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RESEARCH ARTICLE

An Evaluation of the Levels of Fe, Ag, Mn and Co in Fish, Sediments and Water from Adada River

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Abstract

This study was carried out to determine the concentration of Fe, Co, Mn and Ag in the fish, sediment and water from Adada River. The result thus obtained showed the hierarchal arrangement of the heavy metal from the locations. Akpugo Fish (Fe>Mn>Ag>Co, Sediments Fe>Mn>Co>Ag and Water Co>Ag>Mn=Fe, Aku Fish Fe>Mn>Co>Ag. Sediments Fe>Mn>Co>Ag and Water Ag>Co>Mn=Fe, Lejja Fish Fe>Mn>Co>Ag. In the sediments Fe>Mn>Co>Ag and water Ag>Co>Mn=Fe. The result indicates that these heavy metals studied were all detected in sediments, fish and water except that there was complete absence of Mn and Fe in all water collected from the three sites. This suggests pollution of the river which may pose a threat to the aquatic organism.

Keywords: *heavy metals, sediments, manganese, cobalt, iron, silver.*

Introduction

The water bodies and every one of its inhabitants are inclined to unpredictable contamination of their current circumstances (Nitasha and Sanjiv, 2015). This contamination accordingly has come about to the amassing of a few heavy metals in the water, silt, and sea-going life forms too. The water bodies and every one of its occupants are exposed to contamination through diverse sources including sewage. This modern waste could contain radioactive substances along with heavy metals which pollute the water bodies (Jessica *et al*., 2020). River unloading, agricultural pollution such as horticultural cycles, removal of sheep plunge, utilization of pesticides, manures and herbicides can cause pollution of water bodies as they spill over into water bodies during precipitation. Oil Pollution is the majour drivers of oil-related water contamination comes through leakage from oil capacity pipes. The unpredictable release of modern as well as homegrown wastewater into the sea-going climate has represented a significant issue bringing about the gross water contamination (Dibofori-Orji and Marcus, 2012). Heavy metals are poisonous to the stream as a result of their moderately high harmful impact and collection in the climate. The contamination of amphibian creatures by heavy metals and progressive take-up in the sea-going pecking order has a high risk to the human populace (Obaroh *et al*., 2015).

Heavy metals are characterized as metallic components that have a somewhat high thickness contrasted with water (Fergusson, 1990). With the presumption that weight and harmfulness are related, heavy metals likewise include metalloids like arsenic that can prompt toxicity at a low degree of exposure (Duffus, 2002). Heavy metals such as copper, iron, chromium, and nickel are fundamental metals since they assume a significant part in natural frameworks, whereas cadmium and lead are trivial metals, as they are harmful, even in follow sums (Fernandes *et al*., 2008). For the typical digestion of the fish, the fundamental metals should be taken up from the water, food, or silt (Canlı and Atlı, 2003). These fundamental metals can likewise deliver harmful results when the metal admission is unreasonably raised (Tüzen, 2003). The heavy metals that have amassed in fish or other oceanic life forms, or broke up in the water in this way become by implication brought into man either using the water or the utilization of the amphibian organic entities. These heavy metals have been related to so many medical conditions neuropsychological issues, kidney issues, and other various medical issues. Consequently, it is exceptionally important to decide the level of these heavy metals present in the water, dregs, and the oceanic life forms to find out the effect of the modern, business, and human exercises on the climate and afterward the conceivable well-being results on man (Ujah *et al*., 2017).

The water bodies house a series of amphibian life forms going from oceanic animals, plankton, fish, jellyfish, sharks, whales, octopus, barnacle, ocean otters, crocodiles, crabs, dolphins, eels, beams, mussels, to aquatic plants: water hyacinth, water lettuce, water greenery, duckweed, water lilies, and water grass. Sediments assume a significant part in deciding the contamination example of the oceanic framework. It goes about as both transporter and sinks for toxin, mirroring the historical backdrop of contamination and giving a record of catchment input into the sea-going environment (Egborge, 1991). Sediments are a mix of various constituents of inorganic parts and natural remaining parts of which heavy metals are essential for their organization, which are released into the climate (Venktesha *et al*., 2012). Since, sedmients as any particulate matter that can be moved by the liquid stream and which at last is kept as a layer of soil particles on the bed or lower part of a waterway or other fluid, the metals are non-biodegradable and when released into water bodies. They can either be adsorbed on particles or collected in oceanic creatures (Guan *et al*., 2014).

Adada waterway is one of the streams that move through the significant rice creating areas of Uzo-Uwani Local Government Area of Enugu State and Omor in Anambra State. In Enugu, it is arranged in Ezeagu and it's the area in the guide 6° 28' 18" N • 7° 4' 38" E The region falls inside Eastern Nigeria's fourth climatic zone (Inyang, 1975). The point of this work was to find out the heavy metals focuses (Co, Fe, Mn, and Ag) in water, sediments, and fish from the Adada stream branches at Akpugo, Leja, and Aku all in Enugu State.

