all cases were transferred to 100ml volumetric flask and volume was made with distilled deionized water and then filtered and stored in air tight bottles. The concentrations of Zinc, Cadmium, Lead, Mercury, Chromium and Arsenic were measured using Varian Spectra A100 Atomic Absorption Spectrophotometer (AAS). Chromium was determined in the +3 oxidation state and $Cr(NO_3)_3.9H_2O$ as standard. Blanks, duplicates and standard reference materials were included in each set of samples.

2.3 Statistical Analysis

All determinations were carried out in triplicates. Values of mean data obtained from the replicate readings were presented in tables and used to construct bar charts using Microsoft Excel.

3. RESULTS

All the heavy metals assessed except Mercury was accumulated by the medicinal plants (Table 2 and Figure 1), but within the permissible thresholds by WHO/FAO in plants. The plants had differential accumulation of the heavy metals. All the plants significantly accumulated Lead and Zinc. The heavy metal with the highest concentration is Lead was found highest in *Ipomea cairica* (2.872µg/ml) while the least concentration (Chromium) was in *S. monostachyus* (0.013µg/ml). Mercury was not detected in all samples.

Table 2: Mean Concentration of Heavy Metal in Medicinal Plants in Bayelsa State

Plant species	Heavy metals (µg/ml)					
	Cadmium	Mercury	Lead	Chromium	Arsenic	Zinc
I. cairica	0.003	ND	2.872	0.763	0.846	1.429
I. aquatic	0.032	ND	2.073	0.721	0.814	1.378
S. jamaicensis	0.039	ND	1.405	0.609	0.426	1.136
J. secunda	0.032	ND	1.655	0.925	0.65	1.135
S monostachyus	0.024	ND	0.146	0.013	0.020	1.135
C. viscose	0.031	ND	0.132	0.029	0.064	1.135
WHO permissible limit	0.02	0.02	10.00	1.30	1.46	2.74

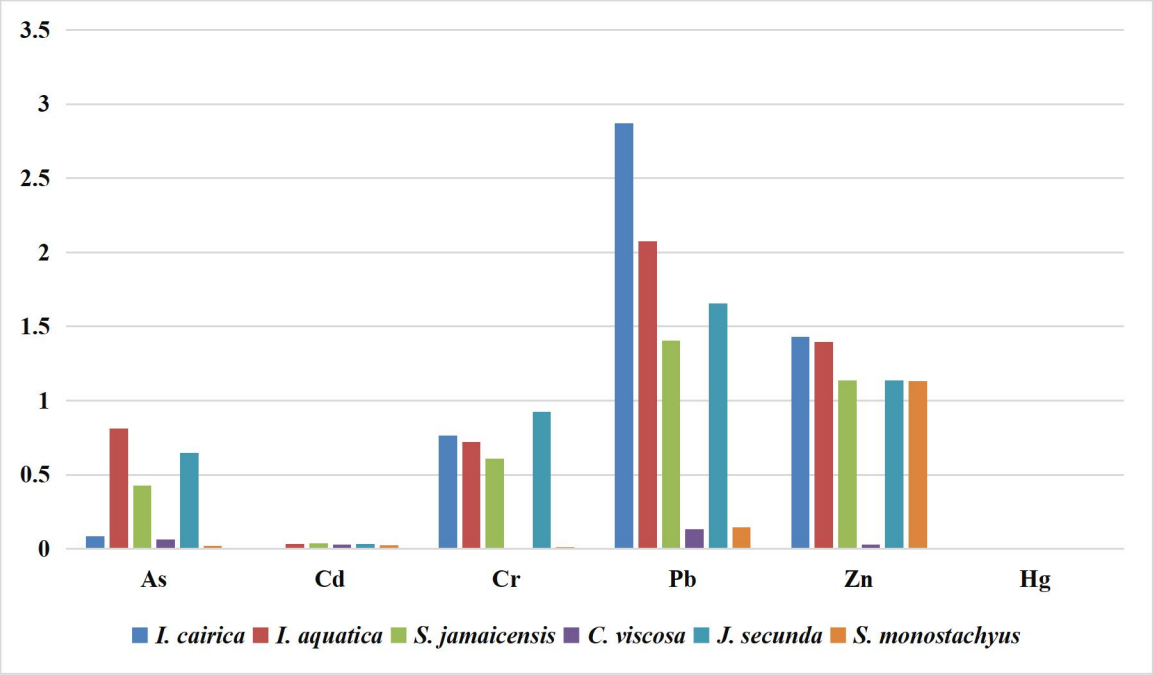

Figure 1: Mean Concentration of Heavy Metal in Medicinal Plants in Bayelsa State

4. DISCUSSION

According to the World Health Organization (WHO), about 80% of the world population use medicinal plant or plant-based medicines mostly collected from the wild. The exploitation of medicine pants by humans has been validated by their active constituents. However, the safety attributable to them is questionable as toxic substances due to natural processes and human activities can be found in the present in their tissues. Medicinal plants have been highlighted as a potential source of heavy metal toxicity to both humans and animals [6]. This study investigated the accumulation of selected heavy metals from six medicinal plants in Bayelsa State. The results indicate most of the plants sampled had the heavy metals in their tissues though within the permissible limits this corroborates previous report of Osioma *et al* [9] of heavy metals in plants in the study area. The accumulation of heavy metals in plants highly depends on the availability in the soil [5]. Hence it can be deduced that the habitats of the medicinal plants is relatively safe in the state and the plants can still be utilized. Lead (Pb) was the most accumulated metal but was found to be below the permissible limit [9]; this was followed by Zinc. Lead contamination is a widespread issue; According to Osioma *et al* [9) and Nwankwoala *et al* [10] particulate from the combustion of leaded gasoline, corrosion of lead-containing materials, and burning of building and electronic wastes are the probable sources of Lead in aquatic habitats. Therefore indiscriminate consumption of these species can result in accumulation in humans and predispose folks to Lead toxicity and related health risk. Lead accumulates with age in bones aorta, kidney, liver and spleen in humans and it can enter the human body through uptake of food.

5. CONCLUSION

The study evaluated six medicinal plants used widely in traditional medicine in Bayelsa State for the accumulation of selected heavy metals. The results herein reveal the plants sampled had the heavy metals in their tissues though within the permissible limits. Lead was the most accumulated metal. The general notion that medicinal plants are safe and devoid of toxicity should be discouraged. Constant monitoring is necessary, and collection of medicinal from an unpolluted area or areas with minimal contamination is advised.

Declarations

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Conflict of interests

The Author declares no conflict of interest

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