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TOXICITY OF SNIPER 1000EC ON RESPIRATORY DYNAMICS OF *OREOCHROMIS NILOTICUS* (TREWAVAS, 1983) UNDER LABORATORY CONDITIONS

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Abstract: Indiscriminate use of Sniper 1000EC has become a serious problem among local fishermen in the Northern parts of Niger state. A 96hrs static bioassay was carried out to determine the effect of 2, 3 dichlorovinyl dimethyl phosphate (Sniper 1000EC) on Respiratory dynamics of *Oreochromis niloticus* (Trewavas, 1983) with mean body weight 16.05 ± 1.02; mean standard length 9.60 ± 0.38cm. *O. niloticus* showed different respiratory dynamics to varying concentrations of sniper 1000EC (0, 3, 4, 5 and 6mg/l) due to its toxicity. OVR (Opercula ventilation rate) appeared to be more sensitive than TFB (Tail fin beat). These changes were attributed to the toxicant. It is concluded that respiratory dynamics were consequences of exposure to sniper 1000EC. It is recommended that the use of Sniper 1000EC by local fishermen be banned to preserve the aquatic ecosystem.

Keywords: Sniper 1000EC, *Oreochromis niloticus,* Respiratory Dynamics, Tail Fin Beat and Opercula Ventilation Rate.

INTRODUCTION

The main aim of toxicological research is to assess the risk of environmental toxicants on the ecosystem in order to provide the framework to protect and maintain them. In general, fish are extremely sensitive to pollution, hence as noted by Dwyer *et al.,* (2005) and Omoregie and Okunsebor (2005), they are good indicators of onset of pollution in the aquatic environment. The respiratory potential and oxygen consumption of an animal are the important physiological parameters to assess the toxic stress because it is a valuable indicator of energy expenditure during metabolism (Presser and Brown, 1973). Respiratory distress experienced by fish in polluted water bodies has been reported by several authors. Banerjee (2007) noted that congestion of blood capillaries, periodic lifting and sloughing of respiratory epithelia of the secondary lamellae and haemorrhages are the major main damages observed on fish gills in polluted water bodies. Omoregie *et al.*, (2009) observed that extensive fusion of secondary lamellae and hyperplasia of the respiratory epithelia due to uncontrolled regeneration are the major causes leading to asphyxiation, and eventually death of the fish if exposure is prolonged excessively.

Widespread application of various pesticides has aggravated the problem of pollution to aquatic environment. Due to these synthetic chemicals, environment has failed to keep its healthy characteristics. The insecticides of proven economic potentialities could not do well in the ecosystem when viewed on extra fronts since these revenue poisons, in a residual form or as a whole, get into the aquatic ecosystem. They cause a series of problems to aquatic organisms (Mastan and Ramayya, 2010).

Sniper 1000EC (2, 3-dichlorovinyl dimethyl phosphate), a brand of dichlorvos, is contact acting and fumigant insecticide (Abubakar, 2013). Like all organophosphates, it kills insects and other target organisms because of its toxicity to the nervous system. This is achieved by inhibition of enzyme acetylcholinesterase (AchE) that breaks down acetycholine at the receptor site for partial uptake into the nerve terminal. Without functioning AchE, accumulation of acetylcholine results in depolarizing block of muscle membrane, producing rapid twitching of involuntary muscles, convulsions, paralysis and early death. Indiscriminate use of Sniper 1000EC is common among local fishermen from Northern parts of Niger state.

Tilapia has become the shining star of aquaculture across the globe (Waleed, 2012). Arrignton (1998) describes *Oreochromis niloticus* as the best species for culture-among the tilapia family-with squat shape. Trewavas (1982) recognized *Oreochromis niloticus* as macrophages and herbivorous used in irrigation channels and dams to control weed. Fagbenro (2002) stated that tilapia species are of major economic importance in tropical and sub-tropical countries throughout the world, particularly in Africa where farms stock mixed-sex tilapia in production ponds. They are disease resistant, highly prolific; feed on wild variety of foods, tolerant of poor water quality with low dissolved oxygen level (Fagbenro, 2002). Tilapia is one of the fisheries resources that suffers from environmental effects and needs to be protected because world production of tilapia exceeds two million tones per year far exceeding the harvest of Atlantic salmon and secondary only to carp as a culture food fish (FAO, 2005).

