Comparison of Heavy Metals levels in Wholefish samples of Mud Fishes

C.U. Erhabor*, E.E. Obasohan[1], I.O Eguavoen[2]

*Polymer Technology Department, Auchi polytechnic,P.M.B. 13, Auchi,Nigeria
[1]Chemistry Department, Ambrose Alli University Ekpoma, Nigeria
[2]Rubber Research Institute of Nigeria, Iyanomon,Benin City, Nigeria
lawekebafe@gmail.com

Abstract: Two mud fishes common in the stream are Claries gariepinus and Parachanna obscura. The concentrations of Lead(Pb), Zinc(Zn), Nickel(Ni) iron, Manganese(Mn) and Copper (Cu) in the whole fish samples of the two mud fishes – Claries gariepins and Parachanna obscura from Ibiekuma stream Ekpoma, Nigria were studied. The fish samples were collected from the three established stations on the stream using variety of fishing gears. The samples were stored, identified, digested and analyzed by atomic absorption spectrometry 969 solar unicam. The whole fish mean concentrations in mg/kg for claries gariepinus ranged from 228.75± 0.1 – 268.00±0.20 (Fe), 5.18±0.02-8.40±0.05(Cu),15.13±0.04-19.03±0.03(Mn), and 18.15±0.03-21.68±0.04 (Zn) Parachanna obscura whole fish bioaccumulation level ranged from 386.30±0.30 – 447.00± 0.50 (Fe), 6.10±0.10 – 11.64± 0.04 (Cr) 26.80± 0.08 – 38.40± 0.03 (Mn) and 34.40± 0.05 – 39.40± 0.02 (Zn) the results showed that both fishes Bioaccumulated heavy metals (except Ni and Pb) to varying levels. Results also showed that Parachanna Obscura Bioaccumulated higher heavy metals more than Claries Gariepinus. The different mean concentrations might be as a result of different ecological needs, metabolism, feeding pattern and different sizes of fishes. Metal concentration also varied from station to station. Some heavy metal concentrations in both fishes in the stream exceeded WHO recommended levels in food fish. Therefore consumption of fishes from Ibielcuma stream could induce metal health hazard in man.

[C.U. Erhabor, E.E. Obasohan, I.O Eguavoen. **Comparison of Heavy Metals levels in Wholefish samples of Mud Fishes.** Researcher, 2011;3(10):7-12]. (ISSN: 1553-9865). http://www.sciencepub.net/researcher.

Keywords: Wholefish, mud fish, Heavy Metals

1. INTRODUCTION

Heavy metals are those metals having relative densities greater than $5g/cm^3$ Ademoroti (1996). They are metals whose atomic mass exceeds that of calcium (Bond et al. 1975). They are toxic even at low concentrations. They are not biodegradable but are assimilated and bioaccumulated in the issues.

Heavy metals are of two types. Some of them are beneficial in trace amount. They are called essential or trace heavy metals. They are nutritionally essential for healthy life when present in small quantities. They become toxic when their concentrations exceed a certain limit. Examples of this class are copper, iron etc. The other class of heavy metals is non essential. They are not metabolized. They become toxic even at a very low concentration.

The two major sources of heavy metals are natural and anthropogenic. Natural sources include earth crust, volcanic emission, geological weathering and atmospheric sources. Anthropogenic sources are as a result of various human activities. Heavy metals are introduced into aquatic system through natural and anthropogenic sources (Chernoff and Dooley, (1979). As the water body receives continual inputs of stormwater containing heavy metals, processes such as precipitation, coagulation settling and biological update result in a large percentage of inputs mass being deposited.

The aim of this study is to compare the levels of heavy metals in mud fishes (*Claries gariepinus* and *Parachanna abscura*) from ibiekuma stream with a view to determine the suitability of these fishes of the stream for consumption purposes.

2. MATERIALS AND METHOD

The sample materials were mud fishes (*Clarias gariepinus* and *Parachanna obseura*). Three sample sites were established on the stream. –station A,B and C. The fish samples were collected from these three stations using fishing nets, cage and hooks. The fish samples were collected and stored frozen in the laboratory. The samples were allowed to thaw at room temperature. They were identified using catalogue and keys by boulengner (1916), reed et al. (1967) and Raji and Olaosebikan (1998).

