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Comparative assessment of some heavy metals in some inland fresh water fish species from River Niger and River Osara in North Central Nigeria

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ABSTRACT

The concentration levels of Cadmium(Cd), Manganese(Mn), Chromium(Cr), Nickel(Ni), Copper(Cu), Zinc(Zn) and Lead(Pb) were determined in fish fillets of some inland fresh water fish harvested from River Niger at Ajaokuta and River Osara at Itakpe North Central Nigeria. Eighty samples each of *Tilapia zillii*, *Oreochromis niloticus, Sarotherodon galileaus* and *Clarias anguillaris* were collected from both rivers and digested using standard methods. The metals were determined using Unicam 969 Flame Atomic Absorption Spectrophotometer fitted with deuterium lamp. The levels of heavy metals detected in the fish fillets of the different species varies with mean concentrations (mg/kg) in the range: Mn, 3.14±1.12-5.77±0.95 in *Sarotherodon galileaus*-5.30±1.48-10.48±2.57 in *Tilapia zillii*; Zn, 1.06±0.84-5.67±1.42 in *Oreochromis niloticus*-2.08±1.13-4.21±1.80 in *Clarias anguillaris*; Cu, 1.54±0.65-3.30±0.79 in *Tilapia zillii*-3.00±1.07-6.23±1.79 in *Sarotherodon galileaus*; Cr, 1.49±0.71-3.16±0.65 in *Tilapia zillii*-2.44±0.61-4.60±2.24 in *Clarias anguillaris*; Ni, 0.76±0.13-1.56±0.52 in *Tilapia zillii*-1.74±0.95-3.25±1.19 in *Clarias anguillaris*; Pb, 0.02±0.03-0.02±0.01 in *Tilapia zillii*-0.51±0.09-0.83±0.09 in *Oreochromis niloticus*, and Cd, 0.02±0.01-0.04±0.01 in *Tilapia zillii*-0.14±0.04-0.18±0.04 in *Oreochromis niloticus*. The differences in heavy metal levels in the different fish species examined were not significant ($p>0.05$), except for Mn in *Tilapia zillii* which was significantly higher ($p<0.05$) than in other species. This is probably because each fish species concentrated the heavy metals differently. *Clarias anguillaris* fillets appeared to hold the metals more except for Zn, followed by *Oreochromis niloticus*, *Sarotherodon galileaus*, and *Tilapia zillii* in that order. The detected levels were however below the WHO/FAO guideline limit in food substances, fish and fishery products. The study showed that there were differences in concentrations of Cd, Mn, Cr, Ni, Cu, Zn and Pb in fillets of *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris,* implying that the fishes concentrated the heavy metals differently. The levels of heavy metals detected in all the fish species were within the natural background levels.

Keywords: Heavy metals, fish fillets, concentration levels, differential, species.

1. Introduction

Heavy metals are of concern due to their toxicity, ability to bio-accumulate in aquatic ecosystems (Miller et al., 2002) and persistence in the natural environment. Fishes have great propensity for bio-accumulation and magnification of heavy metals (Obasohan, 2006), thus fish contamination in fresh water and marine environment by heavy metals is a potential threat to human health. This is because fishes are cheap source of protein in human diets;

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consequently they are regarded as a major food chain vector of heavy metals transfer in an ecosystem. Fishes become enriched with accumulated heavy metals because aquatic microflora and microfauna, which constitute fish foods, are capable of accumulating heavy metals in their living cell (Biney, et. al., 1994; Obasohan, 2006). Therefore, humans and other organisms, on consuming predatory fish suffer from the result of heavy metals enrichment having taken place at each trophic level (Obasohan, et al., 2006; Forstner and Wittman, 1981). The accumulation of heavy metals by different fish species is variable, and this depends on species physiology and metabolism. There is also species differential in the tendency to accumulate heavy metals in different organ of their bodies at different levels (Farombi, et al., 2007). The exposure of fish and other aquatic organism to heavy metals in aquatic environment is a function of the levels of dissolve metals in the water bodies. Heavy metals levels in fresh water and marine environment are defined by the nature of activities (natural and anthropogenic) around the water bodies, and sources of inputs. Information on the accumulation differentials and potentials of bio-accumulation of heavy metals by different fish species is scanty and scarce.

In this study, an assessment of the profiles of Cd, Mn, Cr, Ni, Cu, Zn and Pb in fillets of *Tilapia zillii, Oreochromis niloticus niloticus, Sarotherodon galilaeus galilaeus and Clarias anguillaris* harvested from River Niger at Ajaokuta and River Osara at Itakpe, was undertaken to evaluate species differentials in accumulation of the metals fish fillets.

