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Metal Accumulation in Some Tissues/Organs of a Fresh Water Fish (Clarias Gariepinus) from Some Polluted Zones of River Kaduna

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Abstract
Heavy metal accumulation in the liver, gills, muscles, bone and whole fish of *Clarias gariepinus* collected from some industrially polluted zones (stations) of river Kaduna was investigated. The highest concentration of metals was recorded in the gills and liver. Iron, Zinc and Manganese were generally high in all the organs and tissues and also in the stations. Cadmium was absent in all the organs/tissues in stations 3 & control while chromium was absent in all the organs/tissues except the muscle and liver in stations 1 & 2 and bones in station 3
Key words: Heavy metals, Fish organs/tissues, River Kaduna.

Introduction

Industrialization is considered vital to the nation's socioeconomic development as well as its standing in the international community. Most of the environmental pollution problems arise from anthropogenic sources mainly from domestic and industrial activities. Though water pollution is an old phenomenon, the rate of industrialization and consequently urbanization has exacerbated its effect on the environment (Javeed, 1999, Asonye *et al*, 2007). Although undesirable and costly, pollution is an inevitable and necessary part of life for most of the world's population especially in large communities.

A critical problem of developing countries is improper management of vast amount of waste generated by various anthropogenic activities and the unsafe disposal of these wastes into the ambient environment. This has rendered these natural resources or water bodies unsuitable for both primary and secondary usage (Fakayode, 2005). Aquatic environment is constantly polluted from a variety of sources and presently it has assumed a dangerous proportion for aquatic life and fish species are no exception. Water pollution in Nigeria occurs in both rural and urban areas. Many factories in Nigeria are located on river banks and use the rivers as open sewers for their effluents. A significant proportion of the Nigerian populations still rely on this surface water for drinking, washing, fishing and swimming.

River Kaduna serves as a sink for all industrial effluents in Kaduna city making it one of the most polluted inland waters in Nigeria (Beetseh 1982). This river receives about 500,000 cubic meters of untreated effluent per day from various industries through 53 tributaries (Ali *et al,* 2005). The current demand for fish food in Nigeria is estimated at little over 1 million tones per annum as against a supply of about 800,000 tones per annum (West, 1982). Aquatic organism especially fish readily absorbs heavy metals from abiotic environment. Heavy are stable and persistent in environmental contaminants of both fresh and marine waters (Yousafzai et al 2009). The toxic effects of heavy metals on fish are multi-directional and manifested by numerous change in the physiological and chemical process of their body system. Accumulation of metals in various organs of fish may cause structural lesions and functional disturbances (Jezierska and Witeska, 2001). A survey of heavy metals toxicity shows that heavy metals cause several hematological and biochemical disorders on aquatic organisms (Vasyliene 1999, Shah 2006).

Humans and other animals are exposed to chemicals through water, soil, air and their diet. The survival of man according to Ambasht and Ambasht (2005) depends on how judiciously he manages the earth and maintains the quality of his overall environment. WHO (2003) has attributed the current short life expectancy in Nigeria to exposure to heavy metals. Failure to halt further deterioration of the environmental quality might jeopardize the health of a large proportion of the population resulting in serious political and socio-economic implications (Anokam 1997).

Clarias gariepinus is a conspicuous member of the fresh water fauna of the tropics (FAO 1991). It is common in Nigerian fresh waters and in the catches of fishermen in Kaduna. Since aquatic organisms readily absorb heavy metal from the abiotic environment (Goel, 2006) this work aims at studying the heavy metals content of a Nigerian fresh water food fish *C. gariepinus* in the Kaduna River.

Materials and Methods

Specimen of *Clarias gariepinus* were obtained from local fishermen who fished along the course of river Kaduna. Fishes were collected from four locations (stations) along the course of the river namely:

a. At about 50 meters downstream from the point of discharge of the combined effluents of united Nigeria Textiles limited (UNTL), Kaduna textile limited (KTL) and Nigerian breweries limited (station 1).
b. About 200m downstream from the point of discharge of the combined effluents of UNTL, KTL and NBL (station 2).
c. About 2000m downstream from the point of discharge of the combined effluents of UNTL, KTL and NBL (station 3).
d. About 5000m upstream from the point of discharge of the combined effluents of UNTL, KTL and NBL (control).

