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Heavy Metals Concentration in Selected Fish Species from River Dandaru, Ibadan, Oyo State, Nigeria.

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Abstract
Heavy metals concentrations (Lead, Cadmium, Zinc, Copper, Chromium, Manganese, Iron and Nickel) in selected fish species from river Dandaru reservoir, Ibadan, Oyo State, Nigeria. Three samples each of catfish (Clarias gariepinus), and tilapia (Oreochromis niloticus) were collected from river Dandaru Ibadan Oyo State and taken to the laboratory for heavy metal analysis. The soil sample at the bottom of river Dandaru as well as water sample from the river were also collected. Data obtained were subjected to Analysis of variance using SPSS Version 17.0. This study revealed that heavy metal concentration is significantly higher ($p < 0.05$) in soil sediments at the bottom of the river than in water sample, while those of the water sample are significantly higher than those of the fish samples. Most of the values obtained for heavy metals in this study exceeded the limit in the tissue of the fish proposed by Standard limits. It is hereby recommended that sources of heavy metals in river Dandaru should be checked and controlled by relevant authorities so as to mitigate the risk on humans due to consumption of the fish and other aquatic resources gotten from the river.

Key words: *Heavy metals, Cat fish, Tilapia, River Dandaru, Standard limits.*

Introduction

Heavy metals are defined as metallic chemical that have a relatively high density and are toxic or poisonous at low concentration (Connel, 1984). Living organisms require trace amounts of some heavy metals, including calcium, copper, iron, manganese, molybdenum, vanadium, stratum and zinc. However, heavy metals are also dangerous because they tend to bio-accumulate. The common heavy metals that are found in fish includes potassium, copper, chlorine, phosphorus, calcium, iodine, iron, zinc and manganese, mercury, lead and cadmium (Connel, 1984). Potassium, chlorine, phosphorus, calcium, iodine, iron, copper, zinc and manganese are essential metals, while, mercury, lead and cadmium chromium mercury lead arsenic, calcium and antimony are non-essential heavy metals of particular concern to surface water system. Industrial and agricultural activities were reported to be the leading potential source of the accumulation of pollutants in the aquatic environment including the sea (Freedman*, et al.,* 2002). The noxious wastes in the sea are potentially accumulated in the sediments and marine organism including fish consequently transfers them to human being through food chain (Tusen, 2003). Since, fish are highly consumed by human being and may accumulate large amount of some metals from the water, it is important to determine the concentration of heavy metals in commercial fish in order to evaluate the possible risk through fish consumption. Heavy metals affects fresh water organisms and induces certain harmful modifications at histological and morphological levels, also decreases

the growth and development rates resulting in increase of death rates and decrease the birth rate (Authman, 2008). Some heavy metals are essential for maintaining body growth, health, and reproduction in plants and animals while in excess, they could be poisonous and dangerous to human health through the ingestion of food and water due to the inherent toxicity of some heavy metals (Dura *et al.,* 2007). As heavy metals cannot be degraded, they are deposited, assimilated or incorporated in waters, sediment and aquatic animals (Dura *et al.,* 2007). Micro-organisms, microflora and algae are capable of incorporating and accumulating metal species into their living cells from various supply sources (Biney and Beeko, 1991). Heavy metals worldwide have shown to be harmful and toxic to the human body and constitute a major public health concern (Chovanec *et al.*, 2003). Some heavy metals acts as catalysts in oxidative reactions of biological macromolecules, therefore their intoxication may lead to oxidative tissue damage (Tusen, 2003). Toxic heavy metals can also bind to vital cellular structures or components such as proteins, enzymes and nucleic acids and interfere with functioning (Dura *et al.,* 2007). Moreover symptom and effects can vary according to metal or metal compound dosage hence long term exposure to heavy metals can have carcinogenic, central and peripheral nervous system and circulatory effects. Lead (Pb) may cause learning disabilities impaired protein and haemoglobin synthesis and shorten the life span of red blood cells which leads to severe anemia in children (Dura *et al.,* 2007). The most common toxic effects of cadmium (Cd) in human is renal failure accumulated in the bone resulting in calcium loss and malfunctioning of peripheral and central nervous system (Farkas, 2000). Although, fish can be effective in preventing (CVD) Cardio Vascular Disease, the fish found in waters with heavy metals may increase the incidence of some illness such as cancer (Caper and Yess, 1996). Therefore, the investigation of the heavy metals in fish becomes important to estimate freshwater pollution and the risk potential of human consumption.