The samples were dried to constant weight in an oven at $105^{o}c$. They were ground separately and digested by perchloric acid, nitric acid and sulphuric acid in the ratio of 1.5:1 as described by streedevi et al (1992). Complete digestion is observed by a milky coloured solution indicating that the heavy metals have been ionized after the disappearance of the white chlorate fumes. The content after cooling was made up to 20cm^3 with distilled water. All other samples were digested using the same process. Digested samples were taken to Martlet Environmental Research Laboratory Benin for analysis. The concentration of heavy metals was determined using atomic absorption spectrometry 969 solar unican series and result recorded in mg/kg. The results were subjected to statistical analysis using analysis of variance (ANOVA) to detect if there are significant differences between metal concentrations in both fish samples collected from different station and its suitability as food.

3. RESULTS AND DISCUSSION

3.1 STATION

Table 1: Comparison of mean metal levels in whole fish sample of *Clarias gariepinus* at the stations.

Heavy Metal mg/kg	A	B	C	Tolerance limit mg/kg
Copper	7.30 ± 0.03^b	8.40 ± 0.05^c	5.18 ± 0.02^a	100
Iron	228.75 ± 0.10^a	268.00 ± 0.20^c	244.75 ± 0.15^b	1.5
Lead	BDL	BDL	BDL	2
Manganese	19.03 ± 0.03^c	15.13 ± 0.04^a	16.68 ± 0.03^b	1.0-1.5
Nickel	BDL	BDL	BDL	0.6
Zinc	20.95 ± 0.05^b	21.68 ± 0.04^c	18.15 ± 0.03^a	100

Results are the means of triplicate determinations ± standard deviation. Mean with different superscripts in the same row are significantly different ($p<0.05$). (a, b and c are superscripts)

Table 2: Comparison of mean metal levels in whole fish samples of *Pararchanna obscura* at the stations

Heavy Metal Mg/kg	A	B	C	Tolerance Mg/kg
Copper	11.73 ± 0.04^c	10.70 ± 0.10^b	6.10 ± 0.10^a	100
Iron	447.00 ± 0.50	386.30 ± 0.05^a	401.50 ± 0.04	1.5
Lead	BDL	BDL	BDL	2
Manganese	38.40 ± 0.03^c	28.00 ± 0.05^6	26.80 ± 0.08^a	1.0-1.5
Nickel	BDL	BDL	BDL	0.6
Zinc	39.40 ± 0.02^c	34.40 ± 0.04^a	35.90 ± 0.05^b	100

Results are the means of triplicate determinations ± standard deviation mean with different superscripts in the same row are significantly different ($p<0.05$) (a, b and c are superscripts) BDL = below detection level

