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THEME: SECURING ANIMAL AGRICULTURE AMIDST GLOBAL CHALLENGES

ACUTE TOXICITY OF CALCIUM CARBIDE WASTE TO SILVER CATFISH (*Chrysichthys nigrodigitatus)* JUVENILES

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Abstract

The indiscriminate dumping and accumulation of spent carbide is a potential threat to the survival and good health of fish. Therefore, this study investigated the effect of spent carbide on selected organs (brain and gills) and survival of *Chrysichthys nigrodigitatus*. Fish were exposed to powdered carbide concentration of 0.0 mg/L, 0.018mg/L, 0.0033mg/L, 0.060mg/L and 0.105 mg/L under laboratory condition for 96 hours in a complete randomized design using three (3) replicates. The LC50 value of 0.018 mg/L was obtained using graphic and probit methods. Histological alterations in the brain of fish showed spongiosis, congestion of blood capillaries and vacuolation. The gills recorded structural changes such as stunted primary gill lamellae, congestion of gill capillaries and erosion of gill lamellae. Hence, there is a need to protect the fish and consumers by finding alternative use of carbide waste or safer means of its disposal to avoid contamination of ground water and aquatic life.

Keywords: Chrysichthys nigrodigitatus, Carbide wastes, Probit, Histopathology

Introduction:

Chrysichthys nigrodigitatus (Lacepede, 1802) is a silver coloured African catfish which is native to Nigeria and several West African countries. The rising need to raise fish for consumption for rapidly growing populations in the developing countries has necessitated the need to intensify studies on African freshwater fishes (Akinsanya, 2007). This fish is important both in ecological and economical terms. It plays important role in dynamics determination and structure of aquatic ecosystem apart from high value placed on it as food for man. It is one of the dominant species in Oyan Lake, southwest Nigeria, apart from *Lates niloticus, Tilapia zilli and Clarias gariepinus* (Agbon and Omoniyi, 2010). Indeed, it is a price delicacy on the table of many families and command greater retail price than frozen fish, especially in Abeokuta and neighboring towns (Ikenweiwe *et al.*, 2007).

Calcium carbide is usually used in industrial acetylene production for welding of tools. It is also used during steel production to help in reducing the amount of slag and sulfur, thereby reducing impurity. Production of other chemicals (vinyl acetylene, calcium cyanide amongst others, is also facilitated by calcium carbide (Jonasson, 2006). However, the reaction of calcium carbide with water creates acetylene gas and a residue of calcium hydroxide ($CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$) as reported by Semikolennykh *et al*. (2012). This was a further confirmation of the claim that the main compound in spent calcium carbide is calcium hydroxide which reacts overtime with atmospheric carbon dioxide to form non-toxic calcium carbonate (Semikolennykh *et al*., 2012).

According to L'avoic *et al*. (2002), spent calcium carbide waste is toxic. The toxicity to soil microorganisms and larvae from cave beetle eggs (*Ptomaphagus hirtus*) at very low concentration of about 0.5% had been reported Semikolennykh *et al*. (2012). Consequently, this study investigated the acute toxicity of spent calcium carbide on *Chrysichthys nigrodigitatus* in the laboratory after capture from the wild. This study was also necessitated because of indiscriminate dumping of spent calcium carbide on the street of most States in Western Nigeria after being used by welders associated with car-repairs. The

calcium carbide wastes find their ways, after heavy downpours of rains, into drainages and water bodies in sub-lethal amounts.

Methodology:

Two hundreds advanced juveniles of *Chrysichthys nigrodigitatus* with average weight of 12g and length (cm) of 22.5± 0.7 were purchased from Oyan Dam at Ibaro village, Ogun State, Nigeria. Carbide wastes were obtained from welders at car repair garages. The fish were acclimatized for a period of twenty-one days in the laboratory in plastic tanks(0.5 x 0.33x 0.33m^3); using 2mm Cop pen's feed of 45% crude protein diet, which was fed at 5% of their body weight (Reish and Oshida, 1986). This experiment was carried out in the fisheries laboratory of the Department of Fishery, Oyo State College of Agriculture and Technology, Igboora. A range finding test was conducted first as described by Solbe (1995) using 0.004mg/l, 0.04mg/l, 0.4mg/l and 4mg/l of carbide wastes. Definitive test involved a spacing factor of 1.8 and ten fish in each aquarium was used for the test as described by Solbe (1995). There were five treatments, 0.0mg/l (control), 0.018mg/l, 0.033mg/l, 0.06mg/l and 0.105mg/l, in three (3) replications for each. 30 fish were randomized per treatment. The definitive test lasted for 96hours. Complete static method was used because the test solution was not changed. Mortality of fish in each treatment was recorded every 3 hours. A regression analysis was used to relate log-concentration of spent-carbide and fish mortality. Histopathological investigation involved fixation of tissues, clearing, embedding, sectioning through a rotary microtome and staining using haemathoxylin and eosin methods before viewing under a light microscope (Winzor, 1994). No statement on water quality testing in materials and methods.

Results and discussion:

Water quality in experimental tanks conformed to the standard recommendation for tropical warm water fish as shown in table1 (Boyde, 1981). An insignificant increase in pH values, stable dissolved oxygen and water temperature were observed in experimental water.

