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EVALUATION OF WATER LILY AS BIO-INDICATOR FOR HEAVY METAL POLLUTION IN OPEKI DAM, ERUWA

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ABSTRACT

There is a synergy between pollution of our environment by heavy metals and spread of diseases among human population. It is therefore imperative that any research geared towards the assessement of heavy metals presence in the environment will have a positive impact in promoting better healthy living among human beings. Hence, this study was conducted to determine the potentials water lily as bio-indicator for Lead, Cadmium, Zinc, Chromium and Copper in Opeki Dam, Eruwa, Oyo State, Nigeria. There were six treatments replicated three times.t The treatments were the three distance points each at the length and breadth of the dam and represented as location A, B and C. The replicates were the three plant samples taken along the lines of each treatment. Water lily plant samples were collected, on the water surface, at both length and breadth sides of the dam, between the distance of 0-2m, 2-4m and 4-6m. Within each designated meter, three plant samples were collected at 60cm point apart at three different points. The results from this study revealed the presence of high amount of heavy metals in the water lily plant samples collected. High heavy metal was recorded as Pb 5.46 mg/Kg at location B, Cd 1.51 mg/Kg at location B, Zn 7.65 mg/Kg at location C, Cr 0.69 mg/Kg at location C, and Cu 4.74 mg/Kg at location A. The concentration of these heavy metals was above the WHO and USEAP standards. This indicates that water lily is a good bio-indicator of heavy metals in the polluted dam. High concentration of heavy metals in the water lily is a good indication to conclude that consumption of fish and drinking of water from this dam is harmful to human beings. Heavy metal remediation of the dam is strongly recommended for the safety of human beings making use of the water for both domestic and commercial purposes.

Key words------ *Pollution, Water-lilly, Remediation, Bio-indicator, Heavy Metals, Safety.*

INTRODUCTION

The word heavy metal is described as an element with high ionization energy, density above 5 g cm^{-3} and atomic number greater than 20 and plants naturally absorb heavy metals faster than needed nutrients minerals (Bellino *et al.,* 2020). This brings about nutrient, photosynthetic, biochemical. morphological, physiological, and water flow disturbances in growing plants (Besse et al., 2012, Iftikhar et al., 2021). As asserted by Baldantoni *et al*. (2016; 2018), pollution in water has its origin grouped according to three factors which are municipal waste, industrial and agricultural sources. However, researchers had observed the need for frequent monitoring of water to achieve good water quality. Water pollution could also come from an identified source, or from a source that is non-identified. The one that is identified is referred to as point source, while the one that could not be identified is known as non-point source (Gabriel *et al.,* 2025).

Water-lily (Nymphaceae family) is a macrophyte with floating characteristics. It is commonly found in temperate regions of the northern hemisphere (Ferdinard *et al.*, 2022).

The species inhabits lakes, rivers, reservoirs, and streams. It grows to depths of about 2.5 m (Heslop-Harrison, 1955). The roots of the plant firmly anchored its thick rhizome, in the sediment (Balogh *et al.,* 2016; Ali *et al.,* 2013). Studies have shown that the plant has propensity to accumulate several heavy metals in its tissues at various degrees of concentration (Cardwell *et*

al., 2002; Altintig *et al.*, 2016; Cheng *et al.,* 2017). The plant takes essential macro-elements into its upper and lower organs (Bonanno, 2011; Klink, 2004). In the determination of impact of waste water in the distribution of heavy metals in aquatic ecosystem, water-lily has been successfully used as bio indicator (Boronina *et al.*, 2016).

The fear of environmental contamination by heavy metals is growing world-wide. This could be as a result of their long persistence in the environment (Kosiba *et al., 2011*). Water is universal natural resources that is inevitable for domestic usage, agricultural, transportation, and industrial purposes. The need to have portable water for daily need of mankind cannot be over emphasized (Duman and Obali, 2008). In urban areas, especially in developing countries of the world, surface and groundwater are being continuously susceptible to manufacturing emissions, untreated sludge, and leachates from solid wastes (Babovic *et al.*, 2010).

Water in its natural form has tendency to absorb, adsorb, dissolve and acquire suspended impure particulate substances. This is because of polarity and hydrogen bonds properties of water (Kabata-Pendias, 2011; Brooks and Robinson, 1998). The objectives of this study are; (i) to evaluate the potential of water lily as a bio-indicator for heavy metal pollution in Opeki dam, (ii) to evaluate the types of heavy metals and their concentrations in the dam.

Materials and Methods

Experimental area

The study was carried out at Opeki Dam in Eruwa, Ibarapa area of Oyo State, Nigeria. The water-lilly plant samples were collected according to the design of the experiment. The plant samples collected were dried in the laboratory of Crop Production Technology Department of Oyo State College of Agriculture and Technology, Igboora, at room temperature.

Experimental Design

The experiment was designated into six treatments with three replicates. The dam was separated into two sides. In side 1, there were 0-3m, 3-6m, and 6-9m (Represented as A, B, and C). Within 0-3m, a plant sample was collected at 0-1m, another plant was collected at 1-2m, while third plant sample was collected at 2-3m. This process was repeated at 3-6m point, and at 6-9m point, in the same side A of the dam.