Materials and Method

Three samples each of catfish (*C. gariepinus*), and tilapia fish (*O. niloticus*) from River Dandaru Ibadan Oyo State were bought from fish mongers at the landing site at about 6:30am, the fishes were collected into an ice box and transported to laboratory within 30 minutes for laboratory analysis. The soil sample at the bottom of river Dandaru as well as water sample from the river (where the fishes were caught) was also collected. Sample of the water body were collected in water sampling bottle using standard procedures described by Welz and Sperling (1999): the sampling bottles were conditioned by washing with detergent solution that is metal free and non-ionic and then rinsing it several times with distilled water. The sampling bottle was rinsed with the dam water first before the samples were finally collected. The heavy metal concentration of the fishes, water and sediment were analyzed in triplicate using Atomic Absorption Spectrophotometer.

Statistical Analysis

The data obtained was subjected to statistical analysis using SPSS Version 17.0. Analysis of variance (ANOVA) was carried out using F-test to determine the treatments level of significance, and treatment means were separated using Duncan Multiple Range Test (DMRT) at 95% confidence value ($p<0.05$).

Results and Discussion

Table 1 shows the heavy metal concentration (mg/l) in the fish species, and sediments sampled from river Dandaru Mokola, Ibadan, Oyo State Nigeria. Results indicated that heavy metal concentration is significantly higher ($p < 0.05$) in soil sediments at the bottom of the river than in

water sample, while those of the water sample are significantly higher than those of the fish samples. The study also revealed that the heavy metal concentration in both tilapia and catfish are almost the same except for Mn, Fe and Ni which are significantly higher in catfish than tilapia. This could be as a result of the different feeding habits exhibited by the two fish species i.e catfish is ominivorous while tilapia is herbivourous implying that heavy metals found on tilapia fish bioaccumulated from plant source only while that found in catfish bioaccumulated from both plant and animals in the water body. This agrees with the report of Farkas *et al.* (2000) who stated that the concentrations of mineral elements in fish body could be related primarily to their feeding habits. Ayeloja *et al.* (2014) also stated that who stated that heavy metals concentration in fishes differs, they observed that heavy metals present in herbivorous fish (Tillapia fish) was lower than that observed in ominivorous fish (catfish) while that of carnivorous fish (African pike) was the highest. Atuanya *et al.* (2011) also stated that concentration of heavy metals varies with variation in fish species. Table 1 also indicates that Zinc (Zn) was present in the highest amount in water sample, while Iron (Fe) was present in the highest amount in sediment. However, Chromium (Cr) was not present in Water, Tilapia and Catfish but was found in the Sediment, while Cadmium (Cd) was detected in relatively small amount across Water, Tilapia, Catfish and Sediment.

Table 1: Heavy metal concentration (mg/l) in the fish species, and sediments sampled from river Dandaru Mokola, Ibadan, Oyo State Nigeria.

