International Journal of
AGRICULTURE AND BIOSCIENCES
www.ijagbio.com P-ISSN: 2305-6622 E-ISSN: 2306-3599 editor@ijagbio.com

RESEARCH ARTICLE

# Toxicity of Lead Nitrate and Crude Oil on the Growth of the African Catfish *Clarias Gariepinus*

[1]Ikeogu CF, CI Nsofor[2] and IO Igwilo[3]

[1]Department of Fisheries and Aquaculture, Nnamdi Azikiwe University, Awka, Anambra State Nigeria
[2]Department of Zoology Nnamdi Azikiwe University, Awka, Nigeria
[3]Department of Applied Biochemistry Nnamdi Azikiwe University, Awka, Nigeria

**ARTICLE INFO**

Received: July 13, 2013
Revised: September 17, 2013
Accepted: October 08, 2013

**Key words:**
*Clarias gariepinus*
Crude oil
Lead Nitrate
Toxicity

***Corresponding Address:**
Ikeogu CF
chiubaikeogu@yahoo.com

**ABSTRACT**

Water born environmental contaminants have been shown to exert pronounced effect on various aspects of fish physiology and sometimes lead to large scale mortality. The effects of Lead Nitrate and crude oil on the growth of the African catfish, *Clarias gariepinus* were studied. The acute toxicity tests lasting 96 hours were performed on *Clarias gariepinus* of mean weight 138±12g and mean total length of 28±1.5 cm. The $LD_{50}$ of Lead Nitrate was 57.5 mg/l while the $LD_{50}$ of crude oil was 823.3 ppm. The experimental fish mean weights ranged from 126.0±3.22g to 151.0±0.67g and mean total lengths from 27.38±0.43cm to 31.18±3.76cm were divided into 5 groups A, B, C, D, E, of 20 fish each. Group A was kept as control (no treatment), Group B was exposed to 20mg/l Lead Nitrate, Group C was given to 35 mg/l Lead Nitrate, Group D was administered to 300ppm crude oil, Group E to 600 ppm crude oil. The body weights of the fish were measured weekly. Percentage weight gain and feed conversion ratios were calculated. Treatment lasted for 70 days (10 weeks). The control group showed significant increase in body weight at P<0.05 while the treated groups showed significant reduction in body weight. Therefore, fish under the influence of these pollutants did not mature duly and was susceptible to diseases which lead to low productivity and nutritional value. Environmental protection laws must be enforced to prevent and control pollution of water bodies, thereby safeguarding public health.

**Cite This Article as:** Ikeogu CF, CI Nsofor and IO Igwilo, 2013. Toxicity of lead nitrate and crude oil on the growth of the African catfish *Clarias gariepinus*. Inter J Agri Biosci, 2(6): 337-339. www.ijagbio.com

## INTRODUCTION

Fishes are particularly sensitive to water borne environmental contamination and are recognized as useful models for indicating water quality, (Mathis and Kevern, 1975). Lead, a biologically non-essential metal is relatively abundant in nature and of extensive use in modern times (Todd *et al;* 1996). The residuals of lead in room paints from old houses pose a risk from chips and dust (Hu, 2001). The accumulation and transportation of lead in water, atmosphere and sediment result in bioaccumulation of the metal in various pockets of food chain (Azar *et al;* 1975). Sublethal concentrations of lead cause toxicity which results into oxidative damage in fish tissues through generation of free radicals in which reactive oxygen species (ROS) are most important in causing damage to cells and tissues (Verma and Belsare, 2005). Crude oil pollution is common particularly in countries whose ezconomies are dependent on the oil industry. In Nigeria, oil industry operations and most refineries are located in the Niger Delta region where more than 90 percent of oil related activities take place (Imevbore and Adeyemi, 1981). Exposure of aquatic organisms to crude and refined oils, water soluble and water accommodated fractions of crude oil have been shown to impact on various aspects of fish physiology and sometimes lead to large scale mortality (Dambo, 1992; Barron *et al*; 2003; Couillard *et al*; 2005; Lui *et al*; 2006).Contamination of water by heavy metals and crude oil either directly or indirectly can lead to fish Kills, reduced fish productivity or elevated concentrations of undesirable chemicals in edible fish tissue which can affect the health of humans (Adedeji *et al;* 2009).The aim of the present study is to evaluate the effects of sublethal concentrations of lead nitrate and crude oil on the body weight of the African catfish *Clarias gariepinus.*

## MATERIALS AND METHODS

### Acute Toxicity

Acute toxicity tests lasting 96 hours were performed on the African Catfish of mean weight 138±15 g and mean length 28±1.5 cm according to Adeyemo, *et al*; (2008), to determine the $LD_{50}$ of lead nitrate and crude oil. Thereafter sublethal concentrations of lead nitrate and crude oil were used to treat the fishes in the experimental aquaria labeled A, B, C, D and E.

