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Comparison in the Concentrations of Heavy Metals in Aboru and Ipaja River, Lagos State, Nigeria

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Abstract
Toxic metal pollution has been one of the most serious environmental challenges to both humans and other living species. The effect of these toxic metals cause both short and long term on human because they lower the energy levels and damage the functioning of the brain, lungs, kidney, liver, blood composition and other important organs as they have no biological role and are non-biodegradable. The aim of this study is to assess the levels of heavy metals such as Fe, Zn, Pb, Ni and Cdpresentin Aboruriver and Ipaja river and compare them to the World Health Organization permissible limits. Digestion method was used for the contaminated river water. Atomic Absorption Spectrometer (AAS) technique was employed in the analysis of the trace and toxic heavy metals. The results showedthat, of all the metals, except Fe was found to have the highest concentration in ppm while Cd was found to have the least in the order Fe > Zn >Pb> Ni>Cd at the pH of 4.58 while for Aboru 4.173 > 2.293 > 0.041 > 0.071 > 0.004 at pH of 4.97. It was discovered that Ipajariverhad higher levels of toxic metal pollution compared to Aboruriver. Also, comparing the values to the World Health Organization (WHO) for Fe > Zn >Pb> Ni>Cd: 3.0 ppm >, 3.0 ppm>, 0.05 ppm >, 0.07 ppm > 0.003 ppm. it was found that all the toxic metals in Ipajariver were not within the standard permissible limits but for theAboru river, while some metals were above the standard limits.From the results shown, the dumpsite has a lot of heavy metals which are harmful to the environment and human.

Keywords: *River, Metal-pollution, heavy metals, physicochemical parametersDigestion, AAS*

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I. Introduction

After air, water is a very goodresource to human life. Water is important to both aquatic and non-aquatic life which is of about 70% for humans and 50 – 97% by weight of all plants and animals [1].There are many sources of water pollution but the main ones are pollution from industrial and municipal waste-water discharge that is also an important resource for agriculture, manufacturing, transportation, etc. It is use for domestic purposes, industrial activities, and among many other uses. Water is a basic amenity to humanity on theearth. Water is a good solvent used to dissolve and contain mineral constituents and other substances that it leaches out on contact. Despite its importance, most times water is poorly managed in the world. Many people get infected as emphasized by the public health through untreated water from river and other source s of water that contains toxic metals [2]. Consequently, impurities from surface run-off, sewage discharges and industrial effluents are collected by rivers and streams in their course of flow. Rivers and streams are important sources and channels for the movement and transportation of anthropogenic metals to the ocean.

Some examples of the heavy metals like Iron, copper, cobalt, zinc, manganese and chromium (III) are essential metals required by the body to perform physiological functions of living tissue and regulate many biochemical processes [3]. Non-essential metals are those metals that are not required by living systems and can be toxic even in trace amounts, these include: Cadmium, Mercury, Lead, Titanium, Arsenic, Bismuth and Antimony. Whether essential or non-essential, all metals are toxic at higher concentrations with their toxicity linked to chronic diseases such as renal failure, liver cirrhosis, brain syndrome and many others. These metals continue to pile in concentration to higher levels when they are discharged into natural waters at increased concentrations from agricultural, industrial, and domestic wastes, pesticides or mining operations [4]. Some challenges in environmental protection and conservation that have resulted due to global changes needed for baseline data to evaluate the potential impact of pollutants to ecosystems [5]. Metals are elements, present in chemical compounds as positive ions, or in the form of cations (+ ions) in Solution. Metallic elements with high atomic weight and densitygreater than water (at least 5 times) are called heavy metals. Heavy metals are among the most serious environmental pollutants due to their high toxicity, abundance and ease of accumulation by various plants and animals. Persistent increase of these metals in harbor sediments can be attributed to the contribution of effluent from waste water treatment plants, industries, mining, power stations and agriculture. Heavy metals are extremely persistent in the environment. They are non-biodegradable and non-thermo