Methods

Collection of water and sediment samples

The water and sediment samples were collected from the sampling location by submerging the sample bottle at about 0.5ft below the water surface and transferring the water into stopper bottle which is metal free.

Collection of the Fish

The fish samples were collected using cast nets which were thrown by the fisher men and withdrawn by the means of line attached to its opening. The fish caught by the net were collected, washed, weighed and preserved in refrigerators for a day before analysis. The fishes were brought out and the flesh extracted.

Determination of heavy metal concentrations in the water sample

The digest of the test sample was assayed for the presence of heavy metals using atomic absorption spectrophotometer spectra AA model number 240FS under the appropriate wavelength and detection limit for each heavy metal. The process of sample analysis involves the following, placing the diluted extracts on the bench. The atomic absorption spectrophotometer machine was switched on and set to the required wavelength which is determined by the heavy metal being assayed. The appropriate lamp which is determined by the heavy metal was placed in the appropriate place in machine. A tube from the machine was inserted into the instrument. The machine was then set to take the absorbance as well as the concentration which is displayed on the screen at the front of the machine.

Results

Table 3.1: Concentrations of Co, Mn, Fe and Ag in Fish, Water and Sediments at Akpugo

Heavy Metals	Fish	Water	Sediments
Co	0.219 ± 0.059	0.084 ± 0.004	0.397 ± 0.115
Mn	1.025 ± 0.583	0.000 ± 0.000	1.144 ± 0.641
Fe	4.360 ± 0.332	0.000 ± 0.000	46.99 ± 9.984
Ag	0.347 ± 0.118	0.544 ± 0.068	0.347 ± 0.285

Table 3.2: Concentrations of Co, Mn, Fe and Ag in Fish, Water and Sediments at Lejja

Heavy Metals	Fish	Water	Sediments
Co	0.311 ± 0.006	0.090 ± 0.000	0.355 ± 0.145
Mn	1.802 ± 0.034	0.000 ± 0.000	1.586 ± 0.328
Fe	3.251 ± 0.452	0.000 ± 0.000	47.94 ± 10.656
Ag	0.085 ± 0.067	0.730 ± 0.063	0.212 ± 0.380

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Table 3.3: Concentrations of Co, Mn, Fe and Ag in Fish, Water and Sediments at Aku

Heavy Metals	Fish	Water	Sediments
Co	0.378 ±0.053	0.099 ± 0.006	0.916 ± 0.251
Mn	2.715 ± 0.612	0.000 ± 0.000	3.433 ± 0.978
Fe	4.064 ± 0.123	0.000 ± 0.000	3.687 ± 20.365
Ag	0.102 ± 0.055	0.660 ± 0.014	0.604 ± 0.103

Discussion

The concentration of heavy metals in the different mediums: water, fish and sediments are presented in table 3.1-3.3 with complete absence of Fe and Mn in water from the three sites Akpugo, Aku and Lejja.

From the results obtained from the three sites, cobalt in fish were in the order aku>Lejja>Akpugo. Cobalt in water, Aku>Lejja>Akpugo and cobalt in sediments was Aku>Akpugo>Lejja. Cobalt was obtained in fish in low concentration. Cobalt enters the environment from natural sources and the burning of coal or oil or the production of cobalt alloys. In the air, cobalt will be associated with particles that settle to the ground within a few days. Cobalt released into water or soil will stick to particles. Some cobalt compounds may dissolve. Cobalt cannot be destroyed. It can change form or attach to or separate from particles (ASTDR, 2004). Cobalt alongside Fe and Mn are some heavy metals that are referred to as redox active metals that can damage cells by indirectly generating ROS by up-regulating Haber-Weiss and Fenton reaction (Valko *et al*., 2005). This may have been accounted for by the fact that cobalt is constituted of vitamin B12 (Cobalamin) required by animals (Oduwole, 1997). Cobalt deficiency causes nutritional defects, while its presence in fish body at high concentration, beyond nutritional requirement, poses toxic concentration as means of poisoning (Obasoham, 2008). Exposure to high levels of cobalt can result in lung and heart effects and dermatitis. Liver and kidney effects have also been observed in animals exposed to high levels of cobalt. Exposure to large amounts of radiation from radioactive cobalt can damage cells in your body from the radiation. You might also experience acute radiation syndrome that includes nausea, vomiting, diarrhea, bleeding, coma, and even death. This would be a rare event (ASTDR, 2004).

