Pollution assessment of the aquatic resources in the Lagos lagoon system.

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Abstract: Sediment, water samples and fish (*Oreochromis niloticus* and *Chrysichtys nigrodigitatus)from each of Unilag,Ikorodu and Iddo Lagoons in Lagos State, Nigeria were analyzed for the presence* Zinc (Zn), Lead (Pb), Cadmium (Cd), Copper (Cu), Iron (Fe) and Chromium (Cr) using Buck Scientific 200A model, Atomic Absorption Spectrophotometer (AAS).Sediment contain highest concentration of Fe with a value of 113.02mg/kg against 0.96mg/L in water and 3.92mg/kg in fish, fish contain higher concentration of Zn 7.236mg/kg against 3.740mg/kg in sediment and 3.96mg/L in water. Cu is higher in fish 3.7mg/kg followed by water 2.96mg/L and sediment sample 1.163mg/kg.Cd,Cr and Pb were found not to be present in the water sample while these metals were found to be higher in the Sediment sample than fish tissue. Bioaccumulation was observed in tissues of *Oreochromis niloticus* and *Chrysichtys nigrodigitatus* as higher concentrations of metals were observed in fish tissues than in the water in which they live. The concentration of Zn in the water is above the limits permitted by the Lagos State Environmental Protection Agency (LASEPA) of 1.0 mg/L Zn set for water, there should be need for continuous monitoring of these Lagoons for heavy metals/pollution status.

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Introduction

Fish, water, and bottom sediment are some of the major aquatic resources of marine environment, and they find their use and applications in all phase of life. The Minamata and Itai-Itai disasters in Japan in the 1960s, caused by poisoning and death of several people through the ingestion of fish contaminated by mercury and cadmium-contaminated rice respectively are still fresh in our memories. Ever since the tragic deaths, environmental pollution by heavy metals has received considerable attention in industrialized countries.

The ecological consequences of discharges of effluents from the Nigerian oil industry and domestic sewage and particularly, the environmental effects of heavy metals released from textile and mining industries have been widespread in recent years. Factors such as high population growth accompanied by intensive urbanization, increase in industrial activities and higher exploitation of natural resources including cultivable land have caused pollution increase. There has been a steady increase in discharges that reaches the aquatic environment from industries. There is an increasing concern regarding the roles and fates of trace metals in the Nigerian environment. Much of this concern arises from dearth of information on the concentration of these metals within the environment. The contamination of seafood by trace metals is a potential problem to man, aquatic organisms accumulate metals to concentrations many times higher than present in water.

Fish is a valuable and cheap food item, and also a source of protein to man. Concern about heavy-metal contamination of fish has been motivated largely by adverse effects on humans, given that consumption of fish is the primary route of heavy metal exposure (Nsikak, *et al*, 2007). In order to effectively control and manage water pollution due to heavy metals, it is imperative to have a clear understanding of their distribution pathways, fate and effect on biota. Some research findings have shown that heavy metals in aquatic environment could accumulate in biota especially fish as they are the most common aquatic organisms at higher tropic level (Olaifa *et al*, 2004).

This study was aimed at determining the concentrations of Zn, Pb, Cd, Cu, Fe and Cr in the sediment, water and fish of Lagos lagoon obtained from Unilag, Ikorodu and Iddo with a view to assessing the pollution status of the aquatic resources of Lagos lagoon.

Methodology

Sample Collection

Surface water, fish and sediment samples were collected from three (3) sample stations Unilag, Ikorodu, and Iddo, with the aids of water sampler, cast nets and van-veen grab respectively. The choice of sampling stations was influenced by coastal activities. Samples were collected from January to March 2009. Water and sediment samples were kept in plastic bottles and black polythene bags respectively. Water samples for heavy metal determination were acidified in pre-cleaned plastic containers on the field. Each sample was collected in an acid-cleaned polypropylene bottle, which was rinsed three times with the sample water prior collection.

The fish samples were kept in the ice pack right from sample station to the laboratory. The fish samples were identified in the laboratory, washed and frozen at -18^{0}C as soon as possible to avoid loss of sample integrity. Two species **-** ***Oreochromis niloticus*** and ***Chrysichtys nigrodigitatus*** were identified and reported for the fish samples at the study locations.

Sample Treatment and Analysis

The fish samples were allowed to defrost and then dried to constant weight in an oven at 105^{o}C. Sediment samples were air dried and then ground using mortar and pestle and sieved through 2mm mesh sieve to remove coarse materials. A quantity 0.2g each of sediment and fish samples was digested using 0.02M HNO3 and HCl in the ratio 1:3 (aqua regia) in a fume cupboard at 80^{0}C (Obasoha, *et al,* 2007).