degradable and therefore readily accumulate to toxic levels [5,6,and 7]. They are released into the environment from natural as well as anthropogenic activities. Heavy metals in the environment lack natural elimination processes. As such, heavy metals occur naturally in the earth's crust at varying concentrations in all ecosystems [6,7]. Metal pollution became extensive as mining, industrial activities and mechanized agriculture activities increased in the 19^{th} century and have intensified since then [8,9]. Pollution of ecosystems such as rivers, oceans, lakes and wetlands by heavy metals is causing serious ecological problems in many parts of the world. This is exacerbated by the lack of natural elimination processes for heavy metals in the environment. Many years ago microbial quality of portable water uses was of concern and due to the immediate and potential devastating consequences of waterborne infectious diseases [6]. However, increased concern has shifted over to the concentration of heavy metals in water because the public has now become aware of the toxic effects of heavy metals on human health [9, 10]. In that case, globally heavy metal pollution has been marked as a serious environmental problem owing to their persistent and accumulative properties that even the World Health Organization had to place permissible limits on the toxic metals found in rivers to ensure the safety of humans and even aquatic lives from excessive metal pollution [11,12].Heavy metals are persistent in the environment and they tend to shift from one compartment of the ecosystem to another. Such heavy metals are manganese, chromium (III), copper, zinc, iron, cobalt while some of those that are not required in the bodyare those that exist in high concentrations. For examples,cadmium, lead, arsenic, titanium etcleads to some serious diseases like brain damage, liver cirrhosis, renal blockage etc.[13, 14 15].These metals continue to pile in concentration to higher levels when they are discharged into natural waters at increased concentrations from agricultural, industrial and domestic wastes, pesticides or mining operations. As a result, they end up having severe toxicological effects on humans and the aquatic ecosystem. Trace amount of metals are naturally present in freshwaters from weathering of rocks and soils. However, anthropogenic activities like mining release huge amounts of tailing waste containing heavy metals which could pose serious threat to water sources, agricultural soils and food crops [2,16]. Heavy metals may be introduced and spread in the environment through combustion, extraction, agricultural runoff and transportation. Agrochemicals introduced in the soil as soil nutrients to improve fertility contain metals which in most cases exceed the limits set for land application and their continuous use can exacerbate their accumulation in agricultural soils. The use of agrochemicals such as pesticides and fertilizers may result in undesirable accumulation of trace elements like Cd, Cu, Pb and Zn [17,18, and 19].Copper oxides, chlorides, sulfates, ethanoates, bromides and carbonates are widely used in pest control, inorganic dyes as fungicides, seed disinfectants and algaecides.

II. Materials and Methods

2.1 Description of Study Area

The study areas are Aboruriverand Ipaja river and the Aboruriver is located at Latitude: 5.46667 N and Longitude: 7.91667 E area of Alimosho local government, Lagos state while Ipajariver is bounded by the Latitude of 6.6131° N and 3.2659° E, Alimosho local government, Lagos state, Nigeria. The geology of the area is characterized by the heavy presence of lots of oil and gas pipelines built underground for the transportation of various gases and crude oil. Many toxic wastes are being dumped in these two rivers like soap for washing clothes, nylon, paper, chemical wastes are heavily disposed without proper treatment, untreated sewage, oil spillage as they are close to pipelines, fume exhaust, etc. There is a very high presence of commercial activities in these two areas which consequentially means there is indiscriminate refuse dumping daily as shown by series of pipeline vandalization in these two locations which makes oil get spilled into the river bodies, hence, increase the metal pollution rates in these areas.

Figure 1**:** Ipaja, river sampling site,Alimosho, Lagos State, Nigeria

Figure 2:Aboru river sampling site, Alimosho, Lagos State, Nigeria

2.2 Sampling Procedure

Three different points were randomly selected along the river where pollution sources were identified based on their proximity to pollution sources. Sample collections were done very early in the morning at three different times from the two rivers. Sampling was carried out thrice at different durations form both rivers making a total of 6 samples. The first samples were collected in October 2021 and the second round of samples in December 2021 while the third round of samples were collected in February 2022. Nitric acid was introduced into the samples at the point of collection in other to prevent degradation of the analytes of interest in the samples. All samples were properly labeled and taken to the laboratory, kept in the refrigerator regulated at 4 ^{0}C prior analysis.

2.2.1 Digestion

10ml of each water samples were introduced into conical flasks labeled A and B from Ipaja and Aboru rivers.5ml of nitric acid (HNO_3) was added and stirred evenly and then to the hot plate for heating in the fume cupboard until a tick brown fume was observed.

2.2.2 Analysis

Samples were left to cool, filtered into a 50ml volumetric flask in which distilled water was then added to mark and finally taken for quantification using Atomic Absorption Spectrometry (A.A.S)Bulk Scientific Model (VGR).

