FSN-EN 0010

BIOACCUMULATION OF HEAVY METALS IN FRESHWATER *Clarias anguillaris* AND *Parachanna Africana* from LAKE GERIYO IN YOLA, NIGERIA

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This paper was prepared for presentation at the 25th Annual International Conference and Exhibition in Administrative Staff College of Nigeria (ASCON), Topo-Badagry, Lagos, Nigeria, 25th – 29th October, 2010.

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ABSTRACT

This study was carried out to determine the bioaccumulation of heavy metals in Clarias anguillaris and Parachanna africana from Lake Geriyo Yola, Nigeria using energy dispersive X-ray fluorescence (EDXRF) spectrophotometer.. The results in (mg/kg, dry weight) showed different levels of Cr, Cu, Mn, Fe, Ni, Zn, and Pb in the two fish species. The order of heavy metals accumulated by C. anguillaris and P. africana are Cr>Fe>Zn > Mn>Cu>Ni>Pb and Ni>Fe>Zn>Cu respectively. The levels of Cr, Mn and Ni in C. anguillaris and in Ni in P. africana were higher than WHO and FEPA recommended maximum permissible limits (MPL) in fish, while the levels of Zn, Cu and Pb were below the standards. The results suggest that Lake Geriyo has high pollution loads of these heavy metals in fishes and could pose a health hazards to man. Consequently, close monitoring of heavy metal loads in Lake Geriyo is recommended with a view to minimizing the risks to health of the population that depend on the lake for their water and fish supply.

Keywords: Heavy Metals, Bioaccumulation, Lake Geriyo, *C. anguillaris*, *P. africana*, Nigeria.

INTRODUCTION

The accumulation of heavy metals by aquatic biota has become a problem of increasing concern. Fish has the ability to accumulate heavy metals to hazardous levels with visible sign in the aquatic environments (Fostner *et al.*, 1981)

Anthropogenic activities such as mining operations, petroleum exploration, and agricultural practices, industrial and municipal wastes have increased the concentrations of heavy metals in the lakes, rivers and stream which have caused concern regarding heavy metal bioaccumulation and human health hazards (Forstner *et al.*, 1981). Bioaccumulation has been reported by several authors (Mathis and Cummings, 1973; Alabaster and Lloyd, 1980, Biney *et al.*, 1991).

All heavy metals are potentially harmful when consumed above the recommended standard limits. At low concentrations, Cd, As, Pb and Hg are toxic and they compete for sites with essential metabolites, replacement of essential ions, reactions with-SH groups of Adenosine Diphosphate (ADP) and Adenosine Triphosphate (ATP) (Alloway and Ayres, 1993).

This study was carried out to determine the bioaccumulation of heavy metals by fishes which are associated with potential health hazards to man.

MATERIALS AND METHODS

Lake Geriyo is located at the outskirts of Jimeta, in Yola metropolis (longitude $12^{\circ} 25'E$ and between latitude $9^{\circ} 8'N$ and $9^{\circ} 17'E$). The lake is a natural one that started as a small gully, but was later expanded and filled with water from the rains and some influx from River Benue. The lake has been subjected to intense irrigation and it is a center for metal scraps market (UBRBDA, 1985).

Sample Collection

Two fish species (5 - 10 individuals of each species) namely, *C. anguillaris* measuring 40.57 ± 1.30 cm and weighing 1000.30 ± 30.71 g and *P. africana* 35.56 ± 1.29 cm and weighing 567.20 ± 15.21 g were procured from the local fishermen on the bank of the lake, during the month of April 2007. They were thereafter stored in a plastic cooler with ice flakes.

Sample Preparation of Fish

The two species of fish were oven dried to constant weight at $105^{\circ}C$. The dried samples were ground to powder and quartered to give representative sample weight. 0.5 g of the powdered fish samples was weighed and three drops of organic binder were added to each and were pressed with 10 tons hydraulic press to form pellet of each fish samples. Three replicate of pellets of each fish sample were prepared.

Determination of Heavy Metals in Fish by Energy Dispersive X-Ray Fluorescence (EDXRF)

The heavy metals in fish sample were determined using the modified version of Emission Transmission (E-T), Kump, (1996), Angeyo *et al.*, (1998) and Funtua (1999). The pellet of each fish sample was put into X-ray fluorescence spectrophotometer sample holder and it was bombarded with high energy electrons of ^{109}Cd (22.1keV). Fluorescent X-rays was produced which passes to the silicon lithium detector, through Mo target as a source of monochromatic X-rays. The

spectrum of energy generated on the detector was processed to obtain analytical data.

