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*Full Length Research Paper*

# Toxic stress exhibited by juveniles of *Clarias gariepinus* exposed to different concentration of lead

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**Abstract**

**The toxic stress of lead exposed to *Clarias garienpinus* was determined at 96-hour. Anhydrous Lead II nitrate was used to prepare the stock solution. The concentrations of lead used were: 0.00, 1.80, 3.20, 5.60, and 10.60mg/L. The lethal concentration ($LC_{50}$) was estimated using the logarithmic method and was found to be5.60mg/L. The lethal concentration confirmed that lead II nitrate is highly toxic to *Clarias garienpinus*. The Fish showed various abnormal behaviors upon exposure to lead II nitrate, immediate reaction was erratic swimming and tendency to jump out of the test bowl. Others include restlessness, uncoordinated movement, vertical swimming, air gulping, loss of equilibrium, a period of quiescence and eventually death. There is need for more work to set maximum permissible levels of metals for fish meant for human consumption in Nigeria.**

**Keywords:** Toxic stress, Lead, *Clarias garienpinus*

## INTRODUCTION

Consumption of lead contaminated fish exposed humans to the risk of carcinogenic and non-carcinogenic infection (Okareh and Akaunde 2015). Toxic elements like lead may be taken directly by man or indirectly through the food chain like the consumption of lead poisoned fish (Olafe *et al*, 2003). However, the toxic potential of any chemical exposed to a fish depends on the size of the fish and the species of the fish and its ability to withstand the toxicity of the chemical (Makinde *et al*, 2015). The contamination of water body with chemicals affects the biota that is resident in the water (Dahunsi and Oraunsi, 2012). The acute toxicity of the fish is to evaluate the toxicity of certain poisonous substances in the environment. Acute toxicity test are short duration tests aimed at assessing the effect of toxic materials exposed to aquatic biota within a short time interval of the life of the organisms like the African catfish in this present study (Ebrahinpuur *et al*, 2010).

*Clarias gariepinus* is a rich source of animal protein and the fish is hardy. It is found in all the fresh waters sources in Nigeria and widely cultured everywhere in the country. It is valued highly in Nigeria. This study is therefore aimed at assessing the response of the fish to the graded concentration of lead exposed to it.

## MATERIALS AND METHODS

### Sample collection

Juveniles of *Clarias garienpinus* were obtained from a fish farm in Nyiman layout high level Makurdi, Benue State.

### Acclimatization of fish

The fish were acclimatized for 14 days in plastic bowls containing de-chlorinated tap water at room temperature (about $25^0$C). The fish were fed daily with commercial fish feed (Copens). During the period of acclimatization water was changed daily during the period of acclimatization to prevent build-up of metabolic wastes.

### Preparation of stock and test solution of lead

The test chemical used for the experiment was anhydrous lead nitrate. After a range – finding test, the concentrations prepared for the experiment were 1.8, 3.2,

**Table 1:** 96hours acute toxicity test of *Clarias garienpinus* juveniles exposed to different concentrations of lead.

| s/n | Concentration (mg/L) | Log of concentration | Number of fish Exposed | Number of fish died | %Mortality | Probit Value |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.000 | 10 | 0 | 0 | 0.00 |
| 2 | 1.8 | 0.255 | 10 | 1 | 10 | 3.72 |
| 3 | 3.2 | 0.505 | 10 | 4 | 40 | 4.75 |
| 4 | 5.6 | 0.748 | 10 | 6 | 60 | 5.25 |
| 5 | 10.6 | 1.02 | 10 | 9 | 90 | 6.28 |

5.6, and 10.0 mg/g of lead respectively. A stock solution of 1000mg/l (1g/l) of the lead was prepared by adding 1.0 g of lead to 1litre of distilled water. The amount of lead nitrate which contained 1.0 g of lead was determined from the molecular and atomic weights as:

$$\frac{\text{Molecular weight of lead nitrate}}{\text{Atomic weight of lead (Pb)}}$$

The different concentrations required were calculated as follows:

$$\frac{\text{Wt of lead required x molecular wt of lead}}{\text{Atomic weight of lead}}$$

