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Assessment of Heavy Metal Accumulation in Two Aquatic Macrophyte Tissues in Taylor Creek, Zarama, Bayelsa State

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Abstract:- An investigation of the levels of heavy metals in the aquatic macrophytes, water hyacinth (*Eichornia crassipes*) and water lily (*Nymphaea odorata)* of Taylor Creek was carried out. This was done in order to gauge the pollution status of the creek and to determine the possibility of bioaccumulation and magnification on other living organisms in the food chain. This is of grave public health concern. Heavy metals were measured in whole plants (Leaf, stem and roots) of water hyacinth and water lily from four (4) sampling stations with distinct land use adjacent the creek. Samples were collected in triplicates from each of the stations for water hyacinth and water lily. A total of twenty four (24) samples were collected. Samples were put in dark cellophane bags tagged and sent to the Niger Delta University, Chemical sciences laboratory for analyses. Heavy metals in these plant tissues were determined using standard techniques. Result indicates that a total of five (5) heavy metals were isolated. These are Lead (Pb), Cadmium (Cd), Chromium (Cr), Copper (Cu) and Nickel (Ni).Heavy metal concentrations were higher in the water hyacinth than in the water lily for all metals and all stations sampled. This implies that water hyacinth poses greater quality for use in phytoremediation and greater risk for bioaccumulation than water lily. The heavy metal prevalence shows that Cu>Pb>Ni>Cd>Cr. Heavy metal parameters measured were relatively low Suggesting a low level of prevalence in the environment or a high degree of absorption or affinity for the sediments. Based on the finding of this research it can be concluded that though heavy metal concentration in the macrophytes of Taylor creek is low, the use of the macrophytes for animal feed and curative medicines portends grave danger to human health as heavy metals are lethal even in trace quantities.

Keywords:- *Heavy metal, Macrophytes, Water hyacinth, Water lily, Taylor Creek.*

I. INTRODUCTION

Aquatic macrophytes has recently become the subject of global discuss in several fora due to their importance and high nuisance value. This is as a result of the realization of the myriad of uses of these plants for Agricultural, medicine, environment and industrial purposes. However, they are the undisputable cause of navigational blockades, siltation of water channels and home for wild and harmful animals. They are aquatic photosynthetic organisms, large enough to see with the naked eye, that actively grow permanently or periodically submerged below, floating on, or growing up through the water surface.

Aquatic macrophytes are known to provide food for many animals; Ducks for instance eat the seeds, leafy parts and tubers of plants such as *Potamogeton* spp., *Brasenia Schreberi*, *Polygonum* sp. and *Lemna* sp. Also, Turtles graze on a variety of aquatic plants. The fluffs from Cattails are used by Song birds as nest material and eat the seeds of many emergent plants. Humans have also utilized aquatic plants as a source of food in many parts of the world and have historic medicinal value [1].

It has also been reported that the seeds of *Echinochloa stagnina* is an important food item for fishermen in the Delta of River Niger [2]. Also, the seed of Burugu (Echinochloa stagnina) is collected for food in Monai on the western shore of Lake Kainji [3]. Furthermore, the mangrove palm (*Nypa fruticans*) yields alcohol, sugar and vinegar [4].

Sadly, in recent time, advances in science and technology are leading to the degradation and contamination of aquatic ecosystems due to heavy metal pollution. Pollution in the aquatic ecosystem poses a serious threat to aquatic biodiversity and human health. Aquatic macrophytes are the cornerstones of any aquatic environment and have the physiological ability of removing mineral nutrients and heavy metals [5]. Therefore a good knowledge of the functions of aquatic macrophytes in wetlands and shallow lake ecosystems is critical for understanding the basic ecosystem processes. It is also important for numerous applied issues such as wetland restoration, wastewater treatment, and management of invasive species [6, 7].

In the Niger Delta and Taylor Creek specifically, the two most dominant aquatic macrophytes are the water hyacinth and the water lily. These two macrophytes provide a myriad of uses such as being the source of food for farm animals and man to providing raw material for the pulp and paper industry and materials for domestic craft and medicines. These two macrophytes serve most for farm animals, humans and medicines.