The passage of spent carbide into water environment where fish live, make it toxic to the exposed fish. The present study agrees with the acclaimed toxic ability of powdered carbide waste because the median lethal concentration (Lc_{50}) of 0.018mg/l was far below 1.0. This value indicates high toxicity (FAO, 1977) and a threat to the survival of fish such as *Chrysichthys nigrodigitatus* in natural water bodies (Streams, Rivers, Lakes, and Lagoons) which are common around communities in Western Nigeria.

The present study revealed the histopathological changes (Plates 1 to 6) in the selected organs (Brain and Gill). The brain tissues exhibited spongiosis, congestion of blood capillaries, gliosis and alteration of vacuoles. These structural changes increased with increasing concentration of powdered carbide waste. This direct or positive association between the spent carbide solution and structural alteration agreed with the report of Ajibade and Omitoyin (2011) where increase in toxicant (*Latex of Calotropis procera* against *Clarias gariepinus* juveniles) caused structural destructions of the gill, brain and liver of *Clarias gariepinus*.

Table1: Results of the water quality parameters of the experimental set-up

Treatments	Temperature (^{0}C)	pH	Dissolved oxygen
TR1	26.0	07.9	06.1
TR2	26.0	10.5	06.1
TR3	26.0	09.5	06.1
TR4	26.0	09.7	06.1
TR5	26.0	09.6	06.1

Table 2: Mortality of *Chrysichthys nigrodigitatus* (BLEEKER) exposed to various concentration of powdered carbide waste

SS.	Tr. (s/l)	NS	A. mort	% mort	TC.	Log C(g/l×10^{-3})	PM.
30	0.00	30.00	00.00	00.00	0	0	0
30	0.018	15.00	15.00	50.00	18	1.26	5.0
30	0.033	12.00	18.00	60.00	33	1.52	5.25
30	0.06	01.00	29.00	96.70	60	1.78	6.88
30	0.105	00.00	30.00	100.00	105	2.02	8.09

SS = ? TR.(s/l) = ? A. mort. = ? % mort. = ? TC. = ? PM. = ?

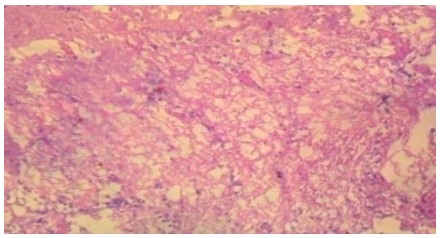

PLATE 1: Brain in the control (0.00 mg/l of spent carbide) exhibiting zero lesions (Mx100).

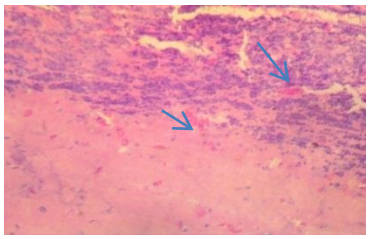

PLATE 2: Brain tissue of *C. nigrodigitatus* (0.018 mg/l) capturing congestion of blood capillaries and vacuolation of neutrophil (Mx100).

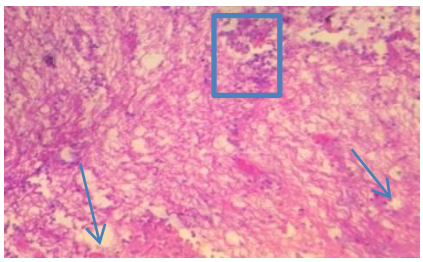

PLATE 3: Brain tissues of *C. nigrodigitatus* (0.033 mg/l)- moderate spongiform vacuolation and mild aggregation of glial cells (box).

PLATE 4: Normal gill architecture (0.00mg/l)

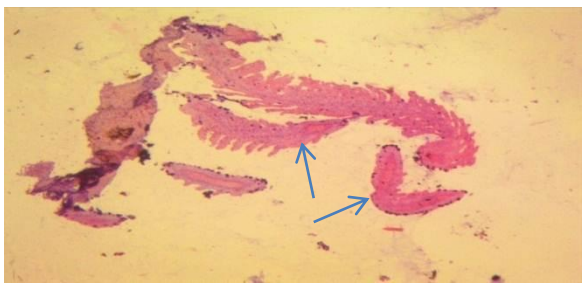

PLATE 5: Gill of *C. nigrodigitatus* (0.018 mg/l) exhibiting stunted primary gill lamellae and thickened secondary gill lamellae (Mx100).

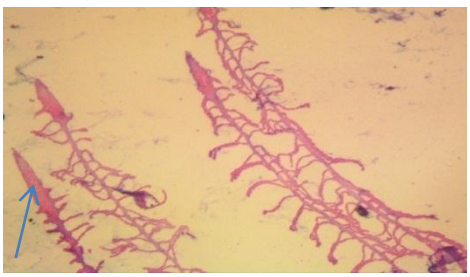

Plate 6: Marked congestion of the gill lamellae.

Conclusion and recommendation

The study showed the ability of spent carbide to cause structural damage to vital organs of *Chrysichthys nigrodigitatus* fish. Furthermore, the attempt of the fish in jumping out of the toxic solutions between five (5) and ten (10) minutes showed irritations in the fish. Indiscriminate dumping of carbide waste in an area close to natural water bodies should be avoided to disallow poisoning in water organism such as fish. There is a need to find alternative use of carbide waste such as incorporation into flooring material for animal house construction.

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