**Exposure of the fish to lead**

Feeding was stopped 24hours prior to and during exposure period that lasted for 96 hours. Acute toxicity test (96 hours$LC_{50}$) was conducted in the fisheries laboratory of University of Agriculture Makurdi following (Odiete, 1999). Ten juveniles of *Clarias garienpinus* were randomly selected and transferred into 20 litres experimental test bowls. The concentration of lead (II) nitrate used was 1.8, 3.2, 5.6 and 10.6mg/L as after a preliminary test. Room temperature condition was maintained during the experiment. There was a control in which ten fish were also used lead concentration. Mortality was observed and recorded within 24 hours up to 96 hours. Fish were considered dead when gill movement ceased and no response upon gentle prodding. Dead fish were removed from the test solution. Probit mortality was used to determine the 96 hours $LC_{50}$ of the lead on *Clarias gariepinus*.

**Determination of the physic-chemical characteristics of the water**

The physico-chemical characteristics of the water used were examined after introducing the test chemical lead (II) nitrate in the different concentrations. These parameters include: temperature, dissolved oxygen, pH, and total dissolved solid and electrical conductivity. All the water parameters were determined using the multi-parameter water checker by selecting the appropriate programme number for the parameter and then selecting the mode and inserting the probe the multi parameter checker into the sample.

**Data analysis**

The test concentrations were converted into logarithm and the corresponding mortality percentage into the probit value (Finney 1971). The obtained probit values were plotted against the graded concentration of the zinc metal. The physico-chemical results were subjected to student t test analysis and descriptive statistics

## RESULTS

The result presented in Table 1 in 96 hours acute toxicity of *Clarias garienpinus* juveniles exposed to different concentrations of lead. This result indicates that highest mortality was recorded in the highest concentration of 10.6mg/L while 1.8mg/L concentration recorded the lowest mortality. This shows that mortality rate increased with increasing concentration of lead in water. Similarly the result presented in Figure1 in Regression of probit kill and concentration of lead II nitrate exposed to *Clarias garienpinus* juvenile. This result indicates a strong relationship between the probit mortality and concentration of lead having an $R^2$ value of 0.95.

The data presented in Table 2 is the physico-chemical characteristics of the water sample during exposure of *Clarias garienpinus* juveniles to lead. The result indicates that temperature ranges from $25.3^0$C to $25.4^0$C, pH ranges from 8.7 to 10.86, total dissolved solid ranges from 468mg/Lto 139mg/L, the dissolved oxygen recorded ranges from 4.2mg/L to 5.0mg/L. Electrical conductivity ranges from 856µS/cm to 937µS/cm.

## DISCUSSION

The findings of this study did not record any mortality in the control where the toxicant was not introduced. All the

