ACUTE TOXICITY OF CADMIUM CHLORIDE TO JUVENILES OF NILE PEARCH, *OREOCHROMIS NILOTICUS* (BÜRCHELL, 1822)

[1]Azi. E. E., [1]Rabo, P.D and [2]Isiyaku, M. S.
[1]Department of Agricultural Technology, Plateau State College of Agriculture Garkawa, Plateau State, Nigeria
[2]Department of Fisheries and Aquaculture, Bayero University, Kano, Nigeria
Correspondence Author's Email: Phone:

ABSTRACT
In the present study, juveniles of *Oreochromis niloticus* were exposed to the cadmium chloride in order to determine the chemical's toxicity to the species at both acute and sub-lethal exposures. Fish were exposed to acute concentrations of 38, 40, 42, 44 and 46mg/l of cadmium chloride. Experiments had a control that served as a reference point. Effects of the herbicide were measured using behavioral as well as growth indices (as suggested by previous authors). Results of the acute toxicity test showed that cadmium was toxic to the species in a dose-dependent manner. The LC_{50} value of cadmium established for the species was 41.03 mg/l. Most importantly, cadmium induced hyperactivity at acute levels of exposure. The study revealed that cadmium was moderately toxic to *O. niloticus* juveniles and affected the behavior as well as growth of the fish. Hence, use of the chemical should be with caution.

Keywords: **Cadmium, Acute, Toxicity, Lethal concentration, *Oreochromis niloticus***

Introduction
From time immemorial man relies heavily on the use of chemicals to protect crops from pests, right from the time of dressing of seeds before planting, through fighting weeds and other pests on the farm, to the preservation of already harvested products. On one side, benefits derived from the use of pesticides in agriculture are immense, but on the other side, environmental pollution and/or degradation is one major problem that is linked to their application (Olusegun, 2001). The aquatic environment is particularly one vulnerable area as it is the ultimate recipient of pollutants due to basin drainage. The indiscriminate use of chemicals has resulted in large scale reduction in aquatic productivity (Mekkawy et al., 2013). Several metals and their effects on the environment and human health have been studied. Cadmium, nickel and chromium among others have harmful effects on aquatic organisms as well as their final consumers. Cadmium is a soft white solid with a density of 8.64 g/cm3 and occurs naturally with zinc and lead in sulphide ores (FAO, 2012).

The Nile tilapia *Oreochromis niloticus* is a deep-bodied fish with cycloid scales, silver in colour and is the most widely cultured fish in the tropics (Offem, Ikpi and Ada, 2010). The choice of cadmium chloride in this experiment is because of its lower toxicity compared to the other forms of heavy metals, it is used in Agriculture as fungicide, in Medicine as tropical antiseptic, disinfectant, dental amalgams and in research laboratories as an intermediate in the production of other compounds, thermometers, barometers, batteries, lamps, refining, lubrication oils and pressure-sensing devices. It is therefore, pertinent to determine its tolerance limit.

Materials and methods
The study was carried out in the Department of Fisheries and Aquaculture Post Graduate Laboratory of the University of Agriculture Makurdi, Benue State. One hundred and eighty (180) *O.niloticus* (mean weight, 24.56 ± 0.7g and mean standard length of 15.42±0.3cm) juveniles were used for the study. They were purchased from a reputable fish farm from Makurdi, Benue State. The Cadmiun Chloride was procured from Emole Nigeria Limited, High Level, Makurdi. Based on available literature on acute toxicity test on tropical freshwater fish species, range-finding tests were conducted to determine the concentrations of cadmium chloride that were used in the definitive tests. This was done by placing six concentrations of the heavy metal in separate plastic bowl containing 20 litres of water. Mortality of fish was determined at 12, 24, 48, 72 and 96 hours. The concentrations of the heavy metal were fine-tuned using lower ranges until about 85 to 95% mortality was recorded in the highest concentration and 25 to 30% in the lowest concentration. The five concentrations used in the acute test were then geometrically ranged between these highest and lowest concentrations and made into triplicates.

Results from range finding tests provided guide for the concentration level to be used in definitive test. The definitive test was carried out by filling eighteen (18) plastic tanks with 20 litres of water each. The test was carried out using concentration of cadmium chloride earlier determined from range finding test. The concentrations used were 38mg, 40mg, 42mg, 44mg and 46mg of cadmium chloride per litres of water (mg/l). The response of the fish to slight stimuli was used as an index of toxicity while non-response of the fish to cadmium chloride estimated to be lethal to 50% of the test organism after 96 hour of exposure. Completely randomized design was used for the experiment. A total of eighteen (18) plastics tanks of (60cmx40cmx40cm) capacity were used. The plastic tanks were washed thoroughly and then filled with 20 litres of water. All plastic tanks were labelled. Fish were weighed and distributed at the rate of 10 fish per tank. A total of one hundred and eighty (180) of *O.niloticus* juveniles were randomly stocked into the tanks at a stocking rate of 10 fish per tank in triplicates. Data collected were subjected to Mini tab 16. ANOVA was used for mean comparison. LSD was used for comparison among the treatments and the control at 0.05% level.