The point of discharge of the combined effluents had no fish. The fish were identified and the length and weight measurements were taken in each station. Each whole fish was weighed. The fishes were then dissected and in each liver, gill, bone and muscle was removed and weighed in a crucible of known weight. The samples were oven dried to a constant weight and ashed in a muffle furnace at a temperature of 425°C. The ash obtained from the sample in each station was digested separately. The ash obtained was cooled and dissolved in 18.0 ml acid solution (mixture of conc. HNO3, conc. HCl and 30% H2O2 in a ratio of 15.0:2.5:0.5). Un-dissolved carbon was filtered off and the remaining solution diluted to 100.0 ml with de-ionized water. This was followed by analysis with UNICAN 919 atomic absorption spectrophotometer (AAS) using 1.0% HNO3 as blank. The metal concentration was read from a standard curve.

Result

The result of the analysis of variance of the Heavy metals in the liver, gill, muscle, bone and whole fish in the different stations are shown in table 1. The result shows that there was no significant difference ($P > 0.05$) between the levels of the metals in the control with that of the different stations. In station 1, the liver accumulated more Zinc, Iron and Chromium while the Gills accumulated more Iron, Zinc and Magnesium (Figure 1). In station 2 there was more Iron, Chromium and Zinc in the liver While the Gills accumulated more Iron, Zinc and Copper (Figure 2). Figure 3 showed that there was more Iron, Zinc and Copper in the Liver while the Gills accumulated more Iron, Zinc and Manganese in station 3. In the control (figure 4) the liver accumulated more Iron and Zinc while the Gills also accumulated more Iron and Zinc

Cadmium was found to be absent in nearly all the tissues or organs in station 3 and control while Chromium was absent in all the tissues/organs in all the stations except for the muscles and liver in stations 1 and 2 and bone in station 3.

Discussion

Water bodies are the ultimate recipient of waste generated by industries and domestic homes. There was presence of heavy metal in the tissue of fish in each Station; this might be attributed to the presence of heavy metals from the industrial and domestic effluents or waste in water. According to Odiette (1977), contaminants are introduced into aquatic ecosystems through many routes such as industrial, domestic, municipal run offs and leachates. This waste water from industries contains a variety of pollutants ranging from organic pollutants to metals. Although many of these metals are essential for the growth of organisms at lower concentrations, yet they are essentially poisons when their concentrations exceed beyond certain level. These elevated levels of heavy metals in the water can be attributed to both natural, industrial and anthropogenic sources. Gelderiech (1990) had reported that effluent generated by various processes in factories and discharged untreated into nearby water bodies may affect water quality and may result in dramatic changes in the chemical quality of the water. In the Ijaw areas of Delta state in Nigeria, Gbaruko and Friday (2007) had reported accumulation of heavy metals such as mercury, lead, zinc, copper and nickel in the fauna and flora. Since fishes live in close contact with and are dependent on aquatic environment, effect of the pollutants in water may be acute or chronic on the fish. Iron, zinc and manganese were high in all the organ/tissuess especially liver and Gills in all the stations. Beetseh (1982) had indicated high level of zinc and cadmium in some effluent of industries in kaduna. There was presence of heavy metals in the control, faraway upstream from the point of entry of the industrial effluents. This could have been from the organic materials from run offs from the surrounding farms. According to Goel (2006), runoffs from urban areas during the rainy season are rich in certain heavy metals such as copper, chromium and zinc. This mixture of organic materials and heavy metals could affect

