Accumulation of Some Heavy Metals in *Clarias anguillaris* and *Heterotis niloticus* from Lake Geriyo Yola Nigeria.

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ABSTRACT:

The accumulation of Cr, Cu, Mn, Ni, Zn, As and Pb in two fish species (*Clarias anguillaris* and *Heterotis niloticus)* from Lake Geriyo Yola Adamawa state Nigeria were investigated in April 2007 the hottest month, atmospheric temperature 42°c. The levels of heavy metals accumulated were assayed using energy dispersive x-ray fluorescence (EDXRF) spectrophotometer and the results were given as mg/kg dry weight. The concentration of heavy metals in the two fish species indicated that *C. anguillaris* accumulated higher levels of Cr, Mn, and Ni than the maximum permissible limits in fish by World Health Organization (WHO 1985), while the levels of Cu, Zn, and Pb are lower. *H. niloticus* accumulated higher levels of Mn and As than the maximum permissible limits in fish by WHO (1985), while Cu and Zn levels are lower. The order of heavy metals accumulation in *C. anguillaris* was Cr > Mn > Pb > Ni > Zn > Cu. Similarly, in *H. niloticus*, the order was Mn > Zn > As > Cu. In all of these heavy metals, the accumulation of Mn and Cr in *C. anguillaris and Mn in H.niloticus* was more pronounced than the other metals. The result indicates that Lake Geriyo is contaminated with Cr, Mn, Ni, and As with respect to the two fish species. This definitely affects the aquatic life of the freshwater fish. These levels of heavy metals accumulated by the two fish species might be due to the increase in agricultural influx waters and some anthropogenic activities within the catchment's area of the Lake. [Nature and Science 2009:7(12):40-43]. (ISSN:1545-0740)

Key words: Accumulation, Lake, Nigeria, heavy metal, *C. anguillaris, H. niloticus*

1. Introduction:

The contamination of freshwater with a wide range of pollutants has become a matter of great concern over the last few decades, not only because of the threats to public water supplies but also their damage caused to the aquatic life (Canli. et al., 1998). The natural aquatic systems may extensively be contaminated with heavy metals released from domestic and industrial wastes, agricultural activities, physical and chemical weathering of rocks, soil erosions, as well as sewage disposal and atmospheric deposition (Alloway and Ayres, 1993).

Aquatic organisms such as fish are capable of accumulating heavy metals in their living cells to concentrations much higher than those present in water, sediment and micro flora in their environment (Forstner and Wittmann; 1981). The presence of heavy metals in river, Lake or any aquatic environment can change both aquatic species diversity and ecosystems due to their toxicity and accumulative behavour (Heath; 1987).

The increasing importance of fish as a source of protein and the interest in understanding the accumulation of heavy metals at the trophic levels of food chain, extend the focus towards fish (Deb and Santra; 1997). Heavy metals in fish, increases with the increments of the metal levels in water, sediment and fish food organism (Arvind; 2002).

Heavy metals like Cu, Co, Zn, Fe and Mn at low concentrations are essential metals for enzymatic activity and many biological processes. Other metals such as Cd, Pb, and Hg have no known essential role in the body of living organisms, and are toxic even at low concentrations. The essential metals also become toxic at high concentration (Bryan, 1976; Alloway and Ayres; 1993).

This study was carried out to quantify the accumulated heavy metals in *C. anguillaris* and *H. niloticus* from Lake Geriyo Yola so as to ascertain their suitability for human consumption and aquaculture.

2. Materials and Methods:

2.1 Study Area:

Lake Geriyo is located at the outskirt of Jimeta metropolis on the North-west region (longitude 12° 25'E and between latitude 9° 8'N and 9° 17'E).

It experiences some influx of waters during rainy season and pollution load coming up stream from river Benue. The Lake has been subjected to intense irrigation, which might have attributed to the major factor for high levels of heavy metals in the lake and fish species.

Temperature ranges from 20°c, a cold and dusty winds in December to January and intense heat with temperatures of 30°c to 42°c in March to April (upper Benue River Basin Development Authority, (U.B.R.B.D.A. 1985).