Therefore the contamination of Taylor creek by diverse contaminants especially heavy metals portends danger to human health and environmental safety due the mechanism of bioaccumulation and magnification. This study was instituted to measure the level of heavy metals in these plant tissues in order to gauge the degree of threat to our health and safety and their possible use as environmental sanitizers where phytoremediation is required.

II. MATERIALS AND METHOD

A. Sampling Stations

The study area is Taylor creek in Zarama clan in Bayelsa State. It is located in the southern parts of Nigeria and has tropical humid climate. Four sampling stations were chosen on the creek as a result of the peculiarities of the land use adjacent the creek. These stations are:

- *Station A (Freetown)*

This station has coordinates of $5^0$9’25.883”N and $6^0$27’46.837”E. Notable activities going on adjacent to the creek are washing and Farming.

- *Station B (Zarama-Epie)*

This station has coordinates of $5^0$7’ 2.076”N and $6^0$25’11.073”E. Notable activities going on adjacent to the creek are fishing and Farming. There are human settlements around the sampling station.

- *Station C (Nyambiri)*

This station has coordinates of $5^0$6’15.61”N and $6^0$24’37.193’’E. Notable activities going on adjacent to the creek are washing and Farming. There is also a local palm oil producing facility here.

- *Station D (Market and Upstream of Taylor Creek)*

This station has coordinates of $5^0$5’57. 22” N and 6024’2.736”E. There is a cassava mill located adjacent to this station. Other notable activities are washing, fishing and farming going on there.

B. Collection of Samples

The two types of Macrophyte samples were collected from each sampling station just by hand pulling. They were put in black cellophane bags and transported to Chemical Sciences Laboratory of the Niger Delta University for analysis.

C. Laboratory Preparation/Analysis

In the laboratory, the macrophyte samples were washed under a running tap water before being drain-dried. They were then left in the sun for 24 hours before put in the oven for proper drying and then grind into powder. 2g portion were weighed into a 100ml digestion flask and 20ml aliquot digestion acid was transferred quantitatively in the flask and the digester was switched on. The plants were digested until clear solutions were obtained before digestion was discontinued. 25ml of distilled water was introduced into the flask and mixed very well. 24 Nos of 100ml volumetric flask were fitted with filtration set and the digest was filtered into the 100ml flasks. The solution was moved up to the mark with water. The solutions were transferred in 120ml plastic sample bottles and made ready for AAS runs. The samples were run in triplicates after the relevant lamps and currents, wavelengths set and the gas/air mixture equalized.

III. RESULT

The result of this study is represented in Table 1 and Figures 1 - 6

Coordinates	Stations	Sample code	Pb, Mg/kg	Cd Mg/kg	Cr Mg/kg	Cu Mg/kg	Ni Mg/kg
$5^0$9’25.883”N- $6^0$27’46.837”E	A1	Hty1	0.0296	0.002167	0.002	0.04	0.013667
$5^0$9’25.883”N $6^0$27’46.837”E	A2	Lly1	0.0166	0.00107	-0.00067	0.01767	0.004
$5^0$7’ 2.076”N – $6^0$25’11.073”E	B1	Hty2	0.0336	0.0023	0.00233	0.032	0.009
$5^0$7’ 2.076”N – $6^0$25’11.073”E	B2	Lly2	0.0183	0.0007	0.00067	0.01167	0.00567
$5^0$6’15.61”N- $6^0$24’37.193’’E	C1	Hty3	0.03933	0.00153	-0.033	0.033	0.0113
$5^0$6’15.61”N - $6^0$24’37.193’’E	C2	Lly3	0.023	-0.00033	0	0.014	0.007
$5^0$5’57. 22”N – $6^0$24’2.736”E	D1	Hty4	0.03	0.0021	0.005	0.022	0.015
$5^0$5’57. 22”N – $6^0$24’2.736”E	D2	Lly4	0.02033	0.0008	-0.001	0.011	0.008

Table 1:- Sample stations and Heavy metals of Macrophytes
Source:- Field work, 2018. Hty – Water Hyacinth, Lly – Water lotus. Stations: A1 – D2