the ecosystem. Similar observations have been made by kenawy and Hamza (1999) who reported that mixture of organic materials and heavy metals resulted to high toxicity which affected the ecosystem drastically. The concentration of metals in the organs was nearly similar in all the stations. It seems plausible to suggest that, this was why fish from these stations accumulated similar heavy metals. The liver and gills were seen to accumulate more heavy metals than the muscle, bone and the whole fish. Metal accumulation by the liver could be due to its functions such as detoxification. Alloway and Ayres (1994) had reported that in humans and higher animals, metabolic conversion of compounds not essential for normal biological functions takes place mainly in the liver. The gills are the first point of contact with water during respiration Goel (2006) had observed that fish and other organisms that respires through the gills can absorb metals through their respiratory surfaces. The removal of the gills and liver could be responsible for the lower metal burden in the whole fish. Similar observations had been made by Onwumere and Oladimeji (1990).

Conclusion

The natural level of heavy metals are usually harmless to the organism but pollution from industrial effluents, agricultural chemicals and the direct contamination of river Kaduna with untreated wastes if not proactively addressed could eventually turn the affected area of the river to biologically dangerous ones.

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Table 1: Analysis of Variance of the different Metals between the control and the different stations

Stations	Ca	Mg	K	Na	Fe	Mn	Cd	Zn	Cu	Cr
Control	0.85± 0.42	0.06± 0.02	1.71± 0.29	0.69± 0.17	303.20± 108.40	44.67± 21.90	5.26± 4.94	196.77± 133.40	4.45± 1.98	2.28± 2.28
Station 1	0.70± 0.35	0.04± 0.01	1.29± 0.23	0.49± 0.13	127.80± 36.65	15.14± 5.38	0.88± 0.88	80.69±4 7.48	2.97± 1.55	10.26 ±8.77
Station 2	0.83± 0.36	0.03± 0.00	4.56± 1.67	0.94± 0.44	293.20± 61.43	23.44± 14.23	11.42 ±4.56	108.20± 58.94	11.94 ±4.83	8.60± 5.99
Station 3	0.80± 0.26	0.06± 0.01	1.82± 0.44	0.76± 0.17	420.40± 134.85	14.23± 1.12	0.00± 0.00	106.70± 29.33	9.90± 6.06	0.00± 0.00

(All Values Expressed as Mean±Standard Error of Mean)

