



*Research Article*

# Evaluating the Potential of African Catfish (*Clarias gariepinus*) to Bioaccumulation of Some Selected Heavy Metals

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ARTICLE INFO	ABSTRACT
<p><b>Article No.:</b> 083013809 <b>DOI:</b> 10.15580/GJAS.2013.10.083013809</p> <hr/> <p><b>Submitted:</b> 30/08/2013 <b>Accepted:</b> 22/10/2013 <b>Published:</b> 29/10/2013</p> <hr/> <p><b>*Corresponding Author</b> Femi Francis Oloye <b>E-mail:</b> <a href="mailto:pen2crown@gmail.com">pen2crown@gmail.com</a></p>	<p>The potential of African Catfish to bioaccumulation of some selected heavy metals was done by introducing heavy metals into the fish water after the fish was starved for 24hr; the test was done by semiotic bioassays method. The results were analysed with AAS and it was observed that different metals attached to various part of the fish with diverse strength and affinity.</p>
<p><b>Keywords:</b> Bioaccumulation, heavy metals, semiotic bioassays</p>	

## INTRODUCTION

Industrial wastes, geochemical structure and mining of metals create a potential source of heavy metal pollution in the aquatic environment [1,2]. In March 2010, an unusually high number of deaths, primarily among children under age 5 in Bukkuyum and Anka Local Government Areas (LGAs) of Zamfara State, northern Nigeria, was reported by Médecins sans Frontières (MSF-Holland) to state health authorities. Further study on blood samples taken by MSF revealed that the increased mortality was the result of acute lead poisoning, determined to be caused by massive environmental contamination from artisanal mining and processing of gold found in lead-rich ore. The grinding of the ore into fine particles resulted in extensive dispersal of lead dust in the villages concerned, including within family compounds. Ingestion and inhalation of the fine lead particles was determined to be the major reason for high blood lead levels in victims' bodies. Blood lead levels (BLLs) were "unprecedented" for human beings, according to the US Centers for Disease Control and Prevention (CDC).

In the sea, pollutants are potentially accumulated in marine organisms and sediments through bioaccumulation and bio concentration and consequently transferred to human being through food chain. The heavy metal pollution of the marine environment has long been recognised as a serious environmental concern [3,4]. Heavy metals could either be essential metals or non-essential metals depending on their toxicity and uses. Zinc, copper, iron, manganese and nickel are example of essential metals while lead, mercury and cadmium are examples of non-essential metals. It is of importance that essential metal could also become threatening and dangerous if it exceeds certain limits. In this study POTENTIAL OF AFRICAN CATFISH (*Clarias gariepinus*) TO BIOACCUMULATION OF HEAVY METALS will be evaluated and necessary conclusion as regards parts of the fish with highest bioaccumulated metals will be made.

## EXPERIMENTAL

### Sample collection and Acclimatization

Healthy specimens of African catfish *Clarias gariepinus* were obtained from a local fish farm at Ikare-Akoko town, Ondo State, Nigeria and were transported in containers to the laboratory. The choice of *Clarias gariepinus* was informed by its ability to withstand stress and its high commercial value in Nigeria. In the laboratory, fishes were kept in large plastic bowls containing 60 L of clean tap water and acclimatized for 6 weeks to the laboratory conditions, during which time they were provided with artificial feed (grower's mash) and ground shrimps obtained locally to avoid possible effects of starvation on any of the parameters of the fish. The size of the fish varied from 18.1 – 22.7cm in standard length and 50.6-97.4g in weight. Fish of both

sexes were used without discrimination. The fish were inspected for disease conditions and general fitness.

Water was changed every other day. Fourteen fingerlings were kept per bowl. There were five different treatment groups and each had three replicates. The fish were fed three times daily on a 40-percent crude protein diet during the period of acclimatization. Feeding was discontinued while aeration continued during the 96-hr test period.

### Determination of Water Physico – Chemical Parameters

The water quality parameters of the diluting water used in the tests were determined by standard methods [6]. The temperature was measured with mercury-in-glass thermometer. Measurements were made also of the pH using pre-calibrated pH meter (Hanna pH 211 microprocessor). The alkalinity and dissolved oxygen were also determined. The results are presented in Table 4.1.

