

The concentration of Lead in Periwinkle (*Tympanotonosfuscatus*) and River sediments in Eagle Island River, Port Harcourt, Rivers State Nigeria

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Abstract In this study, the concentrations of Lead (Pb) in periwinkles (*Tympanotonosfuscatus*) and river sediments and were determined from 25 sampling stations in Eagle Island River in Port Harcourt Rivers State, Nigeria, using Atomic Absorption Spectrophotometer (AAS). The mean \pm SD concentrations of Pb in periwinkles and sediments are 0.91 ± 0.54 mg/Kg and 0.22 ± 0.19 mg/Kg respectively. The mean concentrations of the heavy metal Pb is higher in periwinkle than in sediment ($p < 0.05$). The results obtained from this analysis in periwinkle also showed that it exceeded the tolerable values in fish (aquatic organism). The correlation coefficient between Pb in sediment and that in periwinkle is 61.5%. The result of this study shows that sea foods obtained from this river is a potential source heavy metal poisoning. This calls for adequate legislation to protect the water bodies from heavy metal poisoning.

Keywords: Lead (Pb), periwinkle, bio accumulate, aquatic

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1. Introduction

The pollution of the aquatic environment with heavy metals has become a worldwide problem in recent years, because they are indestructible and most of them have toxic effects on organisms [14]. Among environmental pollutants, metals are of particular concern, due to their potential toxic effect and ability to bio accumulate in aquatic ecosystems [7].

Studies on heavy metals in rivers, lakes, fish and sediments have been a major environmental focus especially during the last decade [9,18,19,20,21], and heavy metals contamination of coastal water and sediment have been identified as a serious pollution resulting from industrialization. Heavy metals contamination of river water is one of the major quality issues in fast growing cities because maintenance of water quality and sanitation infra-structure do not increase along with population and urbanization growth especially in developing countries [2,4].

Heavy metals and other fluvial contaminants in suspension or solution, do simply flow down the stream, form complexes with other compounds and settle to the bottom and are ingested by plants and animals or adsorbed to the sediment [16]. Consequently, aquatic organisms

may acquire heavy metals into their body. Heavy metal concentrations in aquatic ecosystems are usually monitored by measuring their concentrations in water, sediments and biota [6], which generally exist in low levels in water and attain considerable concentration in sediments and biota [15].

The toxicity of heavy metals can result to reduce mental and central nervous system function, lower energy levels, and damage to blood compositions. The lungs, kidneys, liver, and other vital organs are equally affected. Long-term exposure may result in slowly and progressive physical, muscular, and neurological degenerative processes that mimic Alzheimer's disease, Parkinson's disease, muscular dystrophy, multiple sclerosis, or endocrine disruption that can lead to infertility, or other abnormal metabolic situations. Heavy metals are dangerous because they are not easily excreted and therefore tend to bio accumulate over time.

Lead in the environment arises from both natural and anthropogenic sources. Exposure can occur through drinking water, food, air, soil and dust from old paint containing lead. In the general non-smoking, adult population the major exposure pathway is from food and water. Lead is among the most recycled non-ferrous metals and its secondary production has therefore grown steadily in spite of declining lead prices. Its physical and chemical properties are applied in the manufacturing,

construction and chemical industries. It is easily shaped because it is malleable and ductile. There are eight broad categories of use: batteries, petrol additives (no longer allowed in the EU), rolled and extruded products, alloys, pigments and compounds, cable sheathing, shot and ammunition.

Due to the dependence of the populace of Eagle Island in Port Harcourt on this water body for domestic water supply and its aquatic organisms (periwinkle) and other sea foods, as source of food nutrients, and considering the high level of industrial activity in the environment occasioned by the presence of oil industry and other activities of car battery chargers, it became imperative to assess this heavy metal in this water body to assess the level of heavy metals in this aquatic ecosystem in view of the health implications that cut across the food strata

The results obtained from this study would provide information for background levels of this metal in the sediment and periwinkle in this river, contributing to the effective monitoring of both environmental quality and the health of humans living beside the riverside.