2. Materials and Method

2.1 Study Area

River Niger flowing by Ajaokuta, where the Ajaokuta Steel Complex is sited is located along the lower River Niger drain down Lokoja. Ajaokuta is within the Lokoja – Okene geological survey area map 62 delimited by latitudes 7^0 and 8^0N and longitudes 6^0 and 7^0E as shown in Figure 1.

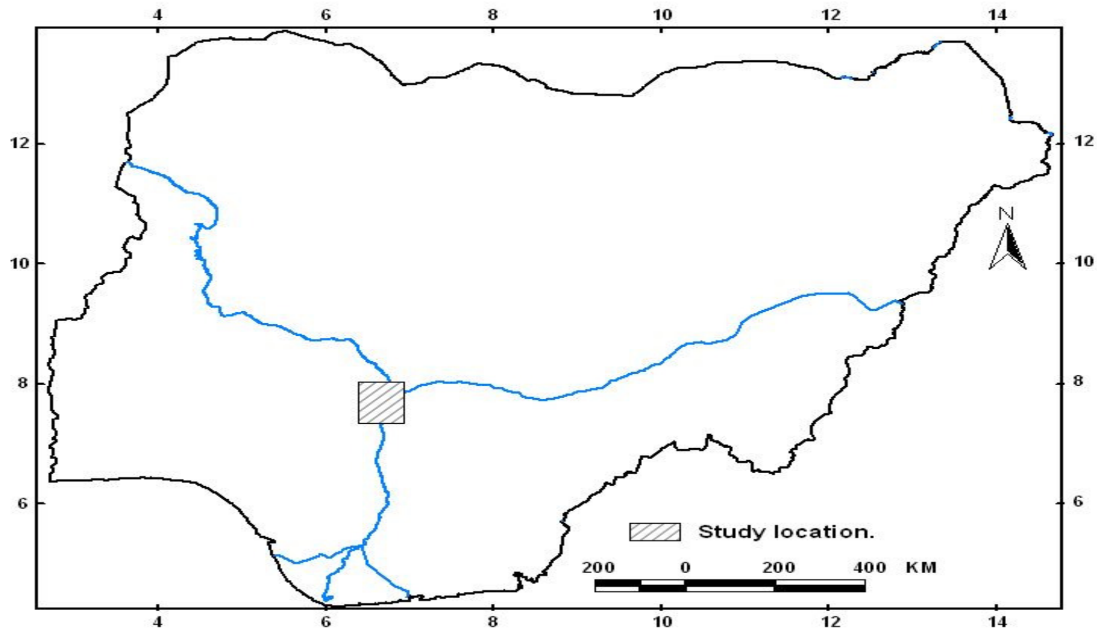

Figure 1: Map of Nigeria (Inset: Location of Study area: Geological Survey area 62): Source GSN, 1986

The river by Ajaokuta area is drained mainly by the Niger - Benue River, whose hydrological regime is seasonally variable. The contribution of River Benue has a pronounced effect on the lower River Niger drainage system.

River Osara, located to the northeastern side of Itakpe is one of the main right bank tributaries of River Niger to the west of the watershed. It flows by the Itakpe Hills Iron Ore deposit on the northern reach of the industrial area of Nigerian Iron Ore Mining Project, Itakpe. River Osara flow is largely controlled by the east–northeastern jointing (GSN, 1986). The content of River Osara is first discharged into River Ero, which subsequently empty its content in River Niger near Ajaokuta. Other watershed contributory tributary rivers from north to south are River Mimi, Ero, Ubo, Obe, Oje and Orle (Figure 2).