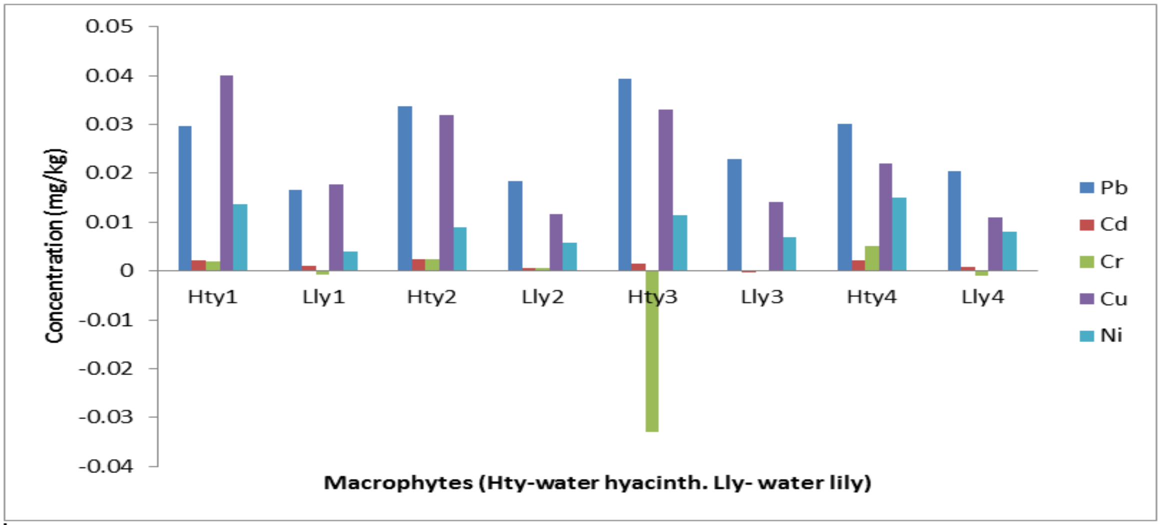

Fig 1:- Concentration of Heavy metals in the different macrophytes and stations

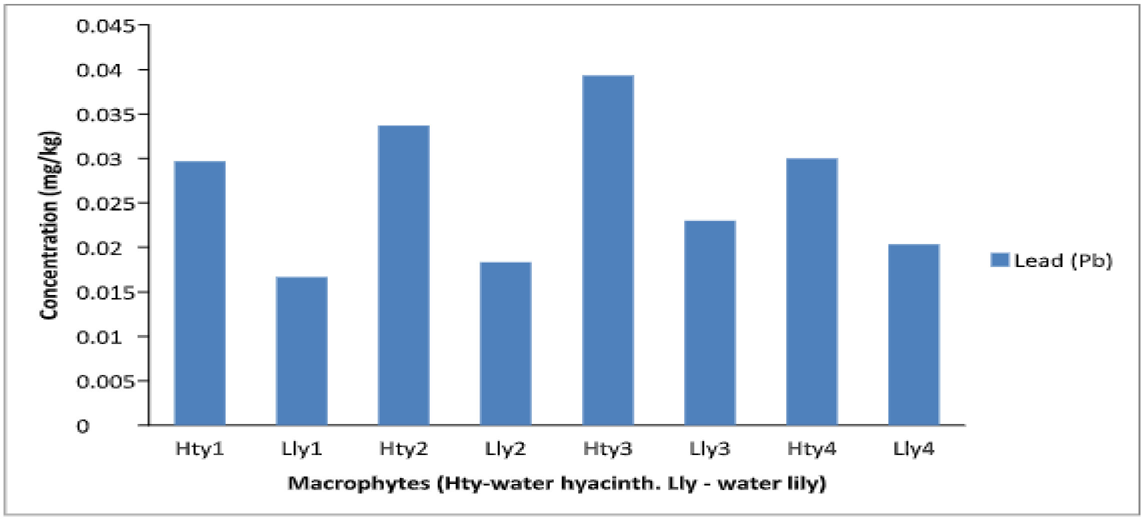

Fig 2:- Concentration of Pb in the different macrophytes and stations

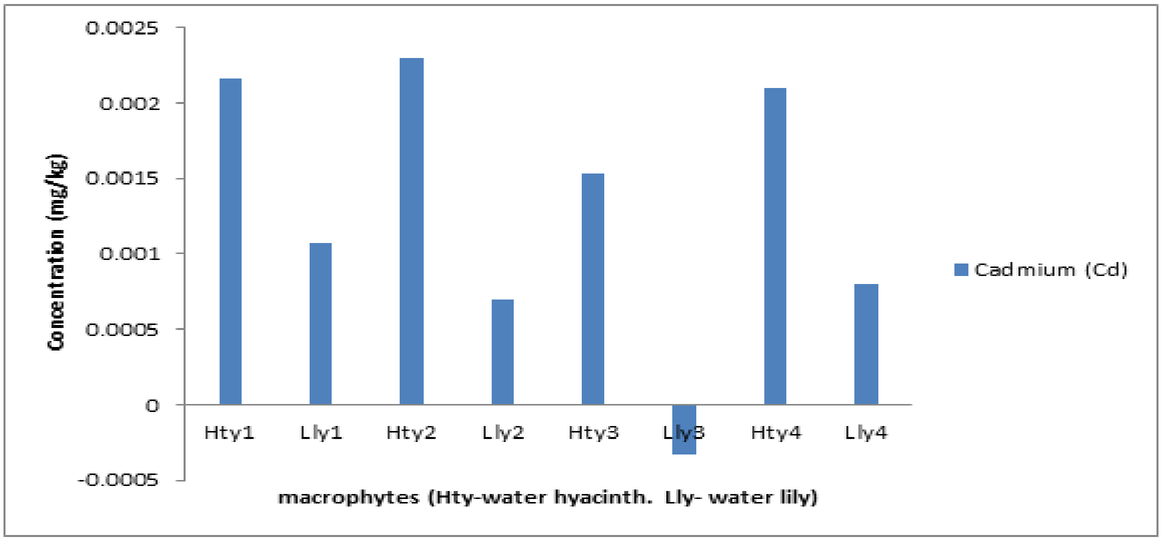

Fig 3:- Concentration of Cd in the different macrophytes and stations

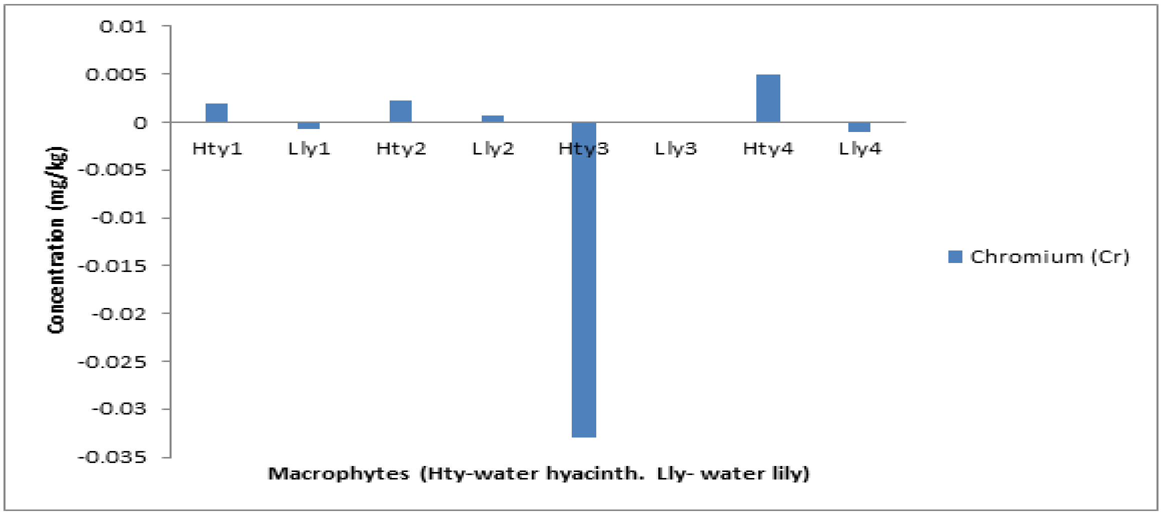

