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Research Paper

Determination of Heavy Metal, Cadmium, Iron, Lead, Mercury, Tin, Nickel and Vanadium in Four Different Water Samples in Bayelsa Metropolis

Ezomoh, O. O., Azikiwe Samson, Sunday Blessing Egwonu, Okemmadu Anastesia Chiamaka
Department Of Biochemistry, Niger Delta Univesity, Wilberforce Island
Department Of Biochemistry, P.M B. 071
Corresponding Author: Ezomoh, O. O

ABSTRACT: *Industrial effluents discharged into the environment pose a serious threat to our agricultural products, aquatic organisms and health. In view of this, levels of some heavy metals, Cd, Fe, Pb, Hg, Sn Ni and V were determined in water samples collected from four pollution prone areas around Bayelsa (Swali, Amassoma, Tombia and Otuokpoti rivers and control site (Niger Delta University). The levels of heavy metals were determined by atomic absorption spectrophotometry. The results obtained shows that the mean values of all heavy metals in water samples from the polluted areas studied were significantly higher than in the control site (P< 0.05). These mean values have also exceeded the acceptable limits.*
KEY WORDS: *Heavy Metals, Pollution, Bayelsa, Environment.*

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I. INTRODUCTION

Trace elements of natural origin are transported by rivers and transferred to the coastal marine system through estuaries. There, trace elements are distributed between the dissolved and particulate phase. Which their fate and bioavailability depend on the particle chemistry and competition between surface and dissolved forms in terms of complexation process. Hence, the estuaries constitute a natural reactor in which heterogeneous process at the interface between dissolved phase and suspended particulate matter and constitute an important part of the trace elements geochemical cycles. The distributions and trace metals and their rate of reactivity vary greatly between estuaries, depending on environmental factors, such as hydrodynamic residence times, mining patterns and transport process, therefore, there is no universal pattern of trace metal behaviour in estuaries.

The ability of a water body to support aquatic life, as well as its suitability for other uses depends on many trace elements. Certain metals like Mn, Zn, and Cu present in trace concentrations are important for the physiological functions of living tissue and regulate many biochemical processes. Water pollution by heavy metals resulting from anthropogenic impact has caused serious ecological problems in many parts of the world. This situation is provoked by the back of natural elimination process for metals. As a result metals shift from one compartment within the aquatic environment to a great extent, including the biota, often with harmful effects.

River Water has been and is still been used for many purposes, which includes drinking, irrigation, animal farming, recreation and serves as habitat to numerous organisms. Therefore, the availability of good quality water is an indispensable feature for preventing diseases and informing quality of life (Oluduro and Adewoye 2007).

Thus the river water contains some types of impurities whose nature and amount vary with source of water. Among environmental pollutants, heavy metals are of particular concern, due to their potential toxic effect and ability to bio-accumulation in aquatic ecosystem (Censi, Spoto, Saiamo, Sprovieri and Mazzola, 2006). Increased urbanization and industrialization are to be blamed for an increased level of trace metals, especially heavy metals, in our water ways. Many dangerous chemical elements if released into the environment acculate in the soil and sediments of water bodies. Therefore, to reduce the accumulations of heavy metals monitoring and assessment of the heavy metal concentration has become a very critical area of study in recent years. The contamination of river water by heavy metals is a serious worldwide ecological problems in general and Ethiopia ecological problems in particular as some of them like Hg, Cd and Pb are toxic event at low concentrations, are non-degradable and can bioaccumulation through food chain. The contamination of river water is directly related to the water population. Therefore, there is need to continuously assess the quality of river, ground and surface water sources. These assessments are carried out by using spectroscopic technique known as atomic absorption spechophotometer (AAS). Atomic absorption spectrometry is an analytical technique that measures the concentrations of elements qualitatively and quantitative. If light of just the right impinges on a free, ground station, the atom absorbs the light as it enters an excited state in a process known as atomic absorption.