**Collection of Animals**

The *Clarias gariepinus* were collected from Rehoboth farms Nkwelle-Ezunaka, Oyi Local Government Area, Anambra State Nigeria and acclimatized for 14 days before being used for the experiment the fish were divided into the five experimental groups in duplicate. They were fed with fish pellets skretting® fish feeds at 1% biomass, half at 9.00 hours and 17.00 hours respectively.

Group A consisted of 20 fish kept as control, Group B consisted of 20 fish treated with 20mg/l lead nitrate, Group C consisted of 20 fish treated with 35mg/l lead nitrate, Group D consisted of 20 fish treated with 300ppm crude oil while Group E consisted of 20 fish treated with 600ppm crude oil.

Water change was done every 7 days to maintain the pollutant strength and Dissolved Oxygen (DO) level as well as minimize the level of ammonia during the experiment which lasted 70 days. Water quality parameters DO, pH and temperature were monitored during the experiment using standard methods. The weights of the fishes were measured on weekly basis. The mean weights and standard error of the means of experimental fishes were calculated for each treatment group as well as the control. Percentage weight gain and feed conversion ratios (FCR) were calculated as indices for growth analysis. The data were statistically analysed using Analysis of Variance (ANOVA).

## RESULTS

Mean weight and standard error of mean of experimental fish (g) are shown in Table 1.

The changes in mean weights of both control and experimental fish during exposure to Lead Nitrate are shown in Figure 1. The control fish increased from 150±0.85 g to 250±7.07 g. While the experimental fish (20 mg/l of Pb nitrate) increased minimally from 151±0.67 to 175±3.54 g. At higher concentration of Lead Nitrate (35mg/l) the 2$^{nd}$ experimental fish decreased in weights from 147±1.81 to 90±7.07. Therefore, the % weight gain of the control, 20mg/l Pb nitrate and 35mg/l Pb nitrate are 66.67, 15.89 and -38.78% respectively.

The changes in mean weights of the experimental fish during exposure to crude oil are shown in figure 2. At the concentrations of 300ppm and 600ppm, the mean weights of the fish decreased from 143±1.66 to 85±3.54 and 126±3.22 to 75±10.61 respectively. This indicates that the % weight gains are -40.56% and -40.48% for fishes exposed to 300ppm and 600ppm crude oil respectively.

Figure 2 shows the weights of experimental fish exposed to Pb nitrate and crude oil contaminations. The feed conversion ratios (FCR) for the control, 20 mg/l Pb Nitrate, 35 mg/l Pb nitrate, 300ppm and 600ppm crude oil groups are 2.10, 6.92, -2.30, -2.30 and -2.14 respectively.

The control group (A) showed significant increase (P<0.05) from onset 150g±0.85 to the end of the exposure period 250g±7.07.

The group B showed significant increase in the first week (P<0.05) 15lg±0.67 to 155±3.54, the weight of this group declined from the second week to the seventh week thereafter they gained weight up till the tenth week. (155g±3.04 to 135±3.54g to 175g±3.54g). Group C showed significant increase in weight in the first week (P<0.05). From the second week to the tenth week weight reduced significantly (P>0.05) Group D showed significant increase in weight (P<0.05) in the first week, from the second week weight significantly reduced (P>0.05) from the third week to the tenth week. Group E showed significant weight reduction (P>0.05) from the first week to the tenth week. This group did not eat.

## DISCUSSION

One effect of lead nitrate and crude oil on *Clarias gariepinus* is loss of weight. This may be attributed to the anorexia observed in treated groups. The control group exhibited very sharp appetite while the treated groups exhibited very poor appetite.

