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# The Assessment of Metal Pollution in Eleyele Lake, Ibadan, Nigeria

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## ABSTRACT

*Eleyele Lake is a multipurpose lake in the metropolitan city of Ibadan. It receives wastes from the surrounding communities. The objective of the study was to determine the levels of metals in water from Eleyele Lake and compare them against standard drinking water quality guidelines. Water samples were collected for three months at two sites and analyzed for metals using standard methods. Samples were taken with proper measures such as preservation, storage, and labeling. Collected data were analyzed using Microsoft Excel 2013. Statistical analysis was performed with SPSS software using one-way ANOVA. The obtained values for metals were compared with the standard values set by the World Health Organization (WHO) and local standards such as Nigerian Industrial standard (NIS). Site A showed comparatively higher values of metal concentrations in all the metals detected in the lake except for calcium in Site B which showed higher concentrations. Manganese, iron, lead, copper, zinc, calcium and magnesium were detected in both Sites A and B while chromium was detected only in Site A. Conclusively, Eleyele Lake contains acceptable concentrations of manganese, copper, chromium and zinc while iron and lead exceeded the recommended limit by WHO and NIS.*

**Keywords:** Metals, Pollution, Anthropogenic, Eleyele Lake.

## INTRODUCTION

One of the greatest challenges of the 21st century is the availability of portable drinking water, a resource basic to our survival and growth. Lake in the urban environment is constructed for portable water, aesthetic and recreational benefits. For human beings, lakes are important sources of water and food. However, the urban environment is vulnerable to the anthropogenic

pollutants. Deterioration of the aquatic environment is associated with urbanization by human populations commencing with the industrial revolution in the eighteenth century. Water pollution refers to any type of aquatic contamination rendering the water body unsuitable for its intended use. This may affect living organisms and all forms of life. This pollution is brought about by rapid urbanization and industrialization in developing countries which leads to the deposition of hazardous wastes in aquatic environments. The increase in pollution of aquatic environments could be attributed to increasing agricultural practices and inadequate consideration for environmental impact, among other factors. One of the serious problems of pollution in the aquatic environments is contamination with metals.

Metals are essential for normal functioning in organisms. However, they are also an important group of pollutants of water bodies due to their persistence and non-biodegradable properties [1]. Metals can affect the organisms directly by contaminating their bodies or indirectly, by transferring them to the next trophic level in the food chain [2]. Metals potential toxic effects are given by the presence in water solution at concentrations exceeding certain threshold levels and their bioaccumulation and bio-magnification in the food webs [3]. Thus, metals act as potential contaminants of aquatic bodies that could cause significant impact on fish morphology, feeding, biochemical and physiological processes [4] that ultimately affect their growth, reproduction and health [5]. Thus, metals in lakes may ultimately have adverse biological effects on human health through drinking water and consuming aquatic products [6]. It is therefore desirable and imperative to monitor their presence in lakes, which can provide valuable information of metal pollution and help evaluate potential environmental risks.

Eleyele Lake is a multipurpose lake situated in the metropolitan city of Ibadan, the capital city of Oyo State. The lake is manmade and was formed in 1939 by damming of the Ona River (part of a dense network of inland waterways that flow southward into the Lagos Lagoon) [7]. described the hydrology of the lake while Olagbemide (in press) described some of the important limnological parameters of the lake. It receives domestic wastes from surrounding communities. Activities like car washing, cloth washing, bathing, fishing, farming, ‘garri’ making, automobile repairing, block making etc. pave the way for high concentration of hazardous chemicals into the lake water [8]. reported in their study on “the physico-chemical properties and concentrations of heavy metals in Eleyele River", that the levels of concentrations of heavy metals in the river water did not constitute any serious pollution threat. However, due to indiscriminate and increasing introduction of anthropogenic pollutants into the lake, the regular monitoring and assessment of this lake has become an environmental issue and is crucial for the well-being and health of the surrounding population which depend on the lake as a source of fish and water supply.

Therefore, this study seeks to determine the levels of metals in water from Eleyele Lake and compare them against standard drinking water quality guidelines.

## MATERIALS AND METHODS

Two sites were selected for sampling. Site 1 is very close to the shore of the lake, it represents the main entrance of water; agricultural and domestic wastes from Apete community, Ibadan Polytechnic and University of Ibadan to the lake. Site 2 is in the middle of the lake. Here, most boating activities are carried out for fishing and it also receives wastes from block making industries, 'garri' processing factories and carwash spots, automobile repairing workshops and domestic wastes from Ijokodo, Awotan, Ologun-eru, Agbaje, Idi-osan and Eleyele area. A global positioning system (GPS) was used to locate the sites. The water samples were collected in the polyethylene bottles that were initially rinsed with sample water. Samples were collected within a period of three months, during the rainy season, between the months of September to November, 2016. This was done between the hours of 8.00 a.m. to 10.00 a.m. in the mornings. These samples were collected using one liter container in other to investigate the current metal levels in the lake.