Fig 4:- Concentration of Cr in the different macrophytes and stations

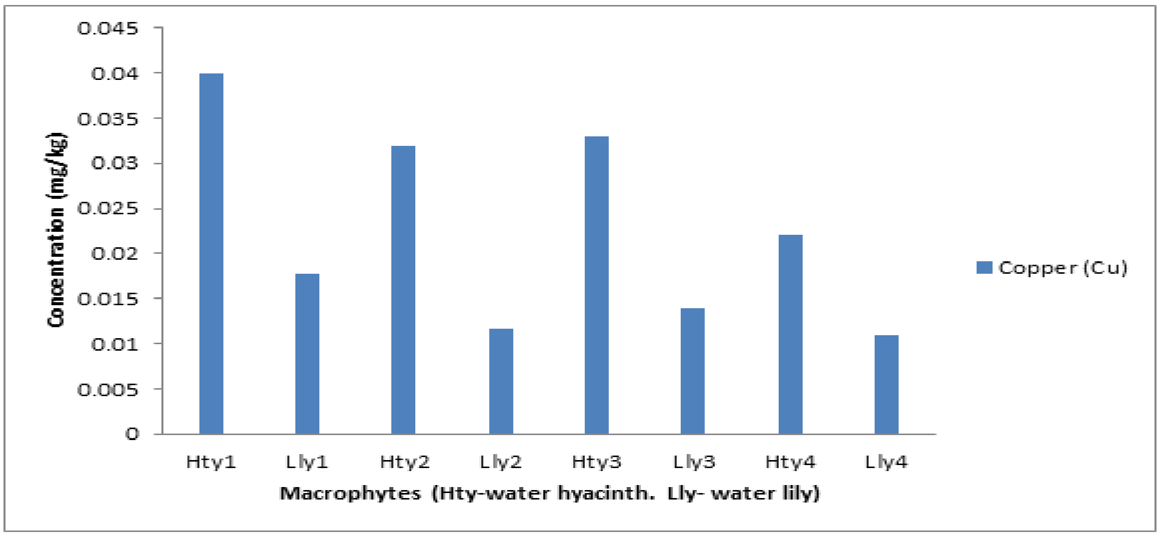

Fig 5:- Concentration of Cu in the different macrophytes and stations

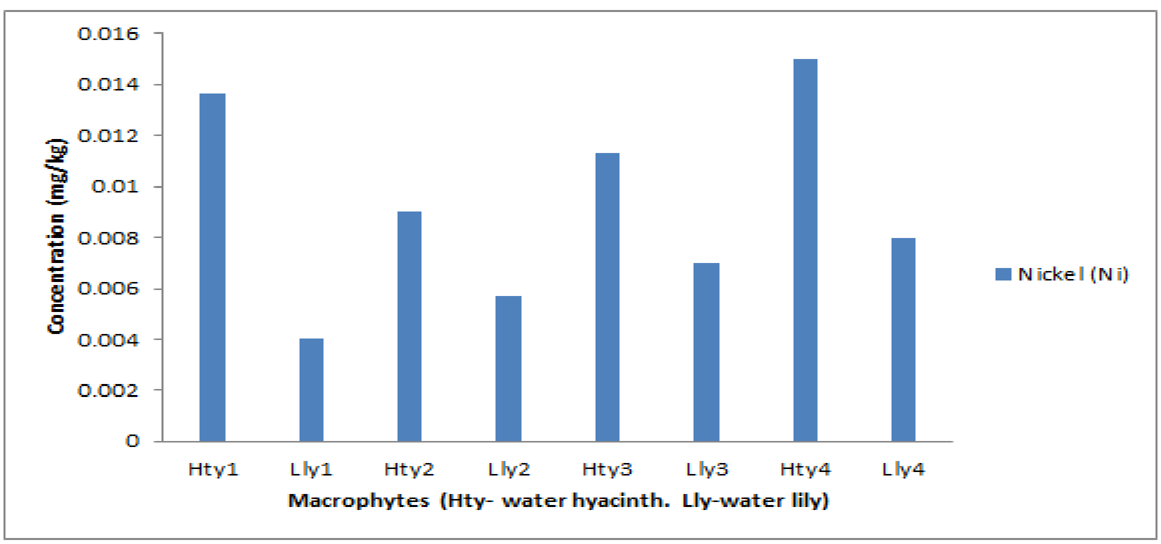

Fig 6:- Concentration of Ni in the different macrophytes and stations

IV. DISCUSSION

This study recorded low metal concentrations of Cu, Pb, Ni Cd and Cr. The level of concentration of metals in all the study stations show that Cu> Pb>Ni>Cd>Cr. This result is at variance with the result of other studies of heavy metal contents in aquatic macrophytes [8, 9]. The general low levels of the metals may be connected with affinity of heavy metals to bond to bottom sediments than remain suspended in water or plant tissues.