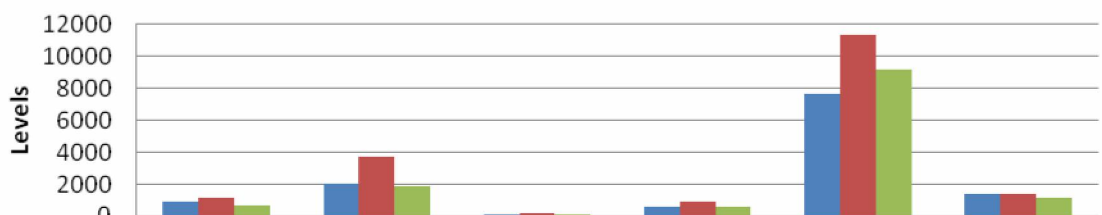
Analysis of all the samples was carried out using a Buck Scientific 200A model, Atomic Absorption Spectrophotometer (AAS) and the values expressed in milligram per litre (mg/l) for water samples and milligram per kilogram (mg/kg) for both sediment and fish samples, (Obasoha, *et al,* 2007).

Results

Heavy metals in Sediment

The mean concentrations of heavy metals in sediment samples are shown in figure 1 below. The highest value for Cu (11.63mg/kg) was observed at Ikorodu; and the least value (7.00mg/kg) was at Iddo location.

Figure 1: Heavy Metals in Sediment Samples



	Cu x 100	Zn x 100	Cd x 100	Pb x 100	Fe	Cr x 100
Unilag	945	2045	45	611	7615	1363
Ikorodu	1163	3740	152	945	11302	1392
Iddo	700	1833	6	552	9135	1162

The highest value for Zn (37.40mg/kg) was recorded at Ikorodu, while the lowest (18.33mg/kg) was at Iddo. The highest mean value for Cd (1.52mg/kg) was recorded at Ikorodu, and the lowest (0.06mg/kg) was at Iddo. Lead has the highest value (9.45mg/kg) recorded at Ikorodu and the least (5.52mg/kg) at Iddo station while Fe and Cr has their highest values at Ikorodu, 113.02mg/kg and 13.92mg/kg respectively.

Heavy metals in Water.

The mean values for heavy metals in water samples are presented in figure 2 below. The highest mean value for Cu (1.59mg/l) was recorded at Ikorodu, while the least (0.11mg/l) was recorded at Iddo station. The mean concentration of Zn (2.96mg/l) obtained at Ikorodu was higher than Unilag and Iddo with mean values of (0.28mg/l) and (0.19mg/l) respectively.

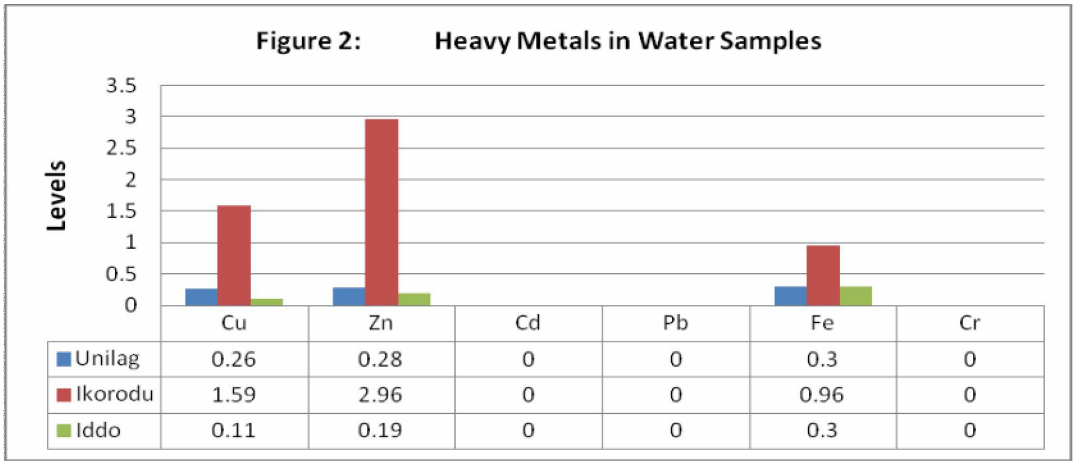


Figure 2: Heavy Metals in Water Samples

Cd, Pb and Cr were not detected in all the three stations while Fe has the highest mean value (0.96mg/l) recorded at Ikorodu and lowest in Unilag and Iddo with (0.3mg/l).

Heavy metals in Fish.

The highest value of Cu (3.7mg/kg) was recorded in Iddo and the least (2.59mg/kg) in Unilag. Zn has the highest value (7.23mg/kg) in Ikorodu and the least in (6.67mg/kg) in Iddo. Cd has the highest value (0.21mg/kg) in Iddo, and it was not detected in Unilag and Ikorodu. Pb was not detected in Unilag, but has its highest value (1.21mg/kg) recorded in Ikorodu and the lowest (0.71mg/kg) in Iddo. The maximum for Fe (3.91mg/kg) was observed in Unilag and the minimum value (2.82mg/kg) in Ikorodu while Cr has highest value (0.78mg/kg) recorded in Unilag, and the lowest value (0.65mg/kg) in Ikorodu.