### Preparation of Stock and Test Solutions of Zinc

Stock solution of the test metal compound, a chemically pure copper tetraoxosulphate IV heptahydrate ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ) was prepared by dissolving 3.906g of Merck grade reagent equivalent to 1 g of zinc in 1000 ml distilled water at concentration of  $1000 \text{ mg L}^{-1}$  (i.e. 1000 ppm). From the stock solutions, 5.0 ppm was prepared by pipeting 5 ml of the stock and add to 995 ml of distilled water. This concentration was used in the study to assess not the mortality rate but the extent to which Zn can be taken up by the fish, its binding potential to the various organs and possibly, extent of recovery within a clean environment

### Toxicants Introduction

The fishes numbering 30, which have been starved for 24-hr was distributed into three 60L capacity plastic containers. To each container, ten fishes were introduced. The toxicant (5.0 ppm Zn solution) was introduced immediately and the time accurately recorded. The exercise lasted for 96-hr. and the mortality during the period were carefully noted and recorded. The test was performed by the semistic (renewal) bioassay method in which the exposure medium was exchanged every 24-hr to maintain toxicant strength and level of dissolved oxygen as well as minimizing the ammonia excretion levels during this experiment [5]. After the 96-hr expiration of the experiment, two fishes from each plastic were removed and preserved in the freezer for metal analysis.

### Recovery Study

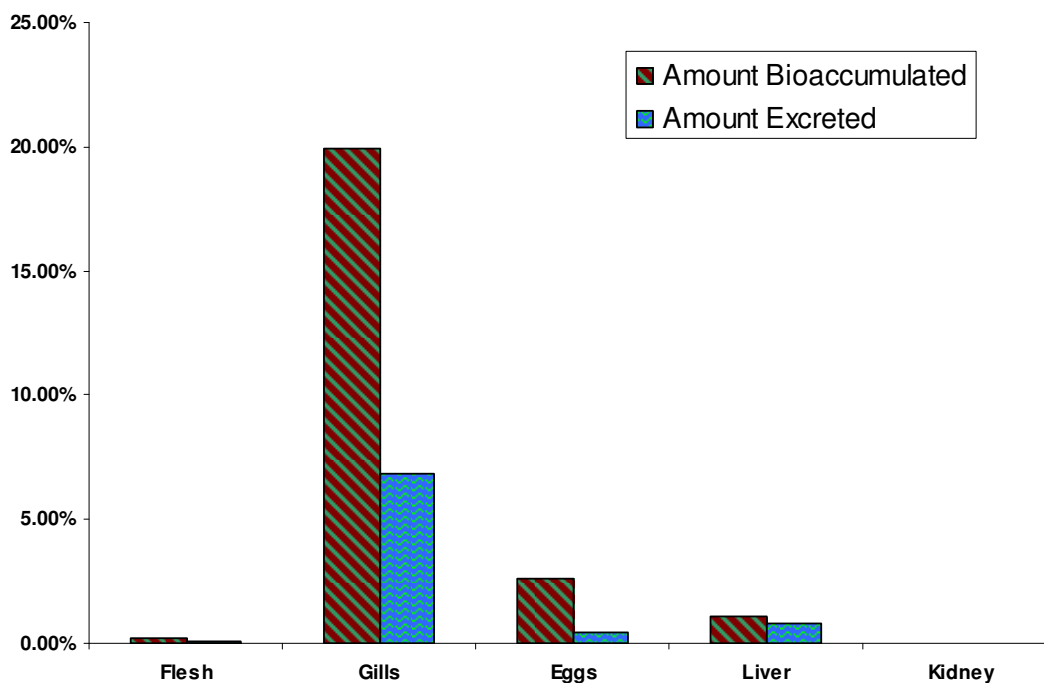
The fishes remaining after the 96-hr bioassay were transferred in a clean water inside similar plastic bowl, fed with fish meals and monitored for another 96-hr. After the 96-hr expiration of the experiment, two fishes from each plastic were removed again and preserved in the freezer for metal analysis.

## RESULTS AND DISCUSSION

The results of the physico-chemical parameters measured are given in table 3.1 while figure 3.1 to 3.2 gives the details of the concentrations of Cu, Cu & Zn, Pb, and Pb & Ni in the various parts of the fish examined in the study, before and after recovery.