Results and Discussion

Table 2: Physico-chemical parameters of the toxicant solution used in the acute bioassay test of *Oreochromis niloticus* juveniles exposed to cadmium chloride**.** The parameters studied increased with the concentration of cadmium chloride

Table 2: Physico-chemical parameters of the toxicant solution

Parameters	Control	T1	T2	T3	T4	T5
pH	7.84 ± 0.00^{a}	$.80\pm0.00^{b}$	7.75 ± 0.01^{c}	7.68 ± 0.00^{d}	7.62 ± 0.00^{e}	7.57 ± 0.01^{f}
TEMP(^{0}C)	25.35 ± 0.01^{a}	25.35 ± 0.01^{a}	25.38 ± 0.02^{ab}	25.36 ± 0.01^{ab}	25.36 ± 0.01^{ab}	25.35 ± 0.01^{c}
TDS (mg/l)	207.33 ± 0.33^{a}	206.33 ± 0.67^{b}	211.33 ± 0.33^{c}	216.00 ± 0.33^{d}	224.33 ± 0.33^{f}	230.33 ± 0.33^{e}
EC (µS)	409.67 ± 0.67^{a}	412.67 ± 1.33^{b}	423.33 ± 0.67^{c}	433.67 ± 1.15^{d}	441.33 ± 0.67^{e}	449.67 ± 0.67^{f}
DO	4.55 ± 0.00^{a}	4.50 ± 0.00^{b}	4.46 ± 0.00^{c}	4.43 ± 0.01^{d}	4.40 ± 0.00^{e}	4.36 ± 0.00^{f}

Mean separation in the same column with different superscript differ significantly ($P<0.05$).

The mortality rates of *O.niloticus* exposed to various acute concentration of cadmium chloride are shown on Table 1. Mortality was directly proportional to the concentration of the toxicant and the length of exposure of the fish to the toxicant. The observations made on the mortality of the fish during the experiment shows that all the mortality recorded in the treatments were due to the toxicants and not otherwise. The fish showed various signs of stress as a result of the toxicants which also confirmed the observation of Ojutiku *et al*. (2014). Among these is loss of balance, rapid opercula movement, respiratory disorder, loss of nervous control, erratic swimming as well as frequent surfacing which are also in agreement with the findings of Aguigwo (2002) who investigated the toxic effects of different pesticides on *Oreochromis niloticus*. However, behavioural changes are not so accurate in determining the toxicity of any chemical to fish and other aquatic organisms. More precise methodology has been described in the form of Lethal Dosage (LD_{50}) and Lethal Concentration (LC_{50}). So, more researchers such as Ojutiku *et al.* (2014) and Satyavani *et al*. (2011) have deem it more accurate to express the toxicity of various toxicants to fish in terms of the 96 hour LC_{50}. In doing this, the LC_{50} of cadmium chloride was determined to be 41.03mg/L, this is a little higher, Sangeeta *et al*. (2005) who obtained at 96hrs LC_{50} of 24.75mg/l and 30.4mg/l when *Colisa fasciatus* and guppy (*Poecilia reticulata*) was exposed to cadmium chloride.

Table 1: Mortality rates of *Oreochromis niloticus* exposed to various acute concentration of cadmium chloride

Parameters	Control	T1	T2	T3	T4	T5
Treatment (mg/L)	0.0	38.0	40.0	42.0	44.0	46.0
No of Fish	30	30	30	30	30	30
Total Mortality	0	7	12	16	23	27
%Mortality	0.0	23.33	40.0	53.33	76.67	90.0
Log Conc.	0.0	1.58	1.60	1.62	1.64	1.66
Probit kill	0.0	4.26	4.75	5.08	5.74	6.28

Conclusion and Recommendation

The results obtained from acute toxicity studies shows that cadmium is toxic to *O. niloticus* at 41.03 mg/L, and that the toxic response in the fish was dose and duration dependent. It can be conclusively deduced from this study that fish has the tendency to bioaccumulate heavy metals in a polluted environment. The consumption of cadmium contaminated fish may pose serious health risks to fish consumers. Therefore, the indiscriminate consumption of fish from a polluted water body should be discouraged.

REFERENCES

Mekkawy, I. A. A., Mahmoud, U. M. and Mohammed, R. H. (2013). Protective effects of tomato paste and Vitamin E on atrazine-induced hematological and biochemical characteristics of *Clarias gariepinus* (Bürchell, 1822). *Global Advanced Research Journal of Environmental Science and Toxicology*, **2**(1): 11-21 (ISSN: 2315-5140) Available online http://garj.org/garjest/index.htm

Ojutiku R. O., Asuwaju, F. P., Kolo, R. J., Obande, R.A. and Agbelege,O.O.(2014). Toxicity and Histopathological Effect of Cypermethrin on Juveniles of *Clarias gariepinus. British Journal of Applied Science & Technology 4(15): 2251-2264*

Olusegun, S. A. (2001). *Toxicity of Apron to juvenile mudfish (Clarias gariepinus Teugel*). M.Sc thesis, Usman Danfodio University, Sokoto, Nigeria, 66pp.

Sangeetha S., Sujatha, K., Senthilkumaar, P., Kalyanaraman, V. and Eswari, S. (2011). Acute toxicity of some agriculture fertilizers to fingerlings of Catla catla. *Indian Journal of Science and Technology*. Vol. 4 No.7 770-772.

Satyavani G., Gopi,R. A., Ayyappan, S., Balakrishnamurthy, P. and Reddy, P. N. *(2011).* Toxicity Effect of Expired Pesticides to Freshwater Fish*, Labeo Rohita. The Journal of Agriculture and Environment Vol: (12)*