The preservative procedures includes: keeping the samples in the dark, adding chemical preservative, lowering the temperature to $4^0$ C (ice/cold packs) in other to retard reactions. The samples were acidified below pH 2 with concentrated $HNO_3$. This was to prevent microbial growth, flocculation and reduce any adsorption on container surfaces. The samples were immediately taken to Kappa Biotechnology Laboratories, Ibadan for metal analysis according to APHA [9].

## RESULTS

The results of the concentrations of metals in Eleyele Lake are shown in Table 1. In this study, manganese, iron, lead, copper, zinc, calcium and magnesium were detected in both Sites A and B while chromium was detected only in Site A. Cobalt and cadmium were not detected in any of the sites.

**Table 1:** Mean concentration of metals at the sampling sites.

| Parameters | Site A (mean value) mg/l | Site B (mean value) mg/l | WHO (2003) Limits mg/l | NIS (2007) Limits mg/l |
|---|---|---|---|---|
| Manganese | $0.03 \pm 0.01^a$ | $0.17 \pm 0.01^a$ | 0.5 | 0.2 |
| Iron | $0.50 \pm 0.10^a$ | $0.33 \pm 0.06^b$ | 0.3 | 0.3 |
| Lead | $0.02 \pm 0.01^a$ | $0.01 \pm 0.00^a$ | 0.01 | 0.01 |
| Cadmium | ND | ND | 0.003 | 0.003 |
| Copper | $0.33 \pm 0.06^a$ | $0.30 \pm 0.10^a$ | 2 | 1 |
| Chromium | 0. 01 ± 0.01 | ND | 0.05 | 0.05 |
| Zinc | $0.43 \pm 0.06^a$ | $0.30 \pm 0.00^b$ | - | 3.0 |
| Cobalt | ND | ND | - | - |
| Calcium | $73.33 \pm 2.89^a$ | $83.33 \pm 2.89^b$ | - | - |
| Magnesium | $26.67 \pm 2.89^a$ | $22.33 \pm 2.52^a$ | - | 0.2 |

**Note:** *Means with the same superscript along the same row are not significantly ($p>0.05$) different; ND- Not detected.

Site A showed comparatively higher values of metal concentrations in all the metals detected in the lake except for calcium in Site B which showed higher concentrations. There were significant differences at $P < 0.05$ in the concentrations of iron, zinc and calcium between Site A and Site B while there were no significant differences in the concentrations of manganese, lead, copper and magnesium between Site A and Site B.

## DISCUSSION

Heavy metals concentrations were relatively higher in Site A, the inlet area than Site B, the middle of the lake. This shows that Site A, where anthropogenic influx from Apete community, Ibadan Polytechnic and University of Ibadan to the lake is more, was found to be comparatively more polluted than Site B. This also explains the increased brown colouration of water in Site A during the sampling period. This may be due to changes in the quantity and quality of organic matter that are rich in iron brought in from the communities. The concentrations of iron in this study were higher at both Sites A and B than the limits set by WHO and NIS for drinking water while the concentrations of lead from Site A were higher than the limits set by WHO and NIS for drinking water. This is a pointer to the severity of the lake pollution. Iron is a dietary requirement for most organisms, and plays an important role in natural processes. However, increasing concentrations of iron can have direct and indirect toxic effects on aquatic biota, causing irritation of the gill tissues which may lead to gill damage and secondary bacterial and fungal infections, thus, impairing ion regulation and oxygen uptake in fish [10].

The high levels of lead especially at Site A is likely due to human activities from pipes and plumbing materials at home, gasoline and batteries from automobile workshops around the lake while the minimal concentrations of lead in Site B may be due to the spill of leaded petrol from fishing boats. Exposure of man to high levels of lead for short term can cause brain damage, paralysis, anaemia and gastrointestinal symptoms. Longer-term exposure can also cause damage to the kidneys, reproductive and immune systems in addition to effects on the nervous system, Consumption of food containing lead also serves as the major source of exposure for the general population. In addition, high levels of lead in the water can cause generative damage in some aquatic life and cause blood and nervous changes in fish and other animals that live there [11,12].

Though chromium was detected only in Site A at concentrations lower than the WHO, NIS recommendations for permissible level for protection of human health and aquatic life. There is still need to guard the lake against further pollution of this metal which may be attributed to industrial and agricultural discharge [13]. Chromium may cause health problems including: allergic reactions, skin rash, nose irritations and nose bleeding, ulcers, weakened immune system, genetic material alteration, kidney and liver damage. This may even cause death for the individual. High concentrations of chromium, due to the disposal of metal products in surface waters, can damage the gills of fish that swim near the point of disposals [14-18]. Copper, manganese and

zinc concentrations in both Sites A and B are lower than the recommended limit by WHO and NIS. However, they need to be closely monitored especially in the aquatic biota in this lake as their bioaccumulation in these organisms may constitute health hazards in the food web that will eventually endanger human life.

## CONCLUSION

It may be concluded from this study that the Eleyele Lake in the metropolitan city of Ibadan contains acceptable concentrations of manganese, copper, chromium and zinc while iron and lead exceeded the recommended limit for drinking water. Hence, the water in its present form is not portable and can only be used for specific purposes after proper treatment.

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