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Some Physicochemical Properties and Heavy Metals in Water from Oboshi River, Ibusa in Delta State, Nigeria

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ABSTRACT: The current study assessed the physicochemical parameters and heavy metal composition of water samples from Oboshi River Ibusa in Delta State, Nigeria using standard methods. Results showed that the physicochemical parameters of the Oboshi River as follows: temperature (30.4^{oC}), pH (6.7), electrical conductivity (8.0ppm) and total dissolve solid (22.6µS/cm). Furthermore, the mean concentration of selected heavy metals detected in the water sample were (Cu = 0.16mg/L, Cr = 0.21mg/L, Pb =0.06mg/L, Zn =1.13mg/L, Mn =0.12mg/L, Fe =0.3mg/L and Cd =0.03mg/L). However, Pb, Cd and Mn were found to be above the permissible limit of World Health Organization. Meanwhile, the mean concentration of Fe was observed to be the same as the minimum permissible limit of WHO. But the mean concentration of Cu, Zn, and Cr were recorded below the minimum permissible standard of WHO. Based on the observed results, it is recommended that Oboshi River be continuous monitored for water quality as it is an important pre-requisite for the prevention of potential health hazards to humans and other tropical levels. The government should consider limiting anthropogenic activities on Oboshi River, Ibusa in Delta State, Nigeria.

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Heavy metals contamination of water bodies has been documented to be as a result of anthropogenic or natural processes. Weathering of metal-containing rocks, volcanic eruptions, forest fires, and naturally occurring weathering processes can all be considered natural activities. Metal penetrates the various ecosystems as a result of these actions. Sulfates, hydroxides, oxides, sulfides, phosphates, and silicates are some of the forms that heavy metals can take form Salgarello *et al.,* (2013). The main causes of the massive buildup of heavy metals in the water are anthropogenic and natural activity. Additional natural sources of heavy metal contamination of water include the wet and dry deposition of atmospheric salts, water-rock contact, and water-soil interaction. While rapid urban and industrial growth are two examples of human-made sources by which water becomes contaminated Priti and Paul (2016). The presence of heavy metals like Hg, Cd, Cr, and Pb in waterways and biota indicates the existence of either natural or anthropogenic sources. Heavy metals are among the most prevalent environmental pollutants (Abdullah, 2013). These pollutants came from soil leaching, chemical fertilizers, pesticides, and runoff from urban and agricultural areas Amman et al., (2002), Nouri *et al.,* (2008). Since rivers have been the primary suppliers of water since ancient times, especially in flat plains, it is crucial to preserve their purity. Rivers are deteriorated by anthropogenic factors Jarvie *et al.*, (1998). River pollution is one of the most significant problems in developing nations since water quality upkeep did not advance with their economic

development Sundaray *et al.,* (2006), Akoto *et al.,* (2008). Therefore, the current study assessed the physicochemical parameters and heavy metal composition of water samples from Oboshi River Ibusa in Delta State, Nigeria.

MATERIALS AND METHODS

Materials: Materials used for this study are Atomic Absorption Spectrophotometer (AAS), Beakers, Volumetric Flask, Measuring cylinders, pH meter, Conductivity meter, Total dissolve solid meter (TDS) and Pippetes.

Sample Location: For this study, water sample was collected from River Oboshi, which is located in Ibusa, Delta State with geographical coordinates of latitude 6.1814ºN and longitude 6.6355ºE.

Research Design: Oboshi River was measured and classified into three different strata (upper, middle and lower level) following Habu *et al.,* (2020). Water sample at each stratum was collected in three replicates and then mixed to form composite sample.

Sample Collection: Composite sample of the Oboshi river water was poured into a sterile bottle of 500ml. The sample was then transferred into 250ml beaker. The sample was then transferred to the chemistry laboratory of Admiralty University of Nigeria for physio-chemical analysis and heavy metals analysis. A working standard solution of 1000 ppm was prepared and then the water sample was digested before elemental analysis.

Determination of Trace Elements in Oboshi River: The following heavy metals; lead (Pb), Chromium (Cr), Iron (Fe), Zinc (Zn), Copper (Cu), Cadmium (Cd) and Manganese (Mn) of all water samples obtained from Oboshi river were determined using Atomic Absorption Spectrophotometer (Bio-base Inquest model).

Determination of physical parameters of Oboshi River: Physical parameters of the Oboshi water body were determined using known standard methods by APHA, (1992). These parameters include the water pH, temperature, electrical conductivity, color, odor, and total dissolved oxygen. The pH meter was determined using digital pH meter (model PHS -3C), electrical conductivity with a Euip-tronic ME- 976^{oC} conductivity meter. The temperature and dissolve oxygen were measured using digital thermometer and TDS meter respectively. The Odor and color of the water were determined by applying visual color and physiological senses.

Statistical analysis: Means and standard deviations of the concentrations of the minerals concentrations for the various samples were calculated with Microsoft office excel (2012) spread sheet. Concentrations of minerals were expressed as mean ± SDM (Standard Deviation of the Mean). Data obtained was subjected to Analysis of Variance (ANOVA) using Statistical Package for Social Sciences version (SPSS) version 20. Significant level $p < 0.05$ was considered and the results were presented in tables.

