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Assessment of Heavy Metals in Water Bodies and Water lily of Sabon birni Local Government, Sokoto State, Nigeria

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ABSTRACT
Heavy metals are serious hazards to living organisms including humans their contamination in water, food and environment can cause organ damage. This study was aim to determine heavy metal concentration in stagnant water and water lily grown in an area where anthropogenic activities took place. The heavy metals composition of the randomized study areas and water lily (leaves, seeds and roots) growing in was determined using Atomic Absorption Spectroscopic technique. The highest concentration of mercury, cadmium, copper and lead was obtained in Lajingestagnant water but Dantudu with highest concentration of manganese and zinc. The highest concentration of mercury, cadmium, copper, iron and zinc was obtained in seeds while leaves have the highest concentration of lead. This study shows that aforementioned water bodies and water lily grown in contains less concentration of heavy metals to pose toxicity.
Keywords: Heavy metals, Concentration, Water lily, Bioaccumulation, Stagnant water

I. INTRODUCTION

Heavy metals are defined as metallic elements that have a relatively high density compared to water (Fergusson, 1990). heavy metals also include metalloids, such as lead, that are able to induce toxicity at low level of exposure (Duffus, 2002)Their multiple is largely depend on; industrial, domestic, agricultural, medical and technological applications have led to their wide distribution in the environment; raising concerns over their potential effects on human health and the environment. Their toxicity depends on several factors including the dose, route of exposure and chemical species, as well as the age, gender, genetics, and nutritional status of exposed individuals. Because of their high degree of toxicity, arsenic, cadmium, chromium, lead, and mercury rank among the priority metals that are of public health significance. These metallic elements are considered systemic toxicants that are known to induce multiple organ damage, even at lower levels of exposure. They are also classified as human carcinogens according to the U.S. Environmental Protection Agency, and the International Agency for Research on Cancer (Paul et al., 2012).

Humans are exposed to all heavy metals just like mercury through accidents, environmental pollution, food contamination, dental care, preventive medical practices, industrial and agricultural operations, and occupational operations (Sarkar, 2005). The major sources of chronic, low level mercury exposure are dental amalgams and fish consumption. Mercury enters water as a natural process of off-gassing from the earth's crust and also through industrial pollution (Doppet al., 2004).Exposure of people to Cd includes, eating contaminated food, smoking cigarettes, and working in cadmium-contaminated work places and in primary metal industries (Pascha, 2000). Algae and bacteria methylate the mercury entering the waterways. Methyl mercury then makes its way through the food chain into fish, shellfish, and eventually into humans (Sanfeliuet al., 2003). However, human exposure has risen dramatically as a result of an exponential increase of their use in several industrial, agricultural, domestic and technological applications (He et al.,2005). Environmental pollution is very prominent in point source areas such as mining, foundries and smelters, and other metal-based industrial operations (Fergusson, 1990, (He et al.,2005) and Bradl, 2002).Metals occurrence in the environment has become a concern because the globe is experiencing a silent epidemic of environmental poisoning, from the ever-increasing amounts of metals released into the biosphere (Young 2005; Nolan 2003; Duruibeet al., 2007).

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II. MATERIAL AND METHODS

The stagnant water and water lily (seeds, leaves and roots) samples was obtained from Sabon birni Local Government, Sokoto State Nigeria, The plant sample was botanically authenticated at the Harbarium of the Botany Unit Department of Biological Science UsmanuDanfodiyo University Sokoto, Sokoto State Nigeria

Sample Preparation

The randomly selected sample was separated into seeds, leaves and roots. Leaves and roots was properly washed to removes dirt particles, however dried samples were grounded into fine powder using pestle and mortar and sieved, kept tightly into polyethene bags prior to use.

Determination Heavy/Metal Elements

The metal elements were determined using AA-240FS of Atomic Absorption Spectrophotometer (Varian, U. S. A Califonia) as reported by AOAC, 1990

Principle

The method is based on nebulizing a sample solution into air acetylene flame where it vaporized. elemental ions were then atomized and then absorbed radiation of characteristic wavelength; the absorbance measured is proportional to the amount analyte in the sample solution

Procedure

The sample was vaporized by aspiration of solution into a flame or evaporation from electrically heated surface (temperature range 1800-3100k) at this connection where the individual atoms coexist, a beam of light is passed through them. The atom absorbed in the visible an ultraviolet region resulting in changes in electronic structure (exited state) so, the resultant light emitted from the sample is corresponding to the wavelength which is a measure of characteristic of sample.