2. Materials and Methods

2.1. Sample Collection Method

With a clean dry plastic container sediments from Eagle Island River was collected at 25 sampling stations where periwinkles live. On collecting the sediment, the periwinkles found in each station was also picked and kept in their respective sediment containers. And this followed for all the 25 sampling stations. The sample containers were covered to prevent the periwinkles from one station container to move to another station container.

2.2. Sample Preparation

2.2.1. Periwinkle

The shell of the fresh periwinkle (*Tympanotonosfuscatus*) sample for each station were cracked and separated to obtain their tissue (edible parts). The tissue separated was rinsed with several changes of distilled water and allowed to air dry. After which, the tissue sample for each station were blended or homogenized to powder form and put into different containers labeled station 1 to station 25 and from which 2 gram of each was weighed using an electronic weighing balance. The weighed tissue sample for each station was transferred to a beaker labeled station 1 to station 25. Into each of the beaker, was added 6 ml of trioxonitrate (v) acid (HNO_3) and 2 ml of perchloric acid and stirred, 30 ml of distilled water was also added. Each beaker was placed on the hot plate and heated for digestion to take place. After heating, the samples were allowed to cool. Then by means of funnel and filter paper, each of the samples labeled station 1 to station 25 were filtered. The filtrate was collected and the volume was made up to 50 ml using the deionized water. Then the prepared samples were ready for Atomic Absorption Spectrophotometric analysis. The samples were analyzed for lead (Pb) using lead hollow cathode lamp. The sample was aspirated into the burning flame [1].

2.2.2. Sediment

The sediments from each station were air-dried, after which the samples were then powdered. The sediment particles were allowed to pass through 160 μg sieve, from the sieved particles of the sediment, 1 gram of the sediment was weighed using an electronic weighing balance. The weighed sediment was transferred to a beaker, followed by the addition of 3 ml of nitric acid (HNO_3) and 1 ml of hydrochloric acid (HCl) with 25 ml of distilled water. After which the sample was heated for one hour. After heating, the mixture was allowed to cool, and then followed by filtration of the mixture using a Watman No. 1 filter paper. Each of the heated mixtures representing sample station 1 to sample station 25 were allowed to cool, then filtered into a measuring cylinder and the volume was made up to 50 ml using deionized water. The prepared samples were ready for atomic absorption spectrophotometric analysis, using lead and nickel cathode lamps for the determination of lead and nickel respectively. Sediment analysis was carried out according to the procedure of [5,12].

2.3. Statistical Analysis

The results were expressed in mean, and standard deviation. The comparison of the means of the two groups of samples was done using the student's t-test to determine if the differences are statistically significant. The Results were considered statistically significant when p is less than 0.05 ($P < 0.05$).

3. Results, Discussion and Conclusion

3.1. Result

Table 1. Lead concentrations in the samples

Samples	Mean \pm SD (n=25)	p. value	Correlation coefficient
Periwinkle	0.91 \pm 0.54	(P<0.05)	61.5%
Sediment	0.22 \pm 0.19		

Table 1 above shows the result of lead concentration in the two samples (periwinkle and river sediment). From this table, it can be observed that Periwinkle had a significantly higher concentration of lead than the river sediment. ($p < 0.05$). Periwinkle has a mean Lead concentration of 0.91 \pm 0.54 mg/Kg (Mean \pm SD) while the river sediments has 0.22 \pm 0.19 mg/Kg (Mean \pm SD). There is also a significant positive correlation between the concentration of lead in the sediment and that in the periwinkle with a correlation coefficient of 61.5% ($r^2=61.5\%$). By interpretation, it is due to the contamination of sediment with lead that led to a significant exposure of the periwinkle and increased exposure will also result to increase in the bio-accumulation of lead in periwinkle. In the contrary, decreased exposure of the heavy metal will lead to decreased accumulation of the heavy metal over time.