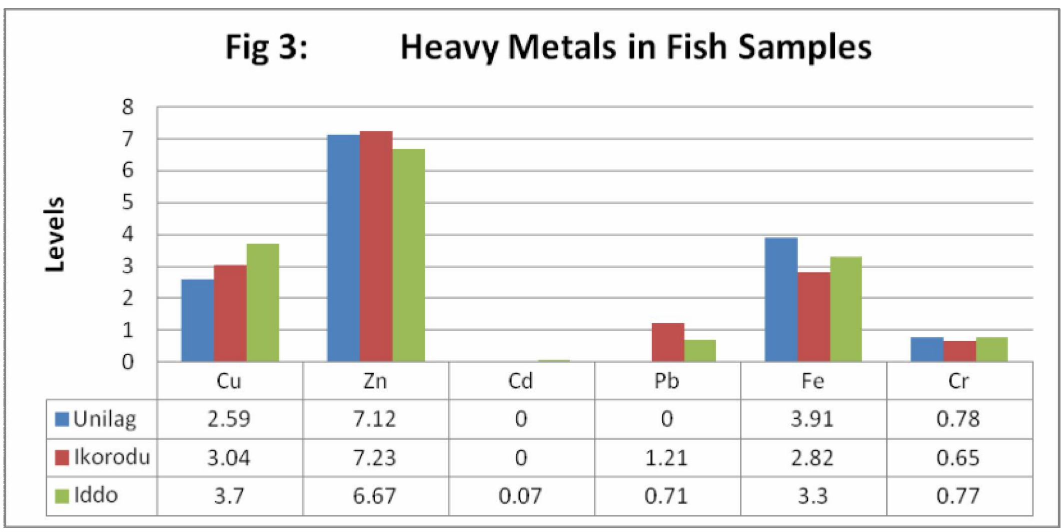


Fig 3: Heavy Metals in Fish Samples

Discussion

The highest metal values in sediment recorded at Ikorodu, may be due to the fact that when metal pollutants are discharged into aquatic environment, they do not remain in aqueous phase but instead adsorbed onto the sediment. Thus, sediment serves as a sink for pollutants, hence the reason for its higher concentration of these metals. This is similar to the findings of Amoo *et al* (2005) where higher levels of these metals in sediment were obtained than in water of Lake Kanji in Nigeria.

It could also be as a result of many activities in the area which include the metal depot at Owode-Onirin, where metal scraps are deposited for sales. Other activities include the use of metal gears for fishing, dumping of metal containers of domestic sources, abandoned fishing canoes / boats with metal linings, etc. Leachates from these activities gained ingress into the Lagos lagoon through its tributaries. The lowest levels of heavy metals recorded at Unilag station is expected, as less human activity involving the use of heavy metals was not observed at this station.

The ranges of all the metals in the sediment samples from the three stations were on "a" pollutional status i.e. non-polluted environment as quoted in the pollutional status of sediments according to metals concentration by Prater and Anderson, 1977.

All the heavy metals analyzed in this study were detected in water, sediment and fish, except for Cd, Pb and Cr that were not detected in the water samples for all the three stations. The mean values of all the metals in sediment collected at the three sampling stations did not exceed the recommended threshold limits of 124 mg/kg, 0.678mg/kg and 30.2mg/kg set for Zn, Cd and Pb respectively by the United States Environmental Protection Agency (USEPA, 2007).

The concentration of Zn in the water is above the limits permitted by the Lagos State Environmental Protection Agency (LASEPA) of 1.0 mg/L Zn set for water while the mean values of Zn in water samples obtained from the three sampling stations are below the limit of 15.000mg/l recommended by Federal Environmental Protection Agency (FEPA, 1999).

Copper is one of the metals classified as essential to life due to its involvement in certain physiological processes and metabolic activities in organisms. However, elevated levels of Cu have been found to be toxic (Spear, 1981). Fe is found in natural fresh waters and has no health-based guideline value, although high concentrations in water give rise to consumer complaints (WHO, 2004).

The data obtained from this study also revealed that ***Oreochromis niloticus*** and ***Chrysichtys nigrodigitatus*** possess the requisite feature for use as bioindicator for heavy metal pollution monitoring.

Conclusion and Recommendations

The tendency of these metals to bioaccumulate in tissue of *Oreochromis niloticus* and *Chrysichtys nigrodigitatus* underscores the need for continuous monitoring of these stations to ascertain its suitability for use as a source of commercial fisheries. Zinc, iron, copper and chromium are essential in human diet. They all play significant roles in metabolic processes. In view of the importance of fish diet to man, it is necessary that heavy metal monitoring of the water and fish meant for consumption should be done regularly to ensure continuous safety of food. Safe disposal of domestic sewage and industrial effluents should be practiced and where possible recycled to avoid these metals and other contaminants from going into the environment.

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