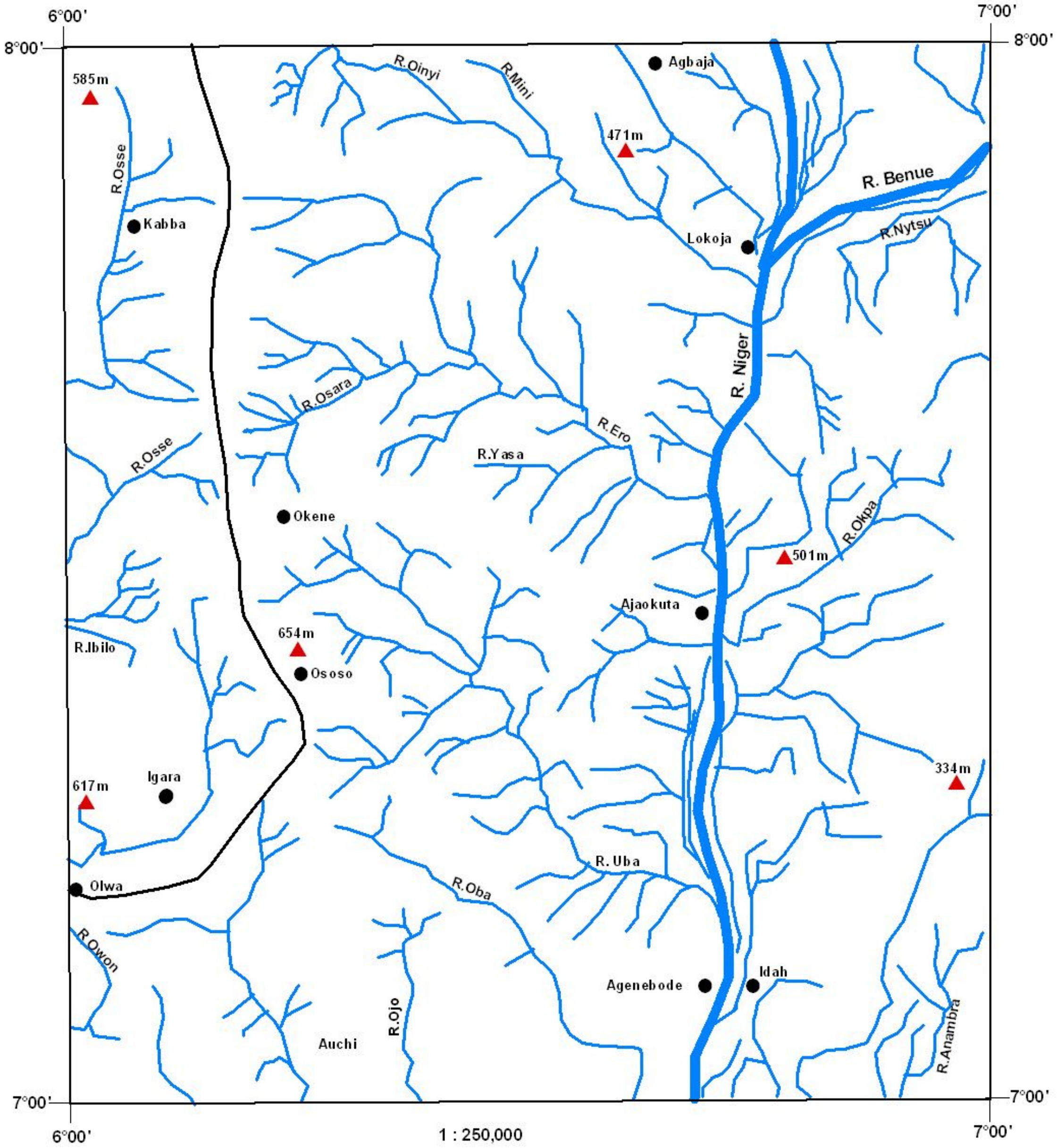

Figure 2: Watershed and drainage pattern of study area

2.2 Samples collection

Samples were collected during the dry and wet seasons, spanning a period of twenty-four months (two years) period between 2004 and 2005. Four different species of fishes were harvested in River Osara near the Itakpe Iron-Ore deposit mining field area (upstream: N 07^0 33,721", E 006^0 41,685" and downstream: N 07^0 33,740", E 006^0 41,694") and River Niger near the Ajaokuta Steel Company (upstream: N 07^0 37,462", E 006^0 19,247" and downstream: N 07^0 37,392", E 006^0 19,623") over a period of twenty (24) months. These include eighty (80) *Tilapia zillii* (Redbelly Tilapia), forty (40) samples each of *Oreohromis niloticus* (Nile Tilapia), *Sarotherodon galilaeus* (Mango Tilapia) and *Clarias anguillaris* (African catfish).

2.3 Sample preparation and digestion

The fish samples were dried to constant weight in hot air oven at temperature of 80^{0}C (Zheng, 2007). The dried fish were sorted to remove bones from the fish muscles (fillets) and thereafter blended to fine sizes suitable for digestion. 1.0gm of each fish samples fillets (dry weight) of each fish species were weighed into 100cm^3 kjeldahl flasks, and 1cm^3 concentrated nitric acid (British Drug House: BDH), analar grade reagent was added to each flask and heated in water bath at 80^{0}C for 3 hours to ensure complete digestion (FAO, 1976; Bernhard, 1976, UNEP, 1984).

2.4 Instrumental Analysis

The fish digests were quantified for Cd, Cr, Mn, Ni, Cu, Zn and Pb, over 2mm burner of Unicam 969 flame atomic absorption spectrometer (FAAS) fitted with deuterium (D_2) lamp.