Manganese was not detectable in water but manganese was detected in fish and sediments. The concentration of manganese was higher in sediment compared to fish in Akpugo. Manganese was higher in fish than sediment in Lejja. Also, manganese was higher in sediments than fish in Aku. The values of the concentration of manganese in fish from the three sites were below WHO (1995) standard of 1.0 mg/Kg. Manganese compounds exist naturally in the environment as solids in the soils and small particles in the water. Manganese particles in air are present in dust particles. These usually settle to earth within a few days. Humans enhance manganese concentrations in the air by industrial activities and through burning fossil fuels. Manganese that derives from human sources can also enter surface water, groundwater and sewage water. Through the application of manganese pesticides, manganese will enter soils. For some animals the lethal dose is quite low, which means they have little chance to survive even smaller doses of manganese when these exceed the essential dose. Manganese substances can cause lung, liver and vascular disturbances, declines in blood pressure, failure in development of animal foetuses and brain damage. In plants manganese ions are transported to the leaves after uptake from soils. When too little manganese can be absorbed from the soil this causes disturbances in plant mechanisms. For instance, disturbance of the division of water to hydrogen and oxygen, in which manganese plays an important part.

Iron was not detectable in water but highest in sediment from (Lejja) than the fish from (Akpugo). Iron is an important chemical element for many organisms that is vital for the survival at low concentrations. Iron is the tenth most abundant element in the universe, the most abundant (by mass, 34.6%) element making up the earth. Iron is found in various iron oxides, such as the minerals hematite, magnetite, and taconite. Iron is essential to almost living things, from micro-organisms to humans. Iron can be found in meat, whole meal products, potatoes and vegetables. The human body absorbs iron in animal products faster than iron in plant products. Iron is an essential part of hemoglobin; the red colouring agent of the blood that transports oxygen through our bodies. Iron may cause conjunctivitis, choroiditis, and retinitis if it contacts and remains in the tissues. Chronic inhalation of excessive concentrations of iron oxide fumes or dusts may result in development of a benign pneumoconiosis, called siderosis, which is observable as an x-ray change. A more common problem for humans is iron deficiency, which leads to anaemia. Iron is essential for many metabolic processes such as oxygen transport, DNA synthetic, electron transport and cofactor for many proteins. (Bury and Grosell, 2003). Iron could be very toxic resulting to mortality of juvenile fish at higher concentration (Tainara *et al*., 2019). Iron (III)-O-arsenite, pentahydrate may be hazardous to the environment; special attention should be given to plants, air and water. Iron is one of the persistent environmental chemicals.

Silver (Ag) was seen to be highest in water compared to fish and sediment of all the three studies sites. The Ag concentration obtained in water gave: 0544$\pm$0.068, 0.730$\pm$ 0.063, 0.660$\pm$0.014 for Akpugo, Lejja and Aku respectively. The location with highest concentration in water is Adada(Lejja). Silver seen in Akpugo increases in this order: water> sediments> fish; silver in Lejja water>sediments>fish and silver in Aku increases in this order water>sediments>fish.

Silver nanoparticles, ions and chlorides have been shown to inhibit autotrophic nitrifying bacterial growth (Choi *et al*., 2008). Within toothpaste, Ag+ ions have been shown to have a stronger effect on gram-negative bacteria than on gram-positive bacteria (Junevičius *et al*., 2015). Once AgO enters the environment, it is oxidized to Ag+ (Su-juan *et al*, 2015). Of the potential species formed in seawater, such as Ag_2S and Ag_2CO_3, AgCl is the most thermodynamically favored due to its stability, solubility, and the abundance of Cl^- in seawater. Ag dissolves more in solution when the pH is low and resulting in bleaching. This effect, coupled with ocean acidification and increasing coral reef bleaching events, leads to a compounding effect of Ag accumulation in the global marine ecosystem (Su-juan *et al*, 2015). These free formed Ag+ ions can accumulate and block the regulation of Na^+ and Cl^- ion exchange within the gills of fish, leading to blood acidosis which is fatal if left unchecked. Additionally, fish can accumulate Ag through their diet. Phytoplanktons, which form the base level of aquatic food chains, can absorb and collect silver from their surroundings (Fabrega et *al*., 2011). As fish eat phytoplankton, the silver accumulates within their circulatory system, which has been shown to negatively impact embryonic fish, causing spinal cord deformities and cardiac arrhythmia (Fabrega *et al*., 2011) The base of complex food webs consists of microbes, and these organisms are most heavily impacted by nanoparticles (Fabrega *et al*., 2011). These effects cascade into the problems that have now reached an observable scale.

Conclusion

This study showed that sediments, fish and water from Adada River at the various sampling locations are contaminated by heavy metals analyzed. This contamination could be as a result of agricultural and commercial activities which directly or indirectly channeled the heavy metals to the water bodies.

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