2.2 Sampling

Two fish species (5 – 10 individual of each fish species) namely, *C. anguillaris* weighing 2543 $\pm$ 16.046g and *H. nilloticus* weighing 3032 $\pm$ 14.352g were randomly caught by the local fishmen using set gill nets of various sizes and traps set overnight prior to collection. The fish samples were immediately bought at the bank of the Lake during the month of April 2007. The fish sample was stored in a cooler with ice and was brought to the laboratory.

2.3 Fish Sample Treatment.

The modified version of transmission-emission (T-E) method (Kump 1996; Angeyo et al 1998 and Funtua 1999) was used. The fish samples were dissected with clean stainless steel instruments on the same day. The tissues from 5-10 individual of the same fish species were dried in an oven at 105°c until a constant weight was reached. The dried tissues of the same fish species were ground to powder, sieved to grain size of less than 125µm and were homogenized.

A quantity of (0.5g) of the powdered fish samples for each fish species was weighed separately and three drops of organic binder was added to each fish sample and were pressed with 10 tons hydraulic press to form pellets of 19mm diameters of each fish sample, three replicate of pellets of each fish sample was prepared.

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2.5 Determination of Heavy Metals in Fish Samples.

The modified version of transmission-emission (T-E) (Kump 1996; Angeyo et al 1998 and Funtua 1999) was used. The pellet of each fish sample was put into the X-ray fluorescence spectrophotometer sample holder and it was bombarded with high energy electrons of ^{109}Cd (22.1KeV).

Fluorescent X-ray was produced which passes to silicon-lithium detector, through Mo target as a source of monochromatic X-rays. The spectrum of energy generated on the detector was processed by a multi-channel Analyzer (MCA) to obtain analytical data.

The intensity of fluorescent X-rays on the detector is proportional to the concentration of individual element of interest in the sample.

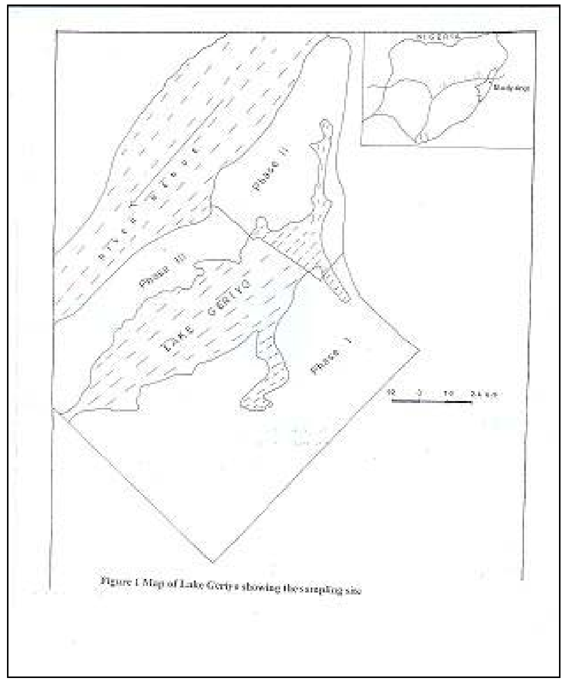

Figure 1. Map of Lake Geriyo showing sampling site

3. Results

The values of the heavy metals in the two fish species are presented in (Tables1). In this study, *C. anguillaris* a bottom feeder and *H. niloticus* a surface feeder were investigated for heavy metals. These two fish species are so common in Lake Geriyo.

Cr in *C. anguillaris* and Mn in *H. noliticus* showed a more pronounced high accumulation values (Table 1). Cr value is 9.010 $\pm$ 1.453mg/kg dry wt in *C. anguillaris.* Cu values ranged from 0.643 $\pm$ 0.001mg/kg dry wt in *C. anguillaris* to 0.684 $\pm$ 0.001 dry wt in *H. niloticus.* For Mn, the values are a minimum of 1.245 $\pm$ 0.001mg/kg dry wt in *C.*

anguillaris, while the maximum value was 9.963 ± 1.250mg/kg dry wt in *H. niloticus.* The value of Ni is 0.953 ± 0.020mg/kg dry wt and it was present in *C. anguillaris* only.