The intensity of the fluorescent x-rays on the detector would be proportional to the concentration of the individual element of interest in the sample.

RESULTS AND DISCUSSION

The mean concentrations of heavy metals in two species of fish from Lake Geriyo (mg/kg, dry weight) and that of water in (mg/l) and set standards are shown in Table I. Cu values ranged from 1.44 ± 0.06 mg/kg to 2.65 ± 0.05 mg/kg and it was recorded in both species. Cr value was 21.4 ± 0.6 mg/kg and it occurred in *C. anguillaris*. It was the most accumulated. Cr and Cu in the two fishes could be attributed to the fact that chemicals made from salts of arsenic, chromium and copper mixed soluble formation (as copper-chronic-arsenate preservative) being used to prevent fungi and pest attack which provide a potential source of chemical spills and drainage within the catchments area of the lake (forstner *et al.*, 1981) Ni values ranged from 1.11 ± 0.01 mg/kg to 7.12 ± 0.01 mg/kg and it occur in both fishes. Pb value was 1.06 ± 0.06 mg/kg it was the least and it was present in *C. anguillaris* only. Pb and Ni presence in the lake could be attributed to the fact that they are naturally found in surface waters due to weathering of minerals and soil erosions (USEPA, 1997). It could also be due to auto exhaust and phosphate fertilizers. Mn value 3.17 ± 0.02 mg/kg, and it was found in *C. anguillaris* only. Zn values ranged from 4.13 ± 0.02 mg/kg to 6.04 ± 0.06 mg/kg and it was present in *C. anguillaris* and *P. africana*. Cr, Cu, Zn and Mn are concentrated in the sediments of lakes and rivers as well as in aerobic and anaerobic bacteria. *C. anguillaris* and *P. africana* are bottom feeders, they therefore concentrate Mn, Zn from sediments and bacteria as well as in fertilizers (Shahunthala, 1989).

Fe values ranges from 5.7 ± 1.3 mg/kg to 9.45 ± 0.13 mg/kg was detected in *P. africana* and *C. anguillaris*.

It could be due to metal works, run-of from rusted metallic pipes and the dumping of metal scraps from metal scraps market on the bank of lake Geriyo.

The levels of Cr, Mn and Ni are higher when compared with WHO and FEPA standard limits and the consumption of these fishes could cause health hazards to man. The levels of Cu, Zn and Pb are lower than WHO and FEPA in the fishes and it could be due to the fact that Cu and Zn have least value in water (Table 1). Similarly the levels of Cr, Mn, Ni, As in water of the lake are higher than WHO and FEPA and the water is considered unsuitable for drinking and aquaculture.

CONCLUSION

Therefore, Lake Geriyo is contaminated with Cr, Mn, and Ni; consequently the fish species *C. anguillaris* and *P. africana* were contaminated with varying level of Cr, Mn, and Ni. The lake has been subjected to intense irrigation and pollution loads coming up stream of river benue during the rainy season to the lake is a major factors for high heavy metal levels in the lake and fishes.

ACKNOWLEDGEMENT

I want to express my profound gratitude to Prof. B.M.B. Ladu of Federal University of Technology Yola and Dr. Femi Daddy Provost, Federal College of Freshwater Fisheries Technology, Baga Maiduguri for their encouragement and unwavering support. I also want thank the laboratory technologist at Energy research Zaria for analyzing the samples.

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Table 1: Mean concentration of Heavy Metals in fish (mg/kg, dry weight) from Lake Geriyo and set Standards. WHO (1985) and FEPA (2003)

<i>Heavy Metals</i>	<i>Fish samples</i>		WHO 1985	FEPA 2003
	<i>C. anguillaris</i>	<i>P. africana</i>		
<i>Cr</i>	21.400 $\pm$ 0.600	BDL	0.15	0.15
<i>Cu</i>	1.440 $\pm$ 0.060	2.650 $\pm$ 0.050	3	1-3
<i>Mn</i>	3.710 $\pm$ 0.020	BDL	0.5	0.5
<i>Fe</i>	9.450 $\pm$ 0.130	5.700 $\pm$ 1.300	N.S	N.S
<i>Ni</i>	1.110 $\pm$ 0.010	7.120 $\pm$ 0.010	0.6	0.5
<i>Zn</i>	6.040 $\pm$ 0.060	4.130 $\pm$ 0.020	10-75	75
<i>Pb</i>	1.060 $\pm$ 0.060	BDL	2.0	2.0

BDL: Below Detectable Limits N.S: Not specified. $\pm$: Standard deviation.