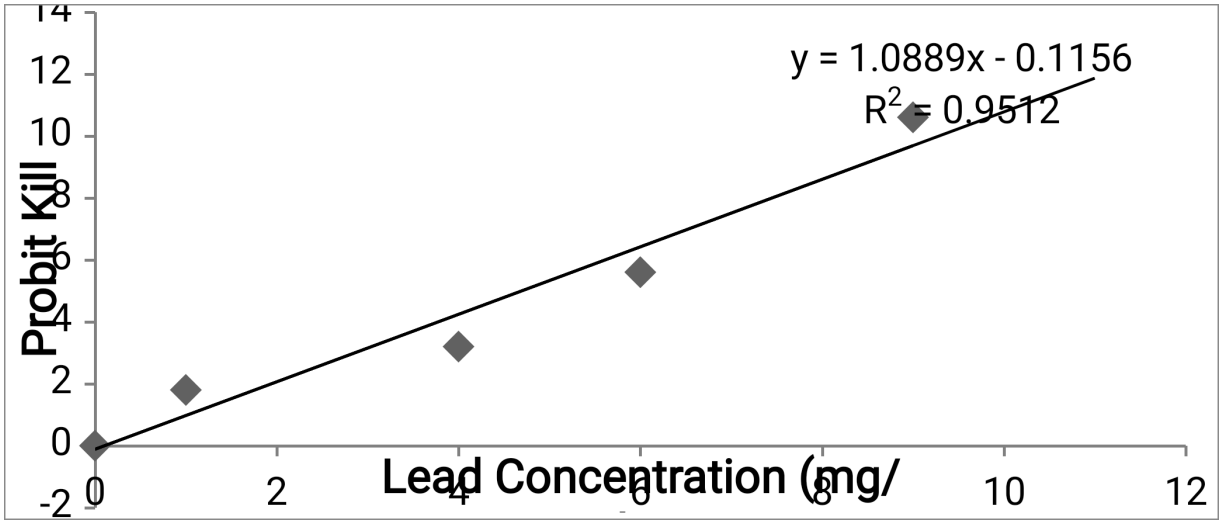


**Figure 1:** Regression of probit kill and concentration of lead II nitrate on *Clarias garienpinus* juveniles

**Table 2:** Physico-chemical characteristics of the water samples during exposure of *Clarias garienpinus* juveniles to Lead.

| Conc mg/L | Temp ($^0$C) | pH | TDS (mg/L) | DO (mg/L) | EC (µS/cm) |
|---|---|---|---|---|---|
| 1.80 | 25.67 | 10.12 | 428.00 | 4.80 | 856.00 |
| 3.20 | 25.23 | 10.16 | 467.00 | 4.63 | 915.00 |
| 5.60 | 25.65 | 10.26 | 467.00 | 4.45 | 926.00 |
| 10.60 | 25.35 | 10.86 | 468.00 | 4.20 | 936.00 |
| Control(0.00) | 25.40 | 8.70 | 139.00 | 5.00 | 937.00 |

same mortality was observed in all the other concentrations. This observation is similar to the report of Zabbey *et al.*, (2014). Generally a common trend was noticed in the death of the fish that increases as the concentration of the lead that is exposed to *C. gariepinus* increases. Consequently the 10.60mg/L concentration of the toxicant which was the highest concentration recoded 90% mortality while 1.80mg/L which was the lowest recorded 10% mortality of the fish during the study period of 96 h exposure. The result mortality of 96 h exposure period of C. gariepinus that survived the first 72 hours of the lead toxicity may be due to the hardy nature and the inherent adaptation strategies in the ability of the fish to withstand stressful conditions. These findings conform to the observation of Ololade and Oginni, 2008).

However, continuous exposure of the of the fish to lead may results to the death of the fish due to damage or injury that comes from the stress that the fish is subjected to.

The results of the regression analysis of the exposure concentration of the toxicant to the mortality of the fish indicate a strong relationship or affinity between the graded concentration of lead and the mortality of *Clarias gariepinus* with a $R^2$ value of 0.9512 during the course of this study. This finding is similar to the report of an earlier study of lead nitrate exposed to *Clarias gariepinus* that reported a $R^2$ value of 0.986. (Bawa-Aallah and Saliu, 2015).

Nevertheless Ayuba *et al*., (2012) reported a $R^2$ value of 0.7501 between probit values and log of concentration of *D. innoxia* leaf extract exposed to *Clarias gariepinus* for 96h. These results deviate from slightly from the findings of this study. Although the variation may be attributed to the difference in the toxicant but the same fish species at different instances.

A perusal at the result of the physico-chemical parameters indicate that the dissolved oxygen decrease with increase in the concentration of the lead toxicant. This may be linked to the high percentage of mortality observed at this concentration due to the suffocation of the fish and consequently its death. This observation is in conformity to those of an earlier study (Ololade and Oginni, 2008, Ayuba *et al.*, 2012). Generally the physico-chemical parameters were more contaminated with the

increase in the concentration of the lead. This observation was noticed across all the water quality parameters examined. This report is similar to the findings of an earlier study (Zabbey *et al.*, 2014). The deteriorating condition of the water quality parameter with the introduction of the varied concentration of lead may also result to the mortality of the fish as compared to the control.

## CONCLUSION

The results of the study revealed that the mortality of the *Clrias gariepinus* increases with the increase in the concentration of the lead nitrate exposed with increase in the exposure time. Although the fish is hardy and has the ability to withstand stress but increase the time and concentration of lead nitrate may results to the death of the fish due to the toxicity of lead. Similarly the graded concentration also deteriorates the water quality thereby facilitating the death of the fish. The study recommends the regulation of releasing toxic metals into the aquatic environment due their toxicity to the fish and other aquatic organisms.

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