The presence of heavy metals in aquatic ecosystem has far-reaching implications directly to the biota and indirectly to man. They also cause irregularity in blood composition, badly effect vital organs such as kidneys and liver. Heavy metals including essential and non-essential elements have a particular significance in ecotoxicology, since they are highly persistent and all have the potential to be toxic to living organisms.

In Nigeria, the major sources of heavy metals pollutions are industrial effluents discharged non various processing industrial and multinational companies like shell (SPDC)., Agip, Cherron, etc. this increases the influx of metals, which can be transported by wind and water and thus become available to plants, animals and aquatic organisms. These heavy metals attain higher concentrations and accumulate in dangerous quantity in different plants parts, and finally pose serious health hazard to human beings and the animals through biomagnifications (Ray, 1992).

Heavy metals are elements having atomic weight between 63.545 and 200.5g (Kennish, 1992) and a specific gravity greater than four (Connel et al, 1984). The toxicity of these metals has also been demonstrated throughout history: Greek and Roman physicians diagnosed symptoms of acute lead poisoning long before toxicology became a science. Exposure to heavy metals has been linked with developmental retardation various cancers, kidney damage and even death (Abdulasis and Mohammed, 1997).

Industrial pollution seriously threatens the quality of resources and the environment in Kano. For instance, the deposition of refuse from food industries has been reported to have contaminated water from virtually all the boreholes in Bompai industrial estate (Egboka et al, 1989). The incidence of water discharge is possibly the biggest threat to city farming and has been identified as a major environmental hazard in the region (Tanko, 2002).

The term heavy metals refers to any metallic chemical or element that has a relatively high density of more than $5gkm^3$ and poisonous at higher concentration (Lenntech, 1998). Heavy metals are therefore referring to a chemical elements with a specific gravity of water. Heavy metals are natural components of the earth's crust, so they cannot be degraded or destroy. Heavy metals are dangerous because they tend to bio-accumulate. Bioaccumulation means an increase in the concentration of a chemical in biological organism overtime, compared to the chemical concentration in the environment (Lenntech, 1998).

There are about 60 natural occurring heavy metals, examples include mercury (Hg), Cadmium (Cd), Arsenic (As), Chromium (Cr), Thalium (Ti), lead (Pb), etc. and physiological functions and hence called nonessential biochemical elements (Alloyway, 1990). However, some heavy metals are beneficial to man, these may include copper (Cu), iron (Fe), manganese (Mn), zinc (Zn), cobact (Co), molybdenum (Mo), Selenium (Se). they are essential in maintaining the metabolism of the human body. Some of these elements are commonly found naturally in food stuffs, in fruits and vegetables and in commercially available in multination products. However, at high concentration they can lead to poisoning or causing metabolic abnormalities. Heavy metals may enter the body through contaminated water, inhalation of higher ambient air concentrations near emission sources, absorption through skin when they come in contact with humans in agricultural and in manufacturing pharmaceutical, industry or residential settings and intake through the food chain (Lenntech, 1998).

A wide range of human activities contributes to the heavy metal pollution of the aquatic environment. The major activities include industrial processing (chemical metal, alloys, chloro alkali and petroleum), mining and ore processing, coal and fuel combustion, agriculture (fertilizers, pesticides and herbicides), domestic and agricultural effluents, transportation (urban and motor runoffs) and nuclear activities. Also heavy metal input can be from atmospheric fallout, leaching, or dumping from the lithosphere or direct into the aquatic system (including rivers, lakes, estuaries and oceans) (Ward, 1987).

II. MATERIALS AND METHODS

A total of four samples (water) where collected in Swali river, Amassoma river, Tombia river and Otuokpoti river, yenagoa L.G.A, Ogbia L.G.A and southern Ijaw L.G.A, Bayelsa state.