Sample	Pb	Cd	Zn	Cu	Cr	Mn	Fe	Ni
Water	0.21^{b} ±0.01	0.01^{b} ± 0.01	4.32^{a} ±0.01	0.03^{a} ±0.01	ND	0.30^{b}±0.01	0.02^{d} ±0.01	0.02^{b} ±0.01
Tilapia fish	0.01^{c} ±0.01	0.01^{b} ±0.01	1.02^{b} ±0.03	0.01^{b} ±0.01	ND	0.01^{d} ±0.01	7.90^{b} ±0.01	0.02^{b} ±0.01
Catfish	0.01^{c} ±0.01	0.01^{b} ±0.01	1.07^{b} ±0.01	0.01^{b} ±0.01	ND	0.26^{c} ±0.02	8.68^{a} ±0.01	0.10^{a} ±0.01
Sediment	0.45^{a} ±0.01	0.03^{a} ±0.01	1.86^{b} ±0.01	0.40^{a} ±0.01	0.02±0.01	0.91^{a} ±0.01	1.67^{c} ±0.01	0.09^{a} ±0.01

N.D: Not Detected

The transfer factor is the rate at which the fish absorb metals from the water, the transfer factor obtained for this study (Table 2) indicates that all the metals tested (except the undetected Chromium) exceeded the standard limit of World Health Organization for both Tilapia and Catfish. This indicates that heavy metals have bioaccumulated in the tissue of these fishes over time.

Table 2: The Transfer factor for sampled fish tissue (mg/l) in River Dandaru, Mokola

Sample	Pb	Cd	Zn	Cu	Cr	Mn	Fe	Ni
Tilapia fish	0.49	1.00	23.49	0.40	ND	0.03	40.75	1.00
Catfish	0.05	1.00	24.82	0.40	ND	0.85	43.25	5.00
WHO (2003)	0.005	0.003	5.00	2.00	0.15	0.03	0.30	0.02

ND: Not Detected

$$T.F: \frac{\text{Concentration of tissue}}{\text{Concentration of water}}$$

Similarly, the result on Table 3 showed that chromium was not detected in water sampled from this river while lead exceeded the limit set by WHO while all other metals (Cadmium, Zinc,

Copper, Manganese, Iron and Nickel) were below the limit of World Health Organization. The concentration of heavy metal in the water is low than that of the fish. This could be due to the fact that the water carries the metal away as it flows (i.e it is not a stagnant water) while fish samples absorb these metals over time as they are discharged into the water. The source of heavy metals in this water body could be from discharge of University Teaching Hospital (UCH) that is discharged into the water as well as runoff from nearby motocycle mechanic workshop that is channeled to Dandaru river.

Table 3: Heavy metal concentration in water (mg/l) sampled from River Dandaru, Mokola

Sample	Pb	Cd	Zn	Cu	Cr	Mn	Fe	Ni
Water	0.205	0.010	4.315	0.020	ND	0.300	0.020	0.020
WHO (2003)	0.010	0.010	5.000	2.000	0.100	0.500	0.300	0.100

ND: Not Detected

The results on Table 4 indicate that chromium was not detected, while lead exceeded the limit set by WHO but other metals detected were below the limit set by WHO. It was also observed that the concentration of heavy metal in the water is low than that of the fish. This result also indicates that only lead and manganese fell within the Lowest Element Level (LEL) and the Threshold Element Level (TEL) while Cadmium, Zinc, Copper and Iron did not.

Table 4: Heavy metals concentration in Sediment (mg/l) of River Dandaru, Mokola

Guideline	Pb	Cd	Zn	Cu	Cr	Mn	Fe	Ni
LEL	0.010	0.480	26.000	2.000		0.600	10.280	
TEL	0.150	0.500	43.400	2.320		0.990	10.300	
Sediment	0.045	0.030	1.855	0.395	0.002	0.910	1.655	0.090

NOAA (2009) Note: LEL= Lowest Element Level; **TEL:** Threshold Element Level

Conclusion

The result of this study supply valuable information on the presence of heavy metals in catfish and tilapia fishes in Dandaru Mokola reservoir, Ibadan, Oyo State, Nigeria. Most of the value obtained for heavy metals in this study exceeded the limit in the tissue of the fish proposed by WHO (2003). It is hereby recommended that sources of heavy metals in river Dandaru (discharge from UCH and mechanic workshops around the river) should be checked and controlled by relevant authorities so as to mitigate the risk on humans that consumes fish other aquatic resources that is gotten from this river.

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