3.2. Discussion

The result of this study shows that Periwinkle had significantly higher levels of Lead than the river sediment. The higher level of lead reported here, in the periwinkle may be explained by the mechanism of bioaccumulation within the food chain as the periwinkles feed on sea organisms that may have absorbed some quantity of the

lead that have found its way into the water bodies, and also by the principle of bio concentration over a period of time, while the water body is not static but following, thereby washing away the heavy metals at any particular sediment site. This finding is in consonance with the report of several other researchers [3,13], who also reported increase in heavy metals in the body of marine animals found in polluted water at a concentration higher than the surrounding environment. This is expected because the heavy metals are not easily excreted from the body, but tend to bio accumulate over a long period of time. This finding is also in agreement with the finding of [17]. The result of this work also shows that Lead concentration in the sediments of Eagle Island River falls within the acceptable limit (UNEP 1985& EC 2005).

On the contrary, the mean concentration of lead in periwinkle in Eagle Island river when compared with the acceptable tolerable Values of metals in aquatic organism are found to be high and well above the tolerable values. Quite a good number of factors may have contributed to lead contamination of the Eagle Island River, sediment and aquatic organisms such periwinkles. These contributing factors could be; geological weathering (natural phenomenon), industrial processing from Agipoil Company located in the community just beside the water body, disposal of old car batteries, metals and metal components into the river, leaching of metals from garbage and solid waste heaps, human excretions and other human activities as supported by the work of [11]. Apart from the oil company located in the community, it was observed that the people in the community disposed all kinds of waste materials into the river, including batteries and other materials that could be a source of heavy metal contamination. In addition, the people in this community live near the river and have their bathrooms and toilets built very close to the river. Thus, there is a possibility that detergents, soaps and creams wash into the water body.

This high level of lead in the periwinkle may be a potential source of lead poisoning to the individuals who consume them. There is the possibility that the high lead level in the periwinkle may not have any adverse effect on the periwinkle, but may have a devastating effect of higher animals that consume them. This is a well-known fact in ecological studies of bioaccumulation arising from food chain as a result of trophic transfer factor (TTF). The TTF comes very handy when explaining the heavy metal transfer at different trophic levels in a food chain, mostly from a lower level to a higher level, just as the case with the humans and periwinkle [13].

There are sufficient evidence in the literature highlighting the pathological effects of heavy metals in human physiology even at low concentrations. Toxic levels of lead may adversely affect sperm shape, motility, and DNA integrity, thereby giving rise to infertility in males [8]. There are reports that lead accumulation can also lead to altered cellular functions including growth and immune functions [13]. In fact lead is known to interfere with a host of human physiological processes in the organs and tissues, including, the nervous system, reproductive system, cardiac and osseous systems, where it interferes with enzyme functions, and sometimes giving rise to metabolic block in physiological pathways. A very important fact about heavy metal poisoning is the fact that

they are not easily excreted out of the body, and their effect on the body is not immediate, so individuals can go on accumulating the heavy metal over a long period of time without knowing, only to manifest much later in life, and at a time for which an appreciable dose has been accumulated. One of the cardinal effects of lead on metabolic processes is that it produces reactive oxygen species which destroy the cellular structures including the cell membranes and DNA transcription enzymes, giving rise to the deficiency of a host of enzyme systems necessary production of blood cells, synthesis of vitamins, collagens bones etc. [10,22], and this has an adverse effect on body metabolic functions requiring the participation of such enzyme systems.

3.3. Conclusion

That the concentration of Lead in periwinkle from this river is higher than acceptable tolerable limit calls for immediate concern. This is in view of the fact that by extrapolation, it may be possible that other sea foods from that river could be equally polluted and the ignorant populace keep consuming these sea foods. Lead is named among the toxic metals that elicit adverse effects in humans such as behavioral and endocrine disturbances and as such high levels can be dangerous to human health and as such should be avoided. Other metals in this group include Cadmium, Nickel and Mercury. The possibility is that there could equally be bioaccumulation of these heavy metals in these individuals and the attendant health implications at the long run. This paper therefore calls for adequate legislation on environmental protection of all water bodies, with the aim to protect the populace from untoward adverse effects that may arise from heavy metal poisoning'.

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