3. Results and Discussion

The concentrations of Cd, Mn, Cr, Ni, Cu, Zn and Pb in fillets of *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguilliaris* varies, suggesting that accumulation of different heavy metals are species variable. Thus, the fish species with the strongest affinity for heavy metals cannot be outrightly asserted, although fillets of *Clarias anguillaris* appears to retain more of the metals, followed by *Oreochromis niloticus* > *Sarotherodon galileaus* > Tilapia *zillii*. The result of recovery studies on spiked fish fillet samples showed good recoveries, thereby validating the method of analysis. The percentage recoveries obtained for the metals were: Cd, 93.70%; Mn, 97.55%; Cr, 92.84%; Ni, 98.20%; Cu, 94.45%; Zn, 101.75% and Pb, 98.45%. The values of the percentage recovery of each metal falls within the generally acceptable recovery 100 ± 20%. The mean concentrations of heavy metals load in fish fillets of *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris* from River Niger at Ajaokuta and River Osara at Itakpe are presented in Table 1 and Table 2 respectively.

Table 1: Mean concentrations (mg/kg) (mean±SD) of heavy metals in fish fillets of four species of fishes from River Niger at Ajaokuta

Sample identity	Cd mg/kg	Mn mg/kg	Cr mg/kg	Ni mg/kg
AJK/FS/D//04-05				
Tilapia Zillii	0.04 ± 0.01	5.44 ± 1.29	3.16 ± 0.65	0.76 ± 0.13
Oreochromis niloticus	0.18 ± 0.04	4.79 ± 1.42	2.67 ± 0.94	2.26 ± 0.12
niloticus	<D/L	5.77 ± 0.95	2.14 ± 0.84	1.84 ± 0.87
Sarotherodon galilaeus	0.08 ± 0.03	4.59 ± 1.14	2.44 ± 0.61	2.27 ± 0.94
galilaeus				

Clarias anguillaris				
AJK/FS/W/04/05				
Tilapia Zillii ***Oreochromis niloticus niloticus*** ***Sarotherodon galilaeus galilaeus*** ***Clarias anguillaris***	0.02 ± 0.01 0.14 ± 0.04 <D/L 0.08 ± 0.04	3.77 ± 0.92 3.57 ± 1.09 3.71 ± 0.97 3.24 ± 1.22	1.49 ± 0.71 2.19± 0.78 4.05 ± 1.32 3.38 ± 1.22	0.85 ± 0.12 2.34 ± 0.77 1.54 ± 0.99 1.74 ± 0.95

AJK/FS/D/O4-05: Ajaokuta fish samples dry season 2004-2005; AJK/FS/W/04/05: Ajaokuta fish samples wet season 2004-05
D/L = Instrument detection limit

Table 2: Mean concentrations (mg/kg) (mean±SD) of heavy metals in fish fillets of four species of fishes from River Niger at Ajaokuta

Sample identity	Cu mg/kg	Zn mg/kg	Pb mg/kg
AJK/FS/D//04-05			
Tilapia Zillii ***Oreochromis niloticus niloticus*** ***Sarotherodon galilaeus galilaeus*** ***Clarias anguillaris***	3.30 ± 0.79 3.77 ± 1.12 6.23 ± 1.79 2.26 ± 1.16	4.03 ± 0.66 2.05 ± 1.85 2.07 ± 1.03 2.94 ± 1.39	0.02 ± 0.003 0.36 ± 0.05 0.83 ± 0.09 0.62 ± 0.12
AJK/FS/W/04/05			
Tilapia Zillii ***Oreochromis niloticus niloticus*** ***Sarotherodon galilaeus galilaeus*** ***Clarias anguillaris***	1.54 ± 0.65 4.48 ± 0.98 4.83 ± 1.52 1.94 ± 1.15	1.98 ± 0.58 1.06 ± 0.84 2.27 ± 1.35 2.45 ± 0.71	0.02 ± 0.03 0.42 ± 0.15 0.62 ± 0.13 0.28 ± 0.15

AJK/FS/D/O4-05: Ajaokuta fish samples dry season 2004-2005; AJK/FS/W/04/05: Ajaokuta fish samples wet season 2004-05
D/L = Instrument detection limit

Table 3: Mean concentrations (mg/kg) (mean±SD) of heavy metals in fish fillets of four species of fishes from River Osara at Itakpe