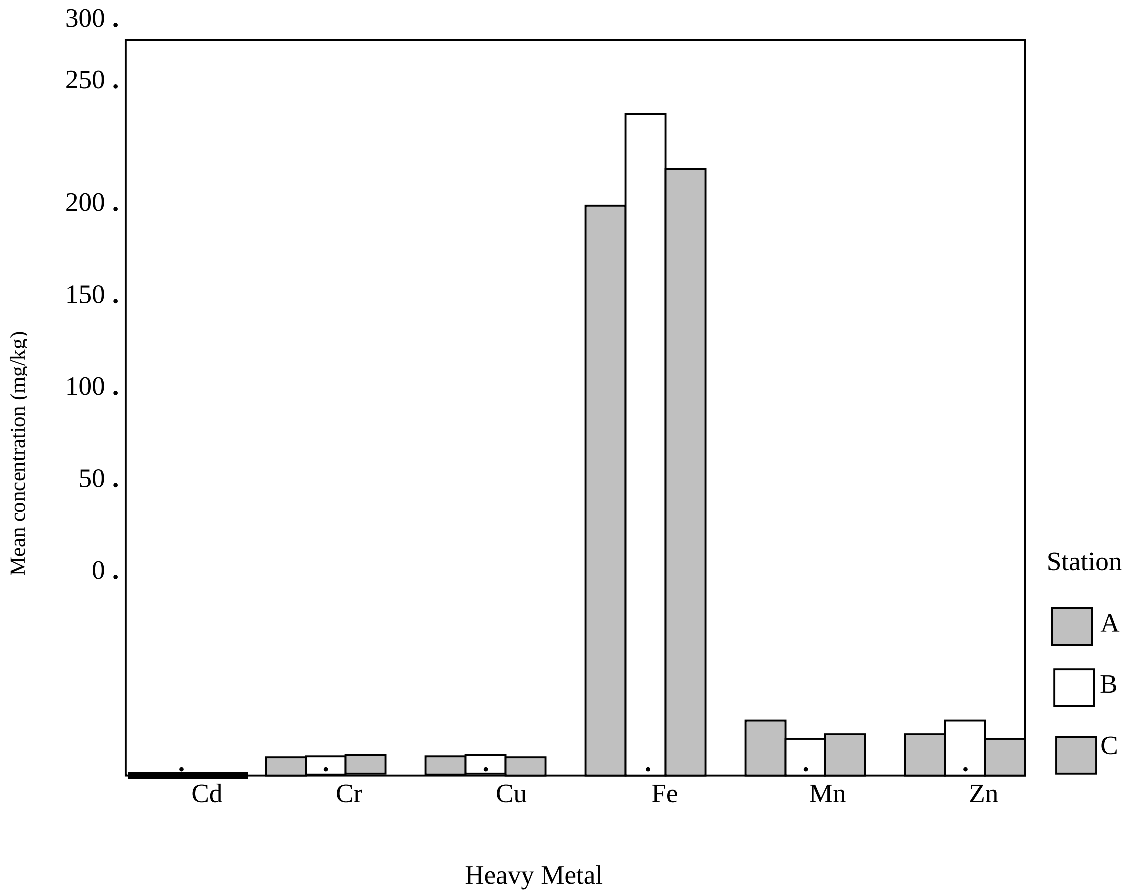

Fig 1: Mean concentrations of Heavy Metals in *Charias gariepinus*

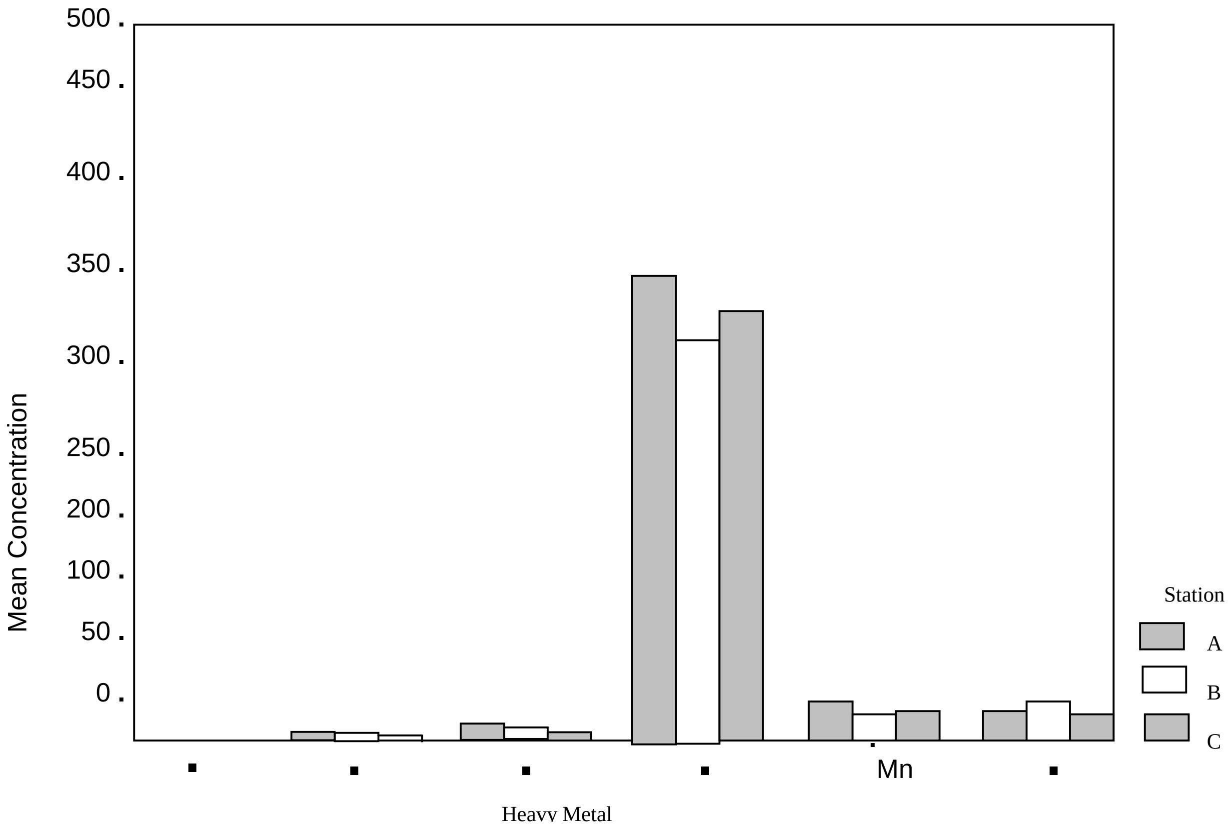

Fig 2: Mean Concentrations of Heavy Metals in Whole Fish (*Parachana obscura*)