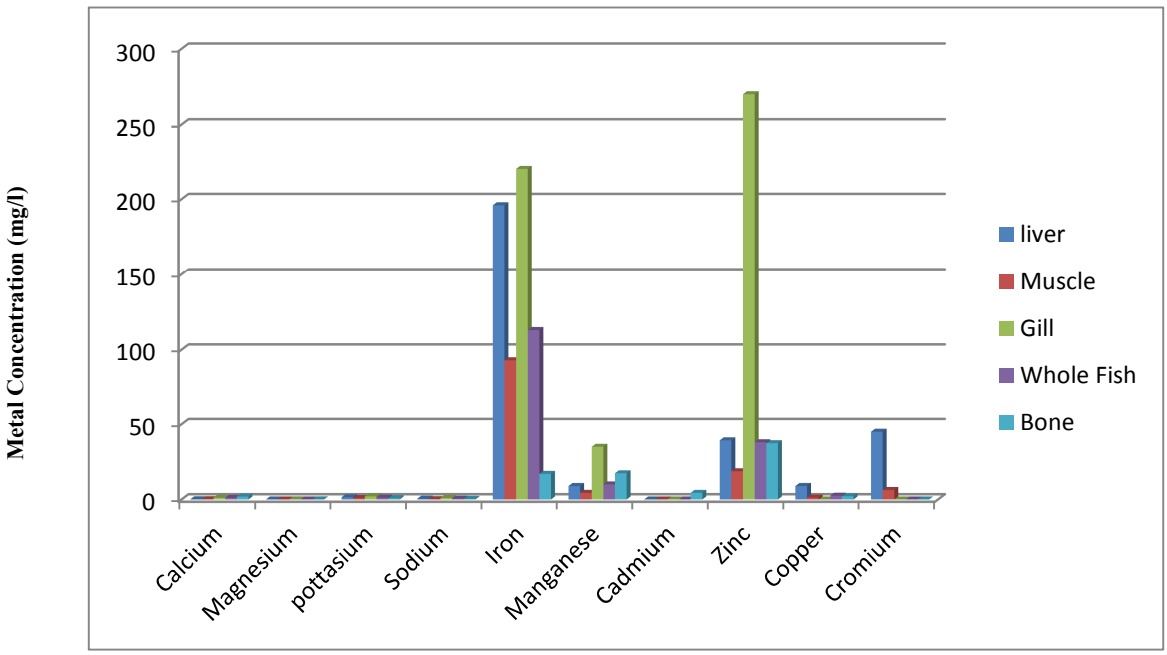
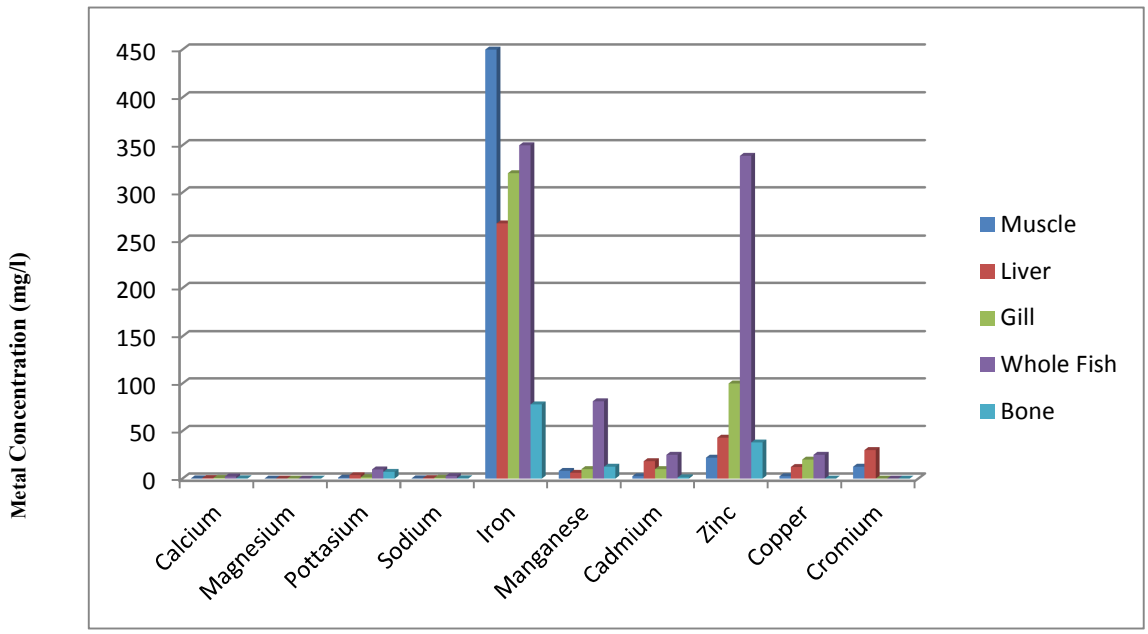
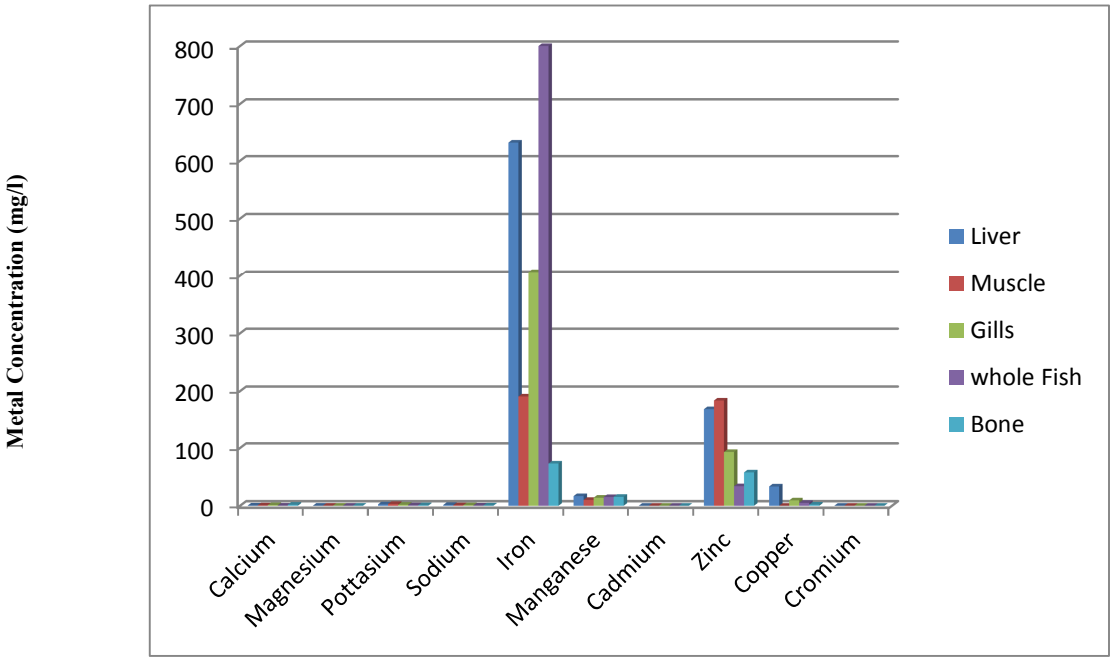