Group E, treated with 600ppm crude oil were described as not being interested in feeding. This is related to the objectionable odour of crude oil (Prasad and Kumari; 2006). The anorexia of the treated groups was attributed to the coagulation of skin mucus, resulting in skin irritation, and interference with vital functions in the body. "The coagulation film anoxia" in fishes is well known from the works of Westfall (1964). The energy gained by the feed ingested was directed to-wards adequate respiration as a result of the effects of the pollutants on the gills, rather than towards weight gain. Frazer and Clark (1984) recorded a significant decrease in the growth rate of rainbow trout caused by the effluent from a settled industrial domestic sewage. Igwilo, *et al* (2012), recorded a significant increase in body weight

**Table 1:** Mean weight and SEM of experimental fish

| Exposure weeks | Control | Lead Nitrate | | Crude oil | |
|---|---|---|---|---|---|
| | | 20mg/l | 35mg/l | 300ppm | 600ppm |
| 0 | 150±0.85 | 151±0.67 | 147±1.81 | 143±1.66 | 126±3.22 |
| 1 | 155±10.61 | 155±3.04 | 150±7.07 | 145±3.54 | 125±3.04 |
| 2 | 160±0.02 | 150±0.01 | 135±7.07 | 135±10.61 | 125±3.54 |
| 3 | 175±3.04 | 145±3.04 | 130±3.04 | 130±7.07 | 125±3.54 |
| 4 | 180±0.01 | 145±3.54 | 125±3.04 | 130±0.01 | 125±3.54 |
| 5 | 185±3.54 | 145±10.60 | 120±0.04 | 130±7.07 | 125±3.54 |
| 6 | 190±7.07 | 140±14.14 | 110±0.02 | 120±7.07 | 115±3.54 |
| 7 | 205±3.54 | 135±3.54 | 105±3.54 | 110±7.07 | 100±7.07 |
| 8 | 225±3.54 | 155±3.54 | 105±3.54 | 105±3.54 | 90±7.07 |
| 9 | 230±7.07 | 165±3.54 | 95±3.54 | 100±0.02 | 85±3.5 |
| 10 | 250±7.07 | 175±3.54 | 90±7.07 | 85±3.54 | 75±10.61 |

**Table 2:** Weight Gain % and Feed Conversion Ratio of Experimental Fish after 70 days exposure to Lead Nitrate and Crude Oil

| Control | | Lead Nitrate | | Crude oil | |
|---|---|---|---|---|---|
| | | 20mg/l | 35mg/l | 300ppm | 600ppm |
| Initial weight (g) | 150 | 151 | 147 | 143 | 126 |
| Final Weight (g) | 250 | 175 | 90 | 85 | 75 |
| Increase in Wt (g) | 100 | 24 | -57 | -58 | -51 |
| Weight Gain (%) | 66.67 | 15.89 | -38.78 | -40.56 | -40.48 |
| F C R | 2.10 | 6.92 | -2.30 | -2.30 | -2.14 |

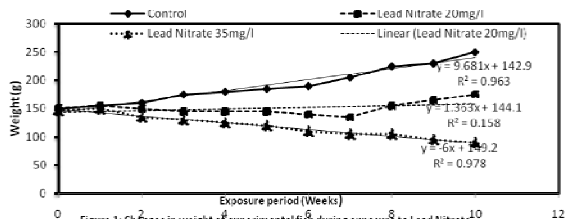


**Fig. 1:** Changes in weight of experimental fish during exposure of Lead Nitrate

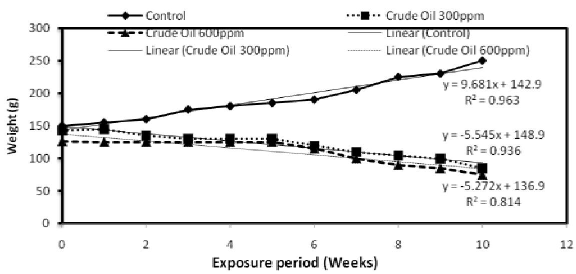


**Fig. 2:** Changes in weight of experimental fish during exposure of Crude Oil

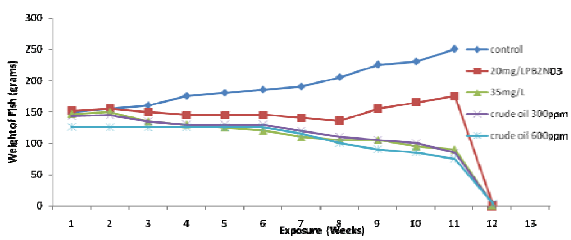


**Fig. 3:** Comparative weight changes of fish subjected to Lead Nitrate and Crude oil for 10 weeks.

gain, specific growth rate and feed conversion ratio in *Clarias gariepinus* fed 20% *Moringa* leaf meal diet as a protein source substitute for fish meal.