III. Results and Discussion

The heavy metal analysis presented in Figure 3 showed that Iron (Fe) has the highest concentration (ppm). This means Fe was present in large quantities in both Aboru river and Ipaja river followed by Zinc (Zn), Lead (Pb), Nickel (Ni) with Cadmium (Cd) being the least in value. The increasing order isFe> Zn >Pb> Ni > Cd.

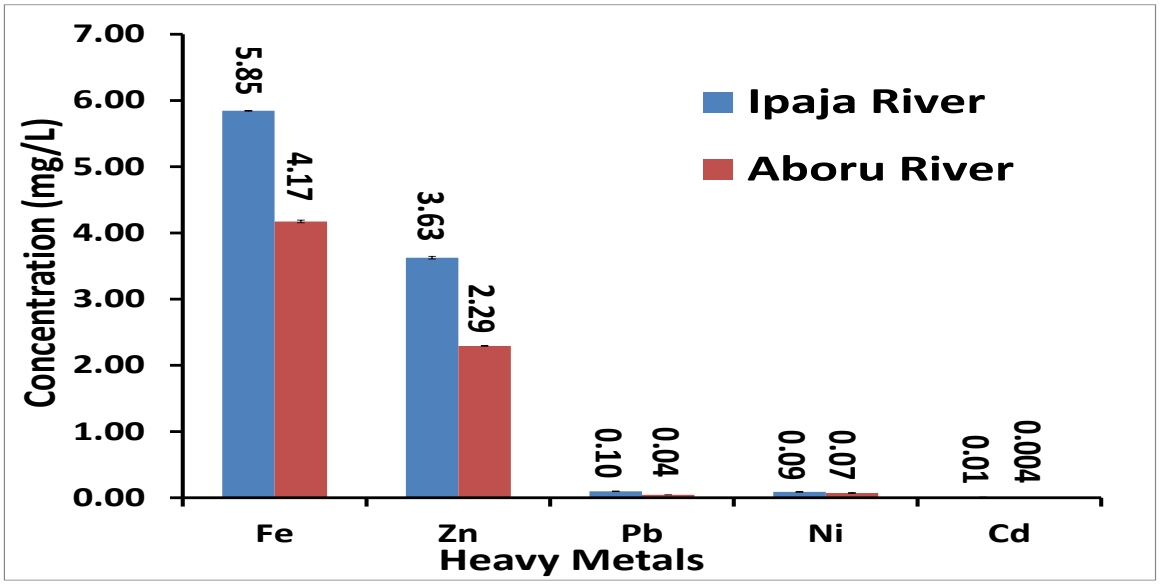

Fig 3: A bar chart showing the comparison of the heavy metals present in both rivers. n = 3

The toxic heavy metal composition in the water samples collected from both rivers shows that Ipajariverhas higher concentrations of heavy metals than Aboruriverwhen compared together. This consequentially means that Ipajariveris more polluted in metal toxicity than Aboruriver. The concentrations of all the toxic metals (Fe, Zn, Pb, Ni and Cd) present in Aboruriver were found to exceed the World Health Organization permissible limits as their concentration in ppm were greater than the national standards of 3.0 ppm for Fe, 3.0 ppm for Zn, 0.05 ppm for Pb, 0.07 ppm for Ni and 0.003 ppm for Cd [20]. The case is rather different for Aboruriver as some of the toxic metals were found to be lower than the World Health Organization permissible limits while the others higher. Fe, Ni and Cd were found to be in higher concentrations above the limits while Zn and Pb were discovered to be below the National standards meaning Zn and Pb are in permissible limits.

IV. Conclusion

The result of this study showed a higherconcentration of heavy metals in the Ipajariverrelative to river Aboru.Anthropogenic factorandre-occurring incidence of oil spillage are the dominant factorsaffecting the concentrations of heavy metals in both Ipajariver and Aboruriver.Thehigh level of iron in Ipajariver and Aboruriver were generally, above W.H.O. permissible standards. This is a clear indication of pollution.

There is a need to keep the concentration of the heavy metals in these rivers low and in-check so that they don't find their way to the food chain because heavy metals are dangerous to the health when ingested. There is need for proper treatment of water from these rivers before usage. Industrial effluent also should be properly treated before disposal. Results of this study can serve as a baseline environmental data benchmark for monitoring build-up of heavy metals in rivers.

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