Sample identity	Cd mg/kg	Mn mg/kg	Cr mg/kg	Ni mg/kg
ITK/FS/D/04-05				
Tilapia Zillii ***Oreochromis niloticus niloticus*** ***Sarotherodon galilaeus galilaeus*** ***Clarias anguillaris***	0.02 ± 0.01 0.19 ± 0.05 <D/L 0.06 ± 0.01	10.48±2.57 5.01 ± 1.18 4.42 ± 0.81 4.07 ± 1.23	2.93 ± 1.09 3.28 ± 0.84 3.42 ± 1.19 3.83 ± 0.97	1.56 ± 0.52 3.01 ± 1.30 2.58 ± 1.15 3.25 ± 1.19
ITK/FS/W/04/05				
Tilapia Zillii ***Oreochromis niloticus niloticus*** ***Sarotherodon galilaeus galilaeus***	0.02 ± 0.01 0.16 ± 0.05 <D/L 0.06 ± 0.03	5.30 ± 1.48 4.60 ± 1.34 3.14 ± 1.12 3.99 ± 1.25	2.02 ± 0.94 3.21 ± 0.80 4.23 ± 1.35 4.60 ± 2.24	1.28 ± 0.56 1.62 ± 0.73 2.02 ± 1.17 2.89 ± 1.35

Clarias anguillaris				

ITK/FS/D/O4-05: Itakpe fish samples dry season 2004-2005; ITK/FS/W/04/05: Itakpe fish samples wet season 2004-05
D/L = Instrument detection limit

Table 4: Mean concentrations (mg/kg) (mean±SD) of heavy metals in fish fillets of four species of fishes from River Osara at Itakpe

Sample identity	Cu mg/kg	Zn mg/kg	Pb mg/kg
ITK/FS/D/04-05			
Tilapia Zillii	2.26 ± 1.41	5.39 ± 1.80	0.02 ± 0.01
Oreochromis niloticus niloticus	2.04 ± 1.05	5.30 ± 1.26	0.43 ± 0.09
Sarotherodon galilaeus galilaeus	3.00 ± 1.07	4.17 ± 1.28	0.58 ± 0.07
Clarias anguillaris	3.36 ± 1.19	4.21 ± 1.80	0.12 ± 0.06
ITK/FS/W/04/05			
Tilapia Zillii	1.95 ± 0.88	3.13 ± 0.68	0.02 ± 0.01
Oreochromis niloticus niloticus	2.06 ± 1.32	5.67 ± 1.42	0.52 ± 0.18
Sarotherodon galilaeus galilaeus	3.07 ± 1.81	2.49 ± 1.32	0.51 ± 0.09
Clarias anguillaris	2.47 ± 1.16	2.08 ± 1.13	0.07± 0.04

ITK/FS/D/O4-05: Itakpe fish samples dry season 2004-2005; ITK/FS/W/04/05: Itakpe fish samples wet season 2004-05
D/L = Instrument detection limit

The concentration levels of Mn was the highest in all the fish fillets with mean concentrations (mg/kg) 3.77±0.92 - 5.44±1.29; 3.57±1.09 - 4.79±1.42; 3.71±0.97 - 5.77±0.95; and 3.24±1.22 - 4.59±1.14 (Table 1) in *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris* of River Niger respectively; and mean concentrations (mg/kg) 5.30±1.48 - 10.48±2.57; 4.60±1.34 - 5.01±1.18; 3.14±1.12 - 4.42±0.81; 3.99±1.25 - 4.07±1.23 (Table 2) in River Osara respectively, except in *Oreochromis niloticus* from River Osara for which Zn (5.30±1.26 - 5.67±1.42mg/kg) recorded the highest concentration. These concentrations are relatively low compared with 1250mg/kg FAO limit in food (fish and fishery products). The mean concentration levels (mg/kg) of Cu (1.54±0.65 - 3.30±0.79; 3.77±1.12 - 4.48±0.98; 4.83±1.52 - 6.23±1.79; 1.94±1.15 - 2.26±1.16) (Table 1) were next to Mn levels in fillets of *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris* respectively of River Niger. This was not the same in fillets of the fish species from River Osara as Zn mean concentration levels (mg/kg) ranged: 3.13±0.68 - 5.39±1.80; 5.30±1.26 - 5.67±1.42; 2.49±1.32 - 4.17±1.28; 2.08±1.13 - 4.21±1.80 (Table 2) were next to that of Mn in *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris* respectively.

The mean concentrations (mg/kg) of Zn in fillets of *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris* of River Niger (Table 1) ranged: 1.98±0.58 - 4.03±0.66; 1.06±0.84 - 2.05±1.85; 2.07±1.03 - 2.27±1.35 and 2.45±0.71 - 2.94±1.39 respectively. However, Cu mean concentration levels (mg/kg) in fillets of *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris* from River Osara (Table 2) ranged: 1.95 ± 0.88 - 2.26 ± 1.41; 2.04 ± 1.05 - 2.06 ± 1.32; 3.00 ± 1.07 - 3.07 ± 1.81 and 2.47 ± 1.16 - 3.36 ± 1.19 respectively. The levels of Cu and Zn concentrated in fillets of the different fish species in this study were not of any definite pattern, and the levels were within the FAO/WHO permissible limits of Cu, 30.00mg/kg and Zn, 1000mg/kg.