The Zn values fluctuated between 0.752 ± 0.002mg/kg dry wt and 1.502 ± 0.001mg/kg dry wt for *C. anguillaris* and *H. niloticus.* As value was 1.042 ± 0.001mg/kg dry wt for *H. niloticus* only. Pb value was 1.012 ± 0.001mg/kg dry wt in *C. anguillaris only*

From the above results, *C. anguillaris* tended to accumulate more heavy metals (Cr, Mn, Cu, Ni, Zn and Pb) than *H. niloticus* (Cu, Mn, As, and Zn).

4. Discussion

Fish species living in contaminated waters tend to accumulate heavy metals in their organs and tissues. Various heavy metals are accumulated in fish body in different amount (Jezierska and Witesta; 2001)

Fish species mostly absorbed heavy metals from its feeding diets, sediments and surrounding waters resulting to their accumulation in reasonable amounts (McCarthy and Shugart; 1990).

The accumulation of heavy metals in fish species are found to be influenced by several factors like temperature P^H of water, conductivity, rainfall, hardness, salinity and also by biotic community interactions (Arvinda; 2002). Microhabitat utilization, feeding habits, age, sex and fish species also determine the accumulation pattern of heavy metals (Kotze; et al 1999).

C. anguillaris accumulated higher levels of Cr, Mn and Ni, while *H. niloticus* accumulated Mn and As to higher levels (Table 1), when compared to the maximum permissible limits by World Health Organization (WHO 1985) in fish.

The levels of Cu, Zn and Pb in *C.anguillaris*, Cu and Zn levels in *H. niloticus* were low when compared with the maximum permissible limits by WHO 1985 in fish.

The differences in the level of heavy metals accumulated by the two fish species respectively could be attributed to the differences in their metabolic rates, feeding habits, age, sex and fish species (Kotze et al; 1999). Body size and health which are closely related to growth and metabolism has been shown to attribute most of the variations in heavy metals content of fishes (Moriarty, et al; 1984).

These heavy metals Cr, Cu, Mn and Zn are concentrated in sediments, aerobic and anaerobic bacteria in Lakes, rivers and streams (Shahunthala 1989).

They are also found to be incorporated and accumulated in food chain which are passed to fishes (Forstner and Wittmann, 1981)

C. anguillaris being a bottom feeder may have accumulated Cr, Cu, Mn, and Zn from the sediment and bacteria in the Lake.

The accumulation of Ni and Pb by *C. anguillaris* could be attributed to the fact that Ni and Pb are naturally found on the surface waters due to weathering of materials and soil erosion (USEPA, 1997).

Cu and Zn essential metals, their levels are low in both fishes. It could be attributed to homeostatic regulation of intracellular metals due to undesirable intracellular interaction which could be restricted, through bonding of the heavy metals to protein to form metallothionein (MT) (Roesjadi, 1992). Pb level in *C. anguillaris* is low, it could be attributed to the fact that Pb do not induce MT formation in tissues of fishes (Arvind 2002).

The sources of heavy metals in Lake Geriyo could results from the exposure of high concentration of metals from the metal scrap market, due to the activities of the blacksmiths by the Lake. It could also be due to the dumping of the municipal wastes on the bank of the lake, others are agricultural activities within the catchments area of the lake, most especially the intense irrigation practices.

Table 1 Mean concentration of Heavy Metals in two fish species from Lake Geriyo Yola in (mg/kg, dry weight) and set standard. WHO (1985)

Metals / Fish Samples	Cr	Cu	Mn	Ni	Zn	As
C. anguillaris	9.010± 1.453	0.634.± 0.001	1.245± 0.001	0.953± 0.020	0.752± 0.001	BDL
H. nlioticus	BDL	0.684± 0.001	9.963± 1.250	BDL	1.502± 0.001	1.042± 0.001
WHO (1985)	0.15	3	0.5	0.6	10-75	0.02

5. Conclusion:

The levels of Cr, Mn, and Ni in *C. anguillaris*, Mn and As in *H. niloticus* were higher than the maximum permissible limits by WHO (1985) in fishes.

The results indicate that heavy metal contamination would affect the fishes, end user and consumer. Hence, a scientific method of detoxification is essential to improve the health of these fishes in any polluted environmental condition

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