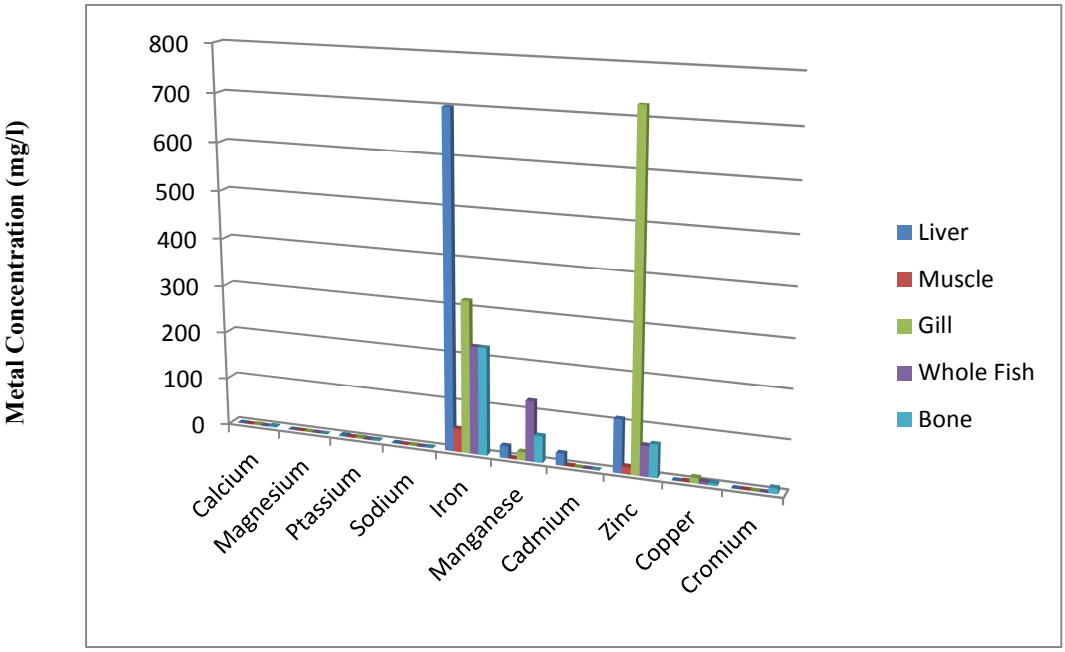
Figure 1: Metal Accumulation in Tissues of Fish (Station 1)



Metal Accumulation in Tissues of Fish (Station 2)



Metal Accumulation in Tissues of Fish (Station 3)



Metal Accumulation in Tissues of Fish (Control)

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