Cadmium was the least accumulated heavy metal in the fish species evaluated in both River Niger and River Osara, with mean concentration levels (mg/kg) ranged: 0.02±0.01 - 0.04±0.01; 0.14±0.04 - 0.18±0.04; 0.08±0.04 - 0.08±0.03 (Table 1) and 0.02±0.01 - 0.02±0.01; 0.16±0.05 - 0.19±0.05; 0.06±0.03 - 0.06±0.01 (Table 2) in *Tilapia zillii, Oreochromis niloticus,* and *Clarias anguillaris* respectively. The levels of Cd resident in the fillets of the fish species assessed in this study were within the FAO/WHO permissible limits of 0.2mg/kg. Variation in Cd concentration levels in fillets of the investigated fish species in both River Niger and River Osara were not significant ($P>0.05$). Thus Cd levels were relatively stable and not affected by seasonal changes. Cadmium was however not detected in *Sarotherodon galilaeus,* probably due to its depuration character or quick tendency to excrete the metal.

The mean concentrations (mg/kg) of Pb in both River Niger and River Osara varied: with wet – dry season Pb fillets levels ranged: 0.02±0.03 - 0.02±0.003; 0.36±0.05 - 0.42±0.15; 0.62±0.13 - 0.83±0.09; 0.28±0.15 - 0.62±0.12 and 0.02±0.01 - 0.02±0.01; 0.43 ± 0.09 - 0.52 ± 0.18; 0.51±0.09 - 0.58±0.07; 0.07±0.04 - 0.12±0.06 in *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris* respectively. The levels of Pb in *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris* were below FAO/WHO permissible limit of Pb, 2.00mg/kg.

The levels of Cr and Ni were variable: fish fillets of *Tilapia zillii,,Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris* had mean concentrations (mg/kg) ranged: 1.49±0.71 - 3.16±0.65; 2.19±0.78 - 2.67±0.94; 2.14±0.84 - 4.05±1.32; 2.44±0.61- 3.38±1.22 respectively in River Niger, and 2.02±0.94 - 2.93±1.09; 3.21±0.80 - 3.28±0.84; 3.42±1.19 - 4.23±1.35; 3.83±0.97 - 4.60±2.24 respectively in River Osara. However, fillets concentration of Cr and Ni are low compared with the WHO/FAO (1983) recommended threshold of 30.00mg/kg; and 50.0mg/kg respectively, in fish and fishery products. The concentrations of Cr and Ni detected in fillets of all the fish species evaluated were within the natural background levels.

The concentration of heavy metals bio-concentrated in the body muscles (fillets) of the different fish species were not of any definite pattern. The availability sequence of metals detected in the fish fillets during dry and wet seasons were in the order (Mn > Zn > Cu >Cr > Ni > Cd > Pb) and (Mn > Zn > Cu >Cr > Ni > Cd > Pb) respectively in *Tilapia zillii* from River Niger and (Mn > Zn > Cr > Cu > Ni > Cd > Pb) and (Mn > Zn > Cr > Cu > Ni > Cd > Pb) respectively in *Tilapia zillii* from River Osara. The fillet's metals availability sequence in *Oreochromis niloticus* were (Mn > Cu >Cr > Ni > Zn > Pb > Cd) and (Cu > Mn > Ni > Cr > Zn > Pb > Cd) in River Niger during dry and wet seasons respectively and (Zn > Mn > Cr > Ni > Cu > Pb > Cd) and (Zn > Mn > Cr > Cu > Ni > Pb > Cd) during dry and wet seasons respectively in River Osara. The observed sequence is consistent with the findings of Onwumere and Oladimeji, (1990) on sequence of heavy metals concentrations in *Oreochromis nilotica* fish tissues. In *Sarotherodon galilaeus* from River Niger, the availability sequence were in the order (Cu > Mn > Cr > Zn > Ni > Pb) and (Cu > Cr > Mn > Zn > Ni > Pb), while those from River Osara were (Mn > Zn > Cr > Cu > Ni > Pb) and (Cr > Mn > Cu > Zn > Ni > Pb). The observed availability sequence for the detected metals in *Clarias anguillaris* from River Niger during dry and wet season were in the order (Mn > Zn > Cr >Ni > Cu > Pb > Cd) and (Mn > Zn > Cr >Ni > Cu > Pb > Cd) respectively and (Zn >Mn > Cr > Cu > Ni > Pb > Cd) and (Cr > Mn > Ni > Cu > Zn > Pb > Cd) if fish from River

Osara. This result suggests species similarity in response to heavy metals, but this may depend on the status of the aquatic environment.