3.2 COPPER

The copper mean concentration ranged from 5.18± 0.02 at c to 8.40± 0.05 at B for *Clarias gariepinus* while that of *Obscura* ranged from 6.10± 0.10 – 11.73±0.04mg/kg. These values were lower than 100mg/kg tolerance limit set by Canadian Food and Drug Directorate (uthe and bligh, 1971). Therefore the fishes from Ibiekuma stream is suitable for consumption as it may not cause cu induced hazards.

Copper mean concentrations in *Parachanna obscura* were higher than that of *Clarias garipinus*. The different may be due to differences in cu bioavailability in water at the stations as well as differences in the fish feeding habits. Mathis and cummings, (1972) reported high cu concentrations in sediments and in animals living in the sediments *Parachanna obscura* is a bottom feeder and obtains food from sediments. The concentrations of Cu in the tissues appear to be more greatly influenced by association with bottom sediments than position in food chain in aquatic organisms (wren et al 1983).

3.3 IRON

The mean levels of iron in *Parachanna obscura* ranged from 386.30± 0.05 – 447.00±0.05 mg/kg. Statistical analysis showed significant differences ($p<0.05$) in iron concentrations in this fish at he three different stations. Iron means concentration in *Clarias gariepinus* ranged from 228.75±0.10 268.00±0.02 mg/kg. *Parachanna obscura* being predatory bioaccumulated more iron than *Clarias gariepinus* which is a detritus. Iron is the prevalent heavy metal in both fishes. The range of iron concentrations in the two species of fish was higher than the WHO, 1985 recommended tolerance limit (1.50g/kg) in food fish. Based on this, both fishes of the stream may be deemed unfit for consumption. Iron is an essential element required for optimal biological function but excess of it leads to liver and kidney disorder (Ademoroti, 1996).

3.4 MANGANESE

The mean levels of Mn in *Parachanna obscura* ranged from 26.80 ± 0.08 – 38.40 ± 0.03 mg/kg. Analysis of variance showed statistical differences (P < 0.05) in Mn concentrations in *Parachanna obscura* at the three different stations. The mean levels of Mn in *Clarias gariepinus* ranged from 15.13 ± 0.04 – 19.03 ± 0.03mg/kg. Analysis of variance also showed significant differences of Mn at the different three stations. This is due to the difference of metal in water and bioavailability at the different stations.

Manganese levels recorded in *Parachanna obscura* were higher than that obtained from *Clarias garvepinus*. This was expected in view of differences in feeding habit of the fishes. Manganese levels recorded in both fishes from this study were higher than those reported for the same species from Ogba and Ikpoba rivers in Benin (Obasohan, 2003). The Mn recorded levels in this study were also higher than the recommended limits of 1.0 – 1.5mg/kg for food fish (WHO, 1985) suggesting that with regards to Mn, the fishes could be said to be unfit for human consumption.

3.5 ZINC (Zn)

The mean concentrations of Zn in whole fish sample of *Parachanna obscura* ranged from 34.40 ± 0.04 – 39.40 ± 0.05 mg/kg while that of *Clarias gariepinus* ranged from 18.15 ± 0.04 – 21.68 ± 0.04mg/kg. Analysis of variance showed significant difference (P < 0.05) in Zn concentrations in both fishes at the three different stations. This difference could be due to bioavailability of zinc at the stations.

The mean concentration levels of Zn in *Parachanna obscura* were higher than that obtained in *Clarias gariepinus* from the same stream and could result from differences in feeding and metabolism between the fishes. These levels were however higher than the mean Zn levels of 15.28 and 13.67mg/kg reported for Ogba river Benin (Obasohan, 2003). The levels of Zn in both fishes reported in this study were lower when compared with WHO (1985) and FEPA (2003) recommended levels in food fish, implying that Zn in fishes of Ibiekuma stream could not pose health hazards to consumers.