**Table 3.1: The physico-chemical characteristics of the water used**

Parameter	Value
Temperature ( $^{\circ}\text{C}$ )	$27.4 \pm 1.1$
pH	$6.51 \pm 0.23$
Alkalinity (as $\text{HCO}_3^-$ )	$193.3 \pm 2.7$
Hardness (as $\text{CaCO}_3$ )	$227.5 \pm 3.1$
Dissolved oxygen	$6.56 \pm 1.23$



**Fig. 3.1 Percent Cu bioaccumulated and excreted in fish.**

It can be seen from fig.3.1 that the concentration of Cu in the flesh, liver and eggs were below 5% and it was below detection limits in kidney while the concentration in the gills is around 20% before recovery above 5% after recovery. The concentration of Cu in various part of the fish changes upon addition of Zn, the concentration of Cu in eggs is the least, then kidney,

liver, gills and flesh but during recovery it loses visually all the Cu present in the flesh and the amount present in other reduced although the concentration of Cu in the Kidney is practically the same. For Zn, liver accumulated the highest amount followed by eggs, flesh, gills and kidney after recovery amount of Zn in all parts reduces with highest reduction in flesh and eggs.

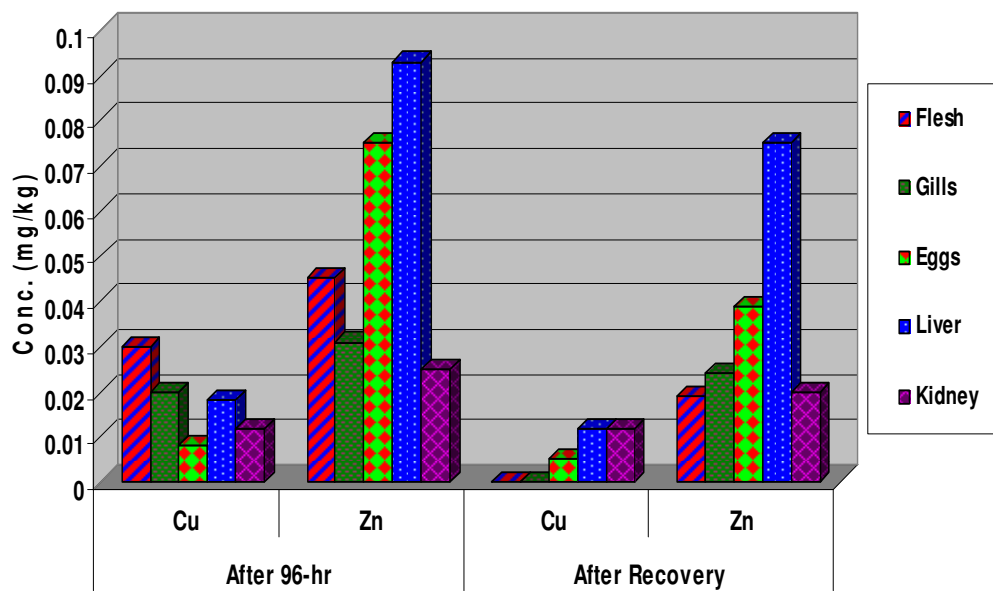


Fig.3.2 Distribution of mixture of Cu and Zn in fish before and after recovery

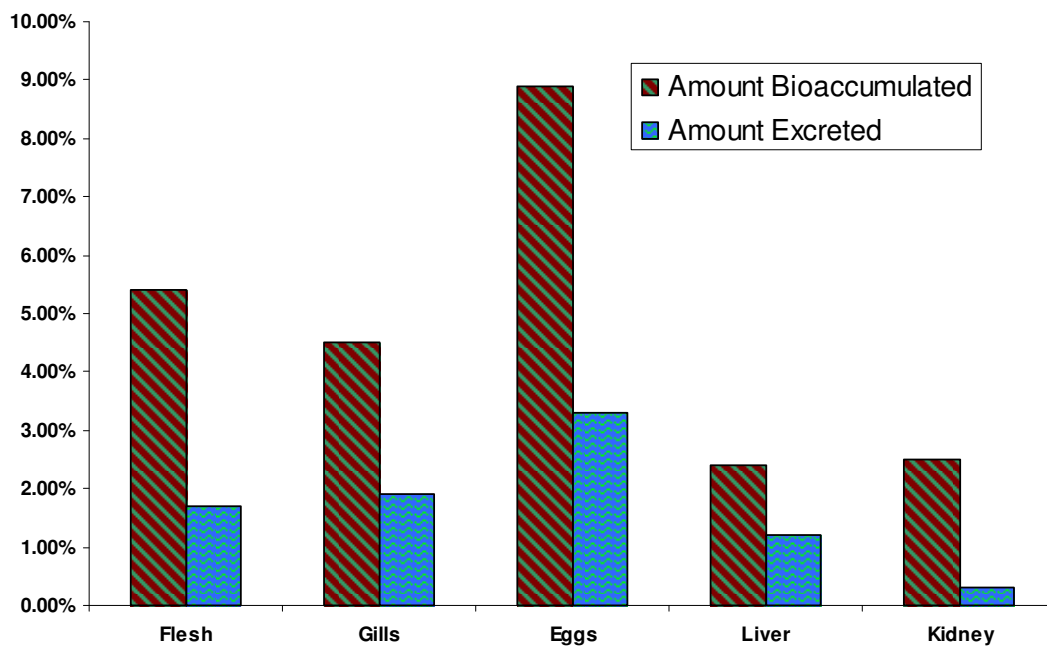