RESULTS AND DISCUSSION

Physical parameters of Oboshi River: The results of physical parameters of the water samples are shown in Table 1. The average water temperature of Oboshi River was observed to be at 30ºC while the pH value was 6.7 which signifies a natural pH level. When these two parameters were compared with the one obtained from WHO permissible level, it was observed that Oboshi river pH and temperature were within the approved WHO range (6.5 - 8.59 and 29 - 32 ºC respectively). Furthermore, the electrical conductivity value of the Oboshi River (22.60 µS/cm) was still observed to be within the WHO standard and the turbidity of the water body was clear with no foul odor. Due to these positive physical observations of the Oboshi River in line with the WHO, it is safe to say that Oboshi River has a good quality for drinking and household activities Denkok *et al.,* (2021).

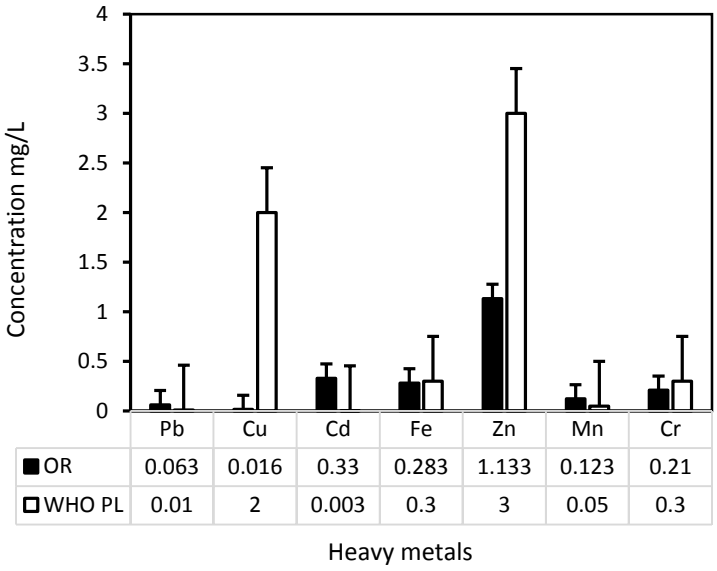
Table 1: Physical properties of Oboshi River

S/N	Parameter	Value
1	Temperature	30.4±0.1
2	Ph	6.7±0.07
3	TDS	8.0± 0.2
4	EC	22.6±0.07
5	Odour	Odourless
6	Colour	Clear white to visual

Key TDS = Total Dissolve Solid, EC = Electrical Conductivity

Chemical properties of Oboshi River: Some selected heavy metals such as Pb, Cu, Cd, Fe, Zn, Mn and Cr were detected in Oboshi river at different concentration. Zinc (Zn) was observed to show highest concentration (1.122 mg/L) in the river, while Cu was observed to show the least (0.016 mg/L) concentration. This may be because most of the anthropogenic activities going on in Oboshi river has high concentration of Zn or because of the persistent and slow immobilization of Zn in water body Habu *et al*., (2020). In order to further investigate the safety of Oboshi River, the heavy metals values obtained were compared with the standard limit by WHO. It was observed that some of the heavy metals detected in Oboshi River (Figure 1) were below the WHO standard for heavy metals in waterbody except for Pb,

Mn and Cd. These may be due to the fast-flowing nature of the Oboshi river. According to Emmanuel *et al.* (2022), lotic water bodies tend to show less heavy metal concentration compared to the lentic due to water transfer and turbulence. However, for Pb which was observed in higher concentration in Oboshi river compared to the WHO limit, it may pose serious health risk to tropical levels that rely on the river. For example, biomagnification of Pb in human system has been linked with several bone diseases in Nigeria Emmanuel *et al*., (2022).



	Pb	Cu	Cd	Fe	Zn	Mn	Cr
OR	0.063	0.016	0.33	0.283	1.133	0.123	0.21
WHO PL	0.01	2	0.003	0.3	3	0.05	0.3

Fig 1: Heavy metal concentration of Oboshi River in comparison with WHO permissible limits (mg/L). OR= Oboshi River. WHO PL= World Health Organization Permissible Limit. Results are average of three replicates. PB=Lead, Cu= Cupper, Cd= Cadmium, Fe= Iron, Zn= Zinc, Mn= Manganese, Cr= chromium.

The high Cd in Oboshi River above WHO permissible limit may be dangerous. This is because high concentration of Cd in human, animal or plant tissue has potential to infect essential amino acids and accumulate in in the proximal tubular cells at extremely high concentrations, causing brittleness in bones and altering the structure and nature of the kidney and lung Anubha *et al.,* (2022). Furthermore, biomagnification of Cd in human system can cause liver malfunction, new-born baby weight loss and premature deliveries in pregnant woman. The value of manganese obtained in the study is 0.12mg/L which is slightly higher than WHO permissible limit of 0.05mg/L. Manganese is said to cause poisoning, some diseases when taken in large amount. Anubha *et al.,* (2022) It a common, naturally-occurring mineral found in rocks, soil, groundwater, and surface water

Conclusion: Oboshi River is still within the permissible limit for some heavy metals, while other heavy metals were higher. Hence, data from this research will inform industries and policy makers on the status of the river for developmental programmes in the community. Furthermore, this will necessitate routine monitoring and inspections of the River in order to reduce pollution and ensure that the river is potable, fit for consumption, acceptable, wholesome, and pleasant.

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