The Canadian food and drug directorate has established a tolerance of 100mg/kg (Uthe and Bligh, 1971). By any of the above, the two species of fish from Ibiekuma stream are fit for consumption.

Zinc is essential element for human and animal growth. However at a certain concentration, Zn is known to be toxic to fish. It causes mortality, growth retardation and cardiac changes

3.6 Lead (Pb) and Nickel (Ni)

Lead and Nickel though present in the stream, were below detection limit in any of the two species of fish collected from the different sampling sites. Fishes from Ibiekuma stream do not pose Pb and Ni health hazards to consumers. Lead does not accumulate in fish except in cases of extreme pollution (Moore and Ramamorthy, 1984) while Nickel was not bioavailable to fish.

4 CONCLUSION AND RECOMMENDATION

The results indicated that both fishes bioaccumulated Cu, Fe, Mn, and Zn to varying levels with exception of Ni and Pb. *Parachanna obscura*, bottom feeder bioaccumulated higher concentration of Cu, Fe, Mn, and Zn than *Clarias gariepinus* which is a detritus feeder. This might be due to ecological needs, metabolism, feeding pattern and different sizes of fishes. *Parachanna obscure* being predatory fish bioaccumulated metals by biomagnification along the food chain.

The concentrations of Fe and Mn in both fishes exceeded the recommended levels in food fish. Consumption of fisher of Ibiekuma stream could therefore induce metal health hazards in man. In fish, metal toxic effects could lead to organic damage, stunted growth and eventually death.

In order to avoid serious health hazards, there is the need to institute water pollution control and management of Ibiekuma stream water body. The followings are therefore recommended:

1. Human activities that lead to the discharge of effluent into the water body must be checked.
2. Pollution levels in the stream must be continuously monitored to provide adequate information necessary for effective management of the stream. Further research work is necessary to provide additional information on aquatic biota of the stream and the chemistry of heavy metals in the stream.
3. Promulgation and enforcement of environmental protection laws to protect the aquatic consumption of the Ibiekuma stream through adequate pollution control.

Corresponding Author's Address:
Department of Polymer Technology
Auchi Polytechnic, Auchi
Phone: +234-805-423-9673 or +234-806-343-2575.
E-mail: lawekebafe@gmail.com

REFERENCES

1. Ademoroti, C.M.A (1996): Environmental Chemistry and Toxicology. Foludex Press Ltd, Ibadan.
2. Bond, G.B et al (1973): Environmental Control Vol 111, Water Supply and Treatment GRP Press, Ohio.
3. Boulengner, G.A (1909 - 1916): Catalogue of Freshwater Fishes of Africa on the British Museum of National History of London.
4. Chernoff, B and Dooley J.K (1979): Heavy Metals in Relation to the Biology of the Mimmichog (Fundulus Heteroclitus) J. Fish Biology 14: 309 – 328.
5. Mathis B.J and Commings, T.F (1973): Selected Metals in Sediments, Water and Biota in the Illinois River. Journal of the Water Pollution Control Federation 45(7): 157 – 83.
6. Moore, J.W and Ramamoorty, S (1984): Nickel in Heavy Metal in Industrial Water Applied Monitoring and Impact Assessment, ed. R.S Desano, New York: Springter – Veriag.
7. Obasoha, E.E (2003): Heavy Metals Concentration in the Water Sediment and Fishes from Ogba River, Benin City, Nigeria Ph.D Thesis, University of Benin, Benin City Nigeria 225p.
8. Olaosebikan, B.D and Raji, A (1998): Field Guide to Nigeria Freshwater Fishes. FCFFT Publication Decency Printers. 106p.
9. Reed, W et al (1967): Fish and Fisheries of Northern Nigeria Ministry of Agriculture, Northern Nigeria. 226pp.
10. Uthe, J.F. and Bligh, G.B (1971): Preliminary Surveys of Heavy Metals Concentration of Canadian Freshwater Fish. Journal of Resource Board of Canada. 8 (5) 786 – 788.
11. World Health Organization (WHO) (1985): Guideline for Drinking Water Quality Vol. 1 Recommendations WHO, Geneva 130pp.
12. Wren, C.D et al (1983): Examination of Bioaccumulation and Biomagnification of metals in a Precambrian Shield Lake. Water, Air and Soil Pollution 19:277 – 2q.

10/2/2011