The concentrations of all the heavy metals in the plant tissues were appreciable except Cr which showed non-detectable values in plant tissues. This low concentration of Chromium (Cr) can be explained by the fact that Cr is considered a metal with low biogeochemical mobility which reduces its availability and toxicity potential [10]. The negative values shown for Cr indicate that the metal being investigated is below detectable limit or not available. Toxic effects of Cr includes vomiting and persisting diarrhea, hemorrhagic diathesis, epitasis, convulsions, perforations of the nasal septum, skin ulceration "chrome holes," loss of the sense of smell, acute dermatitis or allergic eczematous dermatitis, cancer of the respiratory organs and bronchial asthma [11]. The absence of Cr in this study thus portends good environmental health.

Ni showed low bioavailability compared with Cu and Pb metals sampled in the macrophytes, despite the favourable activities adjacent to the creek. Ni on the other hand is widely available to aquatic ecosystems through a variety of anthropogenic sources as household waste waters and other inputs. One reason for this trend may be the fact that a lot of Ni released into the environment ends up in soils and sediments where it is strongly attached to particles. Another reason for the significant concentration of Ni may be as a result of bioaccumulation and magnification, which can lead to toxic levels of these metals in organisms even when the exposure concentration is low [12].

Lead (Pb) levels in the creek were higher than Ni, Cd and Cr in all stations. This could be traced to urban and industrial waste and high petrol-lead used by vehicles in Nigeria [13]. Also, higher levels of Pb may be due to its use in Lead batteries, soldering, paints, ammunition, devices to shield against x-rays and most consumer electronic items.

In the study, Cd exhibited low very levels in plant tissues in all the study stations. This may be due to the fact that Cadmium (Cd) occurs naturally in low levels in the environment and is also used in batteries, pigments and metal coatings. Volcanic activity, industrial processes such as smelting or electroplating and the addition of fertilizers are veritable ways that increase concentration of Cd in the environment. The study creek is located far away from industrial and agricultural activities and thus shielded from Cd inputs.

Each metal examined bio-accumulated differently between water hyacinth and water lily. Bower [14] noted that the extent of bioaccumulation in biota is dependent on the chemical effect of the metal, its tendency to bind to particular materials and on the lipid content and composition of the biological tissues. Gbaruku and Friday [15] also observed differential rate of adsorption of heavy metals in leaf, stem, and root of Bitter leaf and Okro plants in the Niger Delta exposed to metal polluted soils. Plant species and varieties vary in their capacity for heavy metal accumulation. Long et al [16] showed that zinc uptake and accumulation by shoots and roots varied with Zn levels in the growth media and vegetable types. Ni et al [17] observed that Cd concentration (accumulation) in various plant parts of the Chinese cabbage, winter greens and celery in shoots and roots varied with both different Cd levels and type of vegetable.

Uptake of metal ions is an essential part of plant nutrition. Several heavy metals such as Cu, Mn, Zn, Fe, and Ni play important roles in enzyme induction and reaction membrane function and isozyme activity [18]. The response of Plants to high concentration of metals varies across a broad spectrum from toxic reaction to tolerance; some plants are obligate metallophytes with a physiological requirement for elevated metal contents in soils [19].

V. CONCLUSION

The importance of monitoring the heavy metal content in aquatic macrophyte tissues is vital to gauge the environmental status and its implication on human health. In this study, the heavy metals Cu, Pb, Ni Cd and Cr were measured in Taylor creek. Result indicates low levels of these metals in the macrophytes suggesting an ecosystem that is not under serious threat despite the activities in its catchments. The result also shows that water hyacinth absorbed more of the metals than the water lily. Water hyacinth poses more risk for bioaccumulation and thus a better option for phyto-remediation. This study therefore concludes that there is no immediate threat to the environment and human health. However, it is suggested that care be taken in the consumption of these macrophytes as heavy metals can be toxic even at low levels. Also, more study should be done on the bottom sediments of the creek in order to give a holistic picture of metal absorption and speciation throughout the creek.

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