Aquatic pollutants adversely affect weight gain in aquatic organisms with the resultant effect of slow growth shown by the percentage weight gain and feed conversion ratios which imply that fish under the influence of such pollutants will not mature duly and will be susceptible to disease conditions which invariably will lead to low productivity and eventual death of affected fish.

Fish for human consumption will invariably bioaccumulate these pollutants in their tissues and organs such that humans can be affected when they consume contaminated fish. It is therefore recommended that environmental protection laws be enforced so as to prevent water bodies from pollution. This will guarantee adequate inland and marine fisheries as well as conservation of fisheries and other aquatic resources.

## REFERENCES


Adedeji OB, 2009. Effects of Diazinon on blood parameters in the African catfish (*Clarias gariepinus).* Afr J Biotechnol, 8: 3940-3946.

Adeyemo OK, OB Adedeji, OA Adedeji and SA Agbede, 2008. Acute toxicity of diazinon to the African catfish *Clarias gariepinus.* Afr J Biotechnol, 7: 651-654.

Azar A, RD Snee and K Habibi, 1975. Lead toxicity in mammalian blood In: TB Griffin, J.H. Knelson (ed) Lead Academic, New York, p: 254.

Barron MG, MG Carls, JW Short and SD Rice, 2003. Photoenhanced toxicity of aqueous phase and chemically dispersed weathered Alaska North Slope Crude oil to Pacific herring eggs and larval. Environ. Toxicol. Chem. 22: 650-660.

Bellinger D, 1987. longitudinal analyses of prenatal and postnatal lead exposure NEJM Apr 23, 316: 1037-1043.

Couillard CM, K Lee, B Legare and TL King, 2005. Effect of dispersant on the composition of the water soluble-accommodated fraction of crude oil and its toxicity to larval marine fish. Environ Toxicol Chem, 24: 1496-14504.

Dambo WB, 1992. Tolerance of the Periwinkles *Pachymelaniaa aurita* (Muller) and *Tuinpanotanus euscatus* (Linne) to refined oil. Environ Pollut 79: 293-296.

Fraser JAL and ER Clark, 1984. The Effects of a settled industrial-domestic sewage works effluent from percolating filter on the survival and growth of various stages of rainbow trout, *salmo gairdneri* (Richardson). J Fish Biol, 24: 13-27.

HU H, 2001. Poorly controlled hypertension in a painter with chronic lead toxicity. Environ. Health perspect, 109: 95-99.

Igwilo IO, CI Nsofor, FF Avwemoya and CS Adindu, 2012. The Effects of feeds formulated with *Moringa oleifera* leaves on the growth of the African catfish, *Clarias gariepinus.* Res Rev Biosci, 6: 121-126.

Imevbore AMA and SA Adeyemi, 1981. Environmental Monitoring in relation to oil pollution Pp. 135-142 in: Proceedings of the Conf. on the Petroleum Ind. and the Nigerian Environment, NNPC/FMV and H, PTI Warri Nigeria.

Lui B, RPD Romaire, RD Elaune and CW Lindau, 2006. Field Investigation on the toxicity of Alaska North Slope Crude oil and Dispersed ANSC Crude to Gulf Killifish, Eastern Oyster and White Shrimp. Chem, 62: 520-526.

Mathis BJ and NR Kevern, 1975. Distribution of Mercury, cadmium, lead, thallium in a eutrophic lake. Hydrobiologica, 46: 207-222.

Prasad MS and Kumari, 2006. Toxicity of Crude oil to the survival of fresh water fish (*Pontius sophore* (HAM) Acta hydrochemica et hydrobiologica,15: 29-36.

Todd AC, JG Wetmur, JM Moline, JH Godbold, SM Lewin and PI Landrigen, 1996. Unveiling the chronic toxicity of Lead, An essential priority for environmental health, Environmental Health Perspect, 104: 141-146.

Verma K and SD Belsare, 2005. Superoxide Dismutase level in fish tissues as indicator of Lead Toxicity. In Fisheries and Fish Toxicology, APH Publishing Corporation, New Delhi. India 137 pp.

Westfall BA, 1964. Coagulation film anoxia in fishes. Ecology, 26: 283-287.