Data Analysis

Data obtained from analysis was expressed as mean+ standard deviation. All the parameters was analyzed statically at p≥(0.05 by one way analysis of variance (ANOVA) using Graph pad Instant Software, Version 3.05 (San Diego, USA)

Heavy Metal Content in Various Water Bodies

Parameter (ppm)	Amadawa	Danmatsi	Dantudu	Lajinge
Cadmium	0.016 ± 0.0003^{b}	0.016 ± 0.0003^{bc}	0.054 ± 0.0003^{ac}	0.061 ± 0.003^{a}
Copper	0.058 ± 0.0007^{a}	0.062 ± 0.0002^{a}	0.054 ± 0.0003^{a}	0.065 ± 0.0002^{a}
Iron	1.733 ± 0.0009^{b}	1.167 ± 0.0005^{c}	0.285 ± 0.0004^{a}	0.0338 ± 0.0004^{a}
Mercury	0.461 ± 0.0002^{b}	0.183 ± 0.0001^{cb}	0.173 ± 0.0001^{cb}	1.628 ± 0.0001^{a}
Manganese	0.205 ± 0.0001^{a}	0.243 ± 0.0002^{a}	0.270 ± 0.0005^{a}	$0{,}164\pm0.0011^{a}$
Lead	0.044 ± 0.0004^{a}	0.000 ± 0.0004^{a}	0.000 ± 0.0001^{a}	0.340 ± 0.0018^{b}
Zinc	0.084 ± 0.0015^{a}	0.085 ± 0.0011^{b}	0.051 ± 0.0002^{c}	0.092 ± 0.0025^{a}

All the values are expressed as mean ± standard deviation, any result with the same superscript is statistically not significant (p≥0.05) and those with same are statistically significant (p≤0.05).

Heavy Metal Contents of Water lily (Nymphaea lotus)

Parameter (ppm)	Leaves	Seeds	Roots
Cadmium	0.010 ± 0.0001^{a}	0.012 ± 0.0003^{a}	0.012 ± 0.0003^{a}
Copper	0.101 ± 0.0002^{a}	0.105 ± 0.0004^{a}	0.136 ± 0.0002^{b}
Mercury	0.683 ± 0.0006^{a}	0.694 ± 0.0004^{b}	3.440 ± 0.0001^{b}
Iron	18.20 ± 0.0002^{a}	54.01 ± 0.0002^{b}	0.961 ± 0.0004^{c}
Manganese	3.954 ± 0.0036^{a}	2.134 ± 0.0002^{b}	0.436 ± 0.0007^{c}
Lead	0.089 ± 0.0001^{a}	0.015 ± 0.0004^{b}	0.006 ± 0.0001^{b}
Zinc	0.390 ± 0.0005^{a}	0.324 ± 0.0011^{b}	0.489 ± 0.0021^{c}

All the values are expressed as mean ± standard deviation, any result with the same superscript is statistically not significant ($p \geq 0.05$) and those with same are statistically significant ($p \leq 0.05$).

III. DISCUSSION

The concentration (ppm) of heavy metals was reported in ppmas mean ± standard deviation. It was obtained from different stagnant water bodies that are used for domestic purpose, irrigation farming, feeding animals, source of fish and water lily which is used as food. The highest concentration of mercury, cadmium, copper and lead was obtained in Lajinge stagnant water. However, the highest concentration of manganese and zinc was obtained in Dantudu water body and that of iron in Amadawa water body. The result shows that concentration of the metals is less than 2ppm which is attributed as a result of bioaccumulation activity of water lily (Ferdinand, 2022). Although the highest concentration of lead (0.340±0.0018) was obtained in Lajinge water lily which can pose toxic effect to living organism. However, in all water lily parts the highest concentration was obtained in leaves but the concentration is very negligible to cause damage to internal organs as reported by (WHO, 2011). The ranging toxic level of Hg, Pb, Cd, Cu, Mn, Zn and Fe in drinking water are 0.001-0.01, 0.1-1.0, 1.0-5.0, 0.1-1.0, 1.0-5.0 and 1.0-5.0 ppm respectively that is attributed to various problems depending on concentration range which includes organs damage, neurological damage, developmental delay, bone demineralization, gastrointestinal issues, muscle weakness, respiratory problem, cardiovascular problem and reproductive issues (World Bank, 1998). However, Exposure to Pb can occur through inhalation of contaminated dust particles and aerosols or by ingesting contaminated food and water. Lead poisoning in humans damages the kidneys, liver, heart, brain, skeleton and the nervous system (Flora et al., 2004). Lead poisoning may affect to hemoglobin synthesis and lead to anemia (Jarup, 2003). But the concentration of Pb were less all samples to pose toxicity.

The concentration of Cd obtained is less in such way it can pose toxicity to children which is detrimental to the living organism as reported; the chronic toxicity of Cd in children causes damages of respiratory, renal, cardiovascular systems and development of cancers of the lungs, kidneys, prostate and stomach (US EPA, 2010; WHO, 2011). However, it was reported that the level of Cd was higher than the maximum permissible limit (MPL) in canned fish samples, and this was due to discharge of heavy metal rich pollutants into aquatic ecosystems (Sobhanardakani, 2017). although regulatory limit of Cd in drinking water is 5 ppb or 0.005 parts per million (ppm) (Martin and Griswold, 2009). The safe limits of Cd in both wastewatersrecommended WHO and soils is 0.003 ppmChiroma et al., 2014; Aneyo et al., 2016. Hence concentration of Cd in both water bodies and water lily are low to posed toxicity.

IV. CONCLUSION

The study suggest that concentration of heavy metals is lower in such way that; it can pose toxicity to humans and other animals.

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