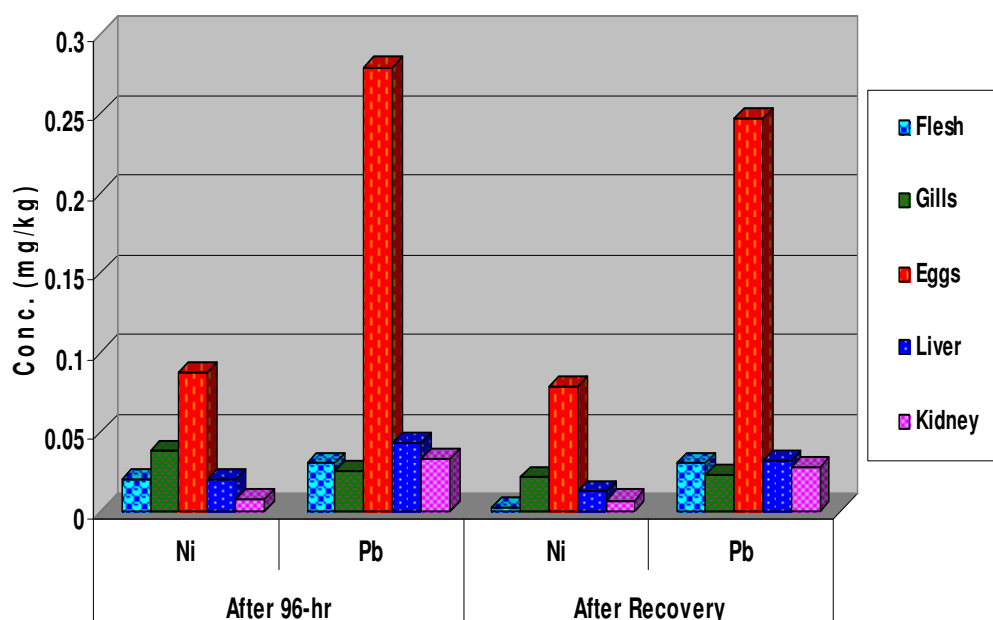


Fig. 3.3 Percent Pb bioaccumulated and excreted in fish



**Fig.3.4 Distribution of mixture of Ni and Pb in fish before and after recovery**

From Fig.3.3 the eggs had the highest concentration of Pb bioaccumulated and excreted. fig.3.4 also confirmed eggs to contain highest concentration of Pb which reduced during recovery. It can also be seen that amount of lead in flesh is the same after recovery, every other information are very clear in the figures, the amount of Pb in the fish were relatively constant after recovery meaning that even after recovery Pb is present in fish body.

## CONCLUSION

It can be seen from the above results that the amount of the selected heavy metals singly and in mixture is very small in fish body and that each heavy metals are attached to different part of the fish with different degree of affinity. It can also be concluded that Cu and Ni easily leaves flesh after recovery but Pb and Zn were attached to the flesh. Caution must be taken when eaten fish from contaminated site or when eaten fishes

kills with Chemicals because some of these heavy metals and other chemicals will be attached to different part of the fish even upon serious washing.

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