The result of this study is consistent with the findings of Amoo, et al., (2005) who reported; Cd, 0.04-0.20 mg/kg; Cu, 0.23-2.93 mg/kg; and Pb, 0.00-1.12 mg/kg, but with higher level of Zn, 15.5-36.8 mg/kg; in *Tilapia Spp., Mormyrus rume, Citharinas citharus, Lates niloticus* and *Bagrus bayad* fish species of Kainji Dam on River Niger. Ajayi and Osibanjo, (1987) reported comparable metal levels of Zn, 4.27-7.64 mg/kg; Cd, 0.01mg/kg; Mn, 0.53-2.98 mg/kg; Cu, 0.11-1.91mg/kg; and Pb, 0.35-0.53 mg/kg, in *Tilapia zillii* fish sample from the Niger Delta of Nigeria. Biney, (1991) reported slightly higher concentration of Pb, 1.37 mg/kg, in fish from Lower Volta River, Ghana, while the Cd, <0.10 mg/kg; Cu, 4.5 mg/kg; and Zn, 20.2 mg/kg are consistent with study results. The findings of Turkmen, et al., (2004) on commercially valuable fish species from Iskenerun Bay North Mediterranean, are comparable to the concentrations levels of the heavy metals detected in this study.

Analysis of metal concentration variation in the different species evaluated showed low concentration variation: ±0.01 mg/kg, (Cd) – ±1.85 mg/kg, Zn in fillets of fishes collected from River Niger, and ±0.01 mg/kg, (Cd, Pb) – ±2.57 mg/kg, Mn in fillets of fishes collected from River Osara. This suggests slight uniformity in the heavy metal levels in fish fillets. The variations in the magnitude of dispersion of the heavy metals suggest differentials in individual fish response and heavy metal accumulation potentials. There was no significant differences ($p<0.05$) in the levels of the heavy metals detected in the fillets of the different fish species, except for Mn in *Tilapia zillii*. Heavy metal levels is in the fillets of the different fish species is in the order *Clarias anguillaris* > *Oreochromis niloticus* > *Sarotherodon galileaus* > *Tilapia zillii.* Although the mechanism of heavy metals bio-concentration and/or bio-reduction in the fillets of fishes is not very clear, it is believed that reduction in concentration of heavy metals in water, leads to low metals concentration levels in microflora and microfauna and consequently reduction in the levels of heavy metals that fishes are exposed to. Metals in the rivers may be from land based sources, which is a function of the geology of the terrestrial areas bordering the rivers, the geology of the underlying waters and activities on the rivers. Zinc and Cu concentration levels may also be enhanced by land base agrochemical use.

The results showed that the different fish species harvested from River Osara were of higher heavy metals concentration levels compared to those harvested from River Niger. The detected Mn, and Zn, levels in different fish species of River Osara were significantly ($p<0.05$) of high than those of River Niger, but for Cu which was significantly ($p<0.05$) high in all the fish species from River Niger than of River Osara. The levels of Cd, Pb, Cr, and Ni in fillets of fish species of River Osara were not significantly different ($p>0.05$) from fillets levels of Cd, Pb, Cr and Ni in fish species of River Niger. Apparently these levels are defined by heavy metal loads in the rivers; consequently affecting the heterotrophic composition of the aquatic food chain, which in turns reflect in fish fillets. Thus there is a probable likely hood that the geology of Itakpe Iron ore deposit and its adjoining land forms may be contributory to heavy metals that are ultimately released into River Osara.

The fishes: *Tilapia zillii*, *Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias angullaris* seems to exhibit some degree of depuration mechanism as the concentration levels of heavy metals detected in their fillets were below guideline values. This implies that the fish samples from River Niger at Ajaokuta and River Osara at Itakpe which although have measurable levels of fillet heavy metals concentrations, have concentrations below or within the recommended guideline limits for heavy metals, hence are not contaminated. Thus consumption of these fish species does not pose health risk. These data may be complimented with biology, toxicology and public health studies, report in order to arrive at inform choice on appropriate environmental management strategy.

4. Conclusion

The result of this study showed that there were differentials in concentration levels of Cd, Mn, Cr, Ni, Cu, Zn and Pb in fillets of *Tilapia zillii, Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias anguillaris,* implying that the fishes concentrated the heavy metals differently. The species with the higher metal levels cannot be outrightly defined; *Clarias anguillaris* appears to hold the metals more, followed by *Oreochromis niloticus, Sarotherodon galileaus,* and *Tilapia zillii* in that order. The detected levels were below the WHO/FAO guideline limit in food substances, fish and fishery products. Therefore fillets concentration levels of heavy metals detected in all the fish species evaluated were within the natural background levels.