The samples which are fresh water, in four different communities of Bayelsa state. The samples were labeled and separated respectively. The water samples were digested as follows. A volume of the sample (100 cm^3) was transferred into a beaker and 15ml concentrated HNO_3 added and covered with watch glass and returned to the hot plate. The heating was continued, and then 0.2ml of HNO_3 was added until the solution appeared light coloured and clear. The volume was adjusted to $100cm^3$ with distilled water. All the digested samples were sub-sampled in pre-cleaned borosilicate glass container for atomic absorption spectrophotometer analyses

Metal Analysis

The samples that were analyzed include tin, vanadium, cadmium, nickel, mercury, iron and lead. Solution of 1.2, 0.4, 0.6, 0.8 and 1.0mg/L were made from each of the metal solution, of 1000mg/L stock solutions of the analysts. The set of standard solutions and the filtration of the digested samples were analyzed by AAS. The detection limit of the metals in the samples was 0.0001mg/L by means of the UNICAM 929 London, Atomic Absorption spectrophotometer powered by the SOLAAR SOPEWARE. Tin, vanadium, cadmium, Nickel, Mercury, Iron and Lead cathode lamps were for the analysis of the respective metal ions in the standards and the filtrate of the samples.

III. RESULTS

The results of analysis of heavy metals are cadmium (Cs), Iron (fe), Lead (pd), Mercury (Hg), Tin (Sn), Nickel (Ni) and Vanadium (V). Samples collected from Swali, Amassoma, Tombia and Otuokpoti river, Bayelsa state .

Table 3.1: Heavy metals concentration (mg/L) in Swali< Amassoma, Tombia and Otuokpoti river (concrol)

S/N	SAMPLES	Cd	Fe	Pb	Hg	Sn	Ni	V
1	Swali river	0.009 ± 0.001	0.737 ± 0.067	0.207 ± 0.006	0.002 ± 0.001	0.001 ± 0.001	0.060 ± 0.005	0.020 ± 0.007
2	Amassoma river	0.911 ± 0.001	0.737 ± 0.059	0.235 ± 0.059	0.002 ± 0.001	0.008 ± 0.001	0.063 ± 0.006	0.016 ± 0.002
3	Tombia river	0.009 ± 0.001	0.542 ± 0.011	0.165 ± 0.009	0.001 ± 0.000	0.007 ± 0.001	0.05 ± 0.006	0.016 ± 0.002
4	Otuokpoti river	0.002 ± 0.600	0.001 ± 0.001	0.002 ± 0.004	0.002 ± 0.058	0.003 ± 0.001	0.001 ± 0.001	0.001 ± 0.000

The table values are mean ± SD of triplicate determinations. Values with different superscripts on the same column are statistically different ($P<0.05$). SUPERSCRIPTS (A,B,C,D), indicates standard deviation.

IV. DISCUSSION

Table 3.1 in the result section is the summary of the measured concentration for the heavy metals in the sample under review.

Differences were observed in the four samples, such remarkable variables may suggest that the samples may either have different degree of exposure to heavy metals. .

The total concentration of cadmium (Cd) are as follows; Swali 0.009 ± 0.001mg/kg, Amassoma 0.911 ± 0.001mg/kg, Tombra 0.009 ± 0.001mg/kg, while that of Otuokpoti 0.002 ± 0.600mg/kg respectively. The variation may be due to their nature of existence or the degree of pollution in the environment. The metal cadmium (Cd) is accumulated more eat the sediment, and it was observed that the concentration of cadmium in Amassoma sample is higher, 0.911 ± 0.001mg/kg, followed by Swali and Tombia samples are the same in concentration 0.009 ± 0.001mg/kg, the least concentration of cadmium metal 0.002 ± 0.600 mg/kg.

The total concentration of Lead (Pb) also varies in the different samples that were analysed are Swali, 0.207 ± 0.006mg/kg, Amassoma 0.235 ± 0.059 mg/kg, Tombia 0.165 ± 0.009mg/kg and Otuokpoki 0.002 ± 0.004mg/kg. the variation may be due to the level of contamination of the environment. The metal lead is accumulated more and it was observed that the concentration of lead in Amassoma sample is still higher, 0.235 ± 0.059mg/kg, Swali, 0.207 ± 0.006mg/kg, Tombia 0.165 ± 0.009mg/kg and Otuokpoti 0.02 ± 0.004mg/kg.

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