In side 2, the same process of collection was repeated there. While the side was equally divided into 0-3m, 3-6m, and 6-9m. In all there were 18 plant samples collected. They were all dried at room temperature in the laboratory.

Preparation of Water lily plant samples and chemical analysis

The dried plant samples were grounded to powdery form using laboratory mortal and pestle. They were thereafter digested with suitable reagents. The digested samples were labelled accordingly. The digested plant samples were analyzed using atomic absorption spectrophotometer (AAS) (model ZA – 3300), for determination of the level of heavy metals present.

Statistical analysis

All the values obtained were subjected to analysis of variance (ANOVA), using Statistical package for social science and mean separated by Duncan multiple range test, with significant difference level of P = 0.05.

Result and Discussion

Table 1: Concentration of heavy metals in plant samples at Opeki Dam, Eruwa, Oyo State

TREATMENTS	Pb (mg/kg)	Cd (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	Cu (mg/kg)
Location A	2.25b	0.44b	4.21b	0.34a	4.74a
Location B	5.46a	1.51a	4.82b	0.48a	1.68b
Location C	4.84a	1.43a	7.65a	0.69a	4.42a
WHO	0.05	0.05	0.3	0.03	0.05
USEPA	0.015	0.05	0.05	0.3	0.015

Means with the same letter are not significantly different using Duncan Multiple Range Test (DMRT) at 5% probability level.

Concentration of heavy metals in plant samples at Opeki Dam, Eruwa, Oyo State. Location A had the lowest significant Lead concentration (2.25 mg/kg), while Locations B (5.46 mg/kg) and C (4.84 mg/kg) were not significantly different from each other. The concentration values of Lead in all the Locations were higher than the WHO and USEPA maximum permissible heavy metal value in plant. Also, the concentration of Cadmium in Locations B (1.51 mg/kg) and C (1.43 mg/kg) was not significantly different from each other, while location A had the lowest significant cadmium concentration. The concentration of cadmium in all the locations was higher than the recommended maximum permissible level for cadmium in plants. Locations A and B produced 4.21 mg/kg and 4.82 mg/kg of Zinc concentration. These values are not significantly different from each other. However, location C produced the highest significant zinc concentration (7.65 mg/kg). All the values of zinc concentration from all the locations are above the WHO and USEPA maximum permissible level of zinc in plants. Moreover, the concentration values of chromium in water-lily plant were above the maximum permissible level of chromium in plants. The levels of concentration of chromium in all the locations were not significantly different from

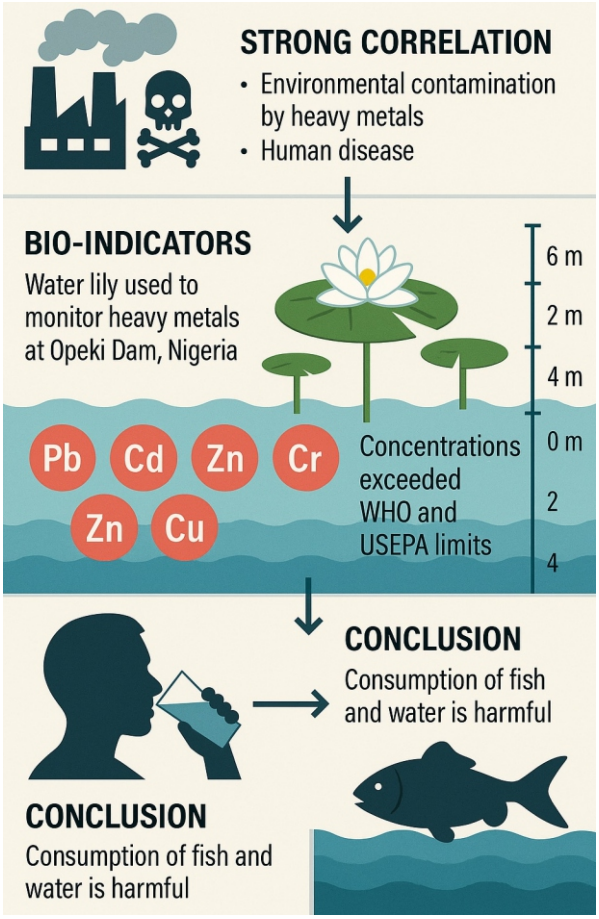
each other. Locations A and C produced 4.74 mg/kg and 4.42 mg/kg copper concentration respectively. These values are not significantly different from each other. However, location C produced the lowest significant copper concentration (1.68 mg/kg).

Limitation and future work

Though, the authors obtained promising results, but, there was no access to plant sample at different distance of water body in the dam. The authors have it in plan to harvest the plant samples at designated time of the year.

Conclusions and Recommendation

The concentration of heavy metals in water lily is high and were above the WHO and USEPA standards. It is therefore concluded that consumption of fish and drinking of water from dam is harmful to human being. Heavy metal remediation of the dam is strictly recommended for the safety of human beings in and around the place.



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Compliance with ethical standards

Conflict of interest

The authors boldly declare that there is no conflict of interest regarding the publication of this research paper.

Author's declaration

The authors affirm that the content of this manuscript is original, has not been published elsewhere, and is not under consideration for publication in any other journal. The authors accept full responsibility for the integrity and accuracy of all data and interpretations presented herein.

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