5. References

1. Ajayi S.O. and Osibanjo O., (1987), Trace metal content of fish and shellfish of the Niger Delta of Nigeria. *Environment International,* 13, pp 247-251.

2. Amoo I.A., Adebayo, O.T. and Lateef, A.J., (2005), Evaluation of heavy metals in fishes, water and sediments of Lake Kainji, Nigeria. *Journal of Food, Agriculture & Environment*, 3(1), pp 209-212.

3. APHA, (1998), Standard methods for the Examination of Water and Wastewater. 1268p 20th Ed. American Public Health, Association (APHA), American Water Works Association (AWWA), Water Water Pollution Control Federation (WPCF), Washington DC, USA.

4. Bernhard M., (1976), Sampling and analyses of biological materials. *Manual of methods in aquatic environment research. Part 3* – FAO Fish. Technical Paper, pp 158.

5. Biney, C. A., (1991), The distribution of trace metals in the Kyong Headpond and Lower Volta.

6. River, Ghana. *In Perspectives in Aquatic Ecotoxicity*: N. K. Shastree (Ed). Norendra Publishing House, Delhi, India.

7. Biney, C, Amuzu, A.T.; Calamari D.; Kaba, N.; Mbome, I. L.; Naeve, H.; Ochumba, P. B.O.; Osibanjo, O.; Radegonde, V. and Saad, M. A. H., (1994), Review of heavy metals in the African aquatic environment. *Ecotoxicity and Environmental Safety,* 28, pp 134-159.

8. Falconer, J. D., (1911), The geology and geography of Northern Nigeria MacMillam and Company Ltd., London, pp 295.

9. FAO, (1976), Manual of methods in aquatic environment research. Part 3 – Sampling and analyses of biological materials, FAO Fish. Technical Paper, pp 158.

10. Farombi E.O., Adelowo, O. A. and Ajimoko, Y. R., (2007), Biomarkers of oxidative stress and heavy metal levels as indicators of environmental pollution in Africa Cat fish *Clarias gariepinus* from Nigeria Ogun river. *International Journal of Environmental Research and Public Health*, 4(2), pp 158-165.

11. Forstner, U. and Wittmann, G. T. W., (1983), Metal pollution in the aquatic environment. 2nd ed., *Springer link-Verlag,* Berlin.

12. Greichus, Y. A., Greichus, A., Amman B. D. and Hopcraft J., (1978), Insecticides, polychlorinated biphenyls and metals in African lake ecosystems. III. Lake Mcllwaine, Rhodesia. *Bulletin of Environmental Contamination and Toxicology,* 19, pp 454 – 461.

13. GSN, (1986), The geology of Lokoja – Auchi Area: Explanation notes on sheet 62. *Geological Survey Report,* No 38, pp 71.

14. Miller, J.R., Lechler, P.J., Hudson-Edwards, K.A. and Macklin, M.G., (2002), Lead Isotopic Fingerprinting of Heavy Metal Contamination, Rio Pilcomayo, Bolivia. In: Allan, R., A.J. Horowitz and J.R. Miller, (Eds.), Metal Mining in the Environment, Special Issue. J. Geochem. Explor. Environ. Anal., 2(3), pp 225-233.

15. Obasohan, E. E. Oronsaye, J. A. O. Obano, E. E., (2006), Heavy metal concentrations in *Malapterus electricus* and *Chrysichthys nigrodigitatus* from Ogba River in Benin City, Nigeria. *African African Journal of Biotechnology*, 5(10), pp 974 – 982.

16. Onwumere, B. G., and Olademeji, A. A., (1990), Accumulation of metals and histopathology in Oreochromis niloticus exposed to treated NNPC Kaduna (Nigeria) petroleum refinery effluent. *Ecotoxicology and Environmental Safety,* 19, pp 123 – 134.

17. Turkmen, Aysun, Turkmen, Mustafa, Tepe, Yalen and Akyurt, Ihsan, (2004), Heavy metals in three commercially valuable fish species from Iskenderun Bay, North East Mediterranean Sea, Turkey. *Pakistan Journal of Science and Industrial Research,* 27(1), pp 102 – 110.

18. UNEP, (1984), Sampling of selected marine organisms and sample preparation for trace metal analysis. Reference Methods for marine studies No. 7 Rev. 2 UNEP, Geneva

19. Zheng Zhang, Li He, Jin Li, Zhen-bin Wu, (2007), Analysis of heavy metals of muscles intestine tissue in fish – in Banan section of Chingqing from Gorges Reservoir, China. *Polish Journal of Environmental studies,* 16(6), pp 949 – 958.