The aim of the present study was to evaluate the effect of acute concentrations of Sniper 1000EC on respiration dynamics of *Oreochromis niloticus* (Trewavas, 1983) under laboratory conditions.

MATERIALS AND METHODS

Experimental Fish and Test Chemical

Juveniles of *Oreochromis niloticus* (mean body weight 16.05 ± 1.02; mean standard length.9.60±0.38.) were purchased from a reputable fish farm in Minna, Niger State. The samples were transported to the laboratory in plastic container of 100L capacity filled with water to two-third volume between 07:00 hours and 09:00 hours. They were held in large water baths of 160L capacity and acclimated for 14days to laboratory conditions. The top of water bath was covered with netted material to prevent jumping out of the fish. A slit was made at middle of the net to allow for feeding fish and cleaning of the bath. Feeding commenced two days after the arrival and stopped twenty-four hours before the commencement of the experiment. During acclimation, fish were fed twice daily (08:00 and 16:00 hours) with formulated feed (35% crude protein) at 5% body weight. The fishes were accepted as well as adapted to laboratory conditions when less than 5% death was recorded for the 14 days. The water in the bath was changed daily and uneaten food and faecal matters were siphoned out. Dead fish were also removed to minimize contamination of water.

Test chemical (2, 3-dichlorovinyl dimethyl phosphate), a brand of Dichlorvos with the trade name Sniper 1000EC was obtained from Minna central market and was used for the study. The test concentrations were prepared with reference to the Manual of Method in Aquatic Environment Research.

96hrs Static bioassays were conducted in the laboratory following the methods of American Environmental Protection Agency (1972) and The American Public Health Association (1987). Juvenile of *O. niloticus* (mean body weight 16.05±1.02; mean standard length 9.60±0.38.) were exposed to Sniper 1000EC in fifteen 60x30x20 cm plastic aquaria. The fish species were separately exposed to four concentrations of the toxicant (Sniper 1000EC) and the fifth had no toxicant which served as the control. The nominal concentrations were 3mg, 4mg, 5mg, 6mg and a control with no toxicant. Each concentration which served a treatment was triplicated. The desired stock solution was measured and introduced into 10L of dechlorinated tap water. The mixture was allowed to stand for 30 minutes for proper mixing before randomly introducing test fishes. One hundred and fifty juveniles of *O. niloticus* were randomly distributed into the toxicant concentrations to give a stocking density of 10 fish per aquarium as adopted after Sprague (1969). Only fish without ulcer or cut fins were selected at random from a single source without considering sex. Each aquarium was covered with nylon mesh screen to prevent the fish from jumping out of the tank. Temperature, p^H and dissolved oxygen were measured daily while alkalinity and hardness were measured on the first and last day. During exposure, the Opercular Ventilation Rate (OVR) and tail fin beats (TFB) per minute of both control and exposed fish species were estimated as described in Omoregie (2002) by visual observation of individual fish in the experimental aquaria.

Statistical Analysis

All the data generated were managed with Microsoft office Excel 2003; they were analyzed with one-way analysis of variance (ANOVA) using Statistical Package for Social Sciences (SPSS), version 16.0 for window. Statistical significance of difference among means was compared using Turkey (HSD) test at 95%.

RESULTS

Respiratory Dynamics

Opercular Ventilation Rates (OVR) and Tail beat Frequency (TBF)

There were no significant difference in the frequency of opercular and tail fin beats of both exposed and control groups at the initial period. The opercular ventilation rates and tail fin beats of the fish species exposed to toxicant were significantly higher at $P<0.05$ within 24 hours at the highest concentration level (6mg/l) in the exposed *O. niloticus* than in their controls as presented in Table 1 and Figures 1 and 2 showing dose-dependent nature of the experiment. The frequencies of the beats declined in the exposed groups between 72 and 96 hours, showing that it is not only dose- dependent but also depend on period of exposure (The longer the experiment, the weaker the effects of the toxicant). In all the figures, opercular and tail fin beats per minute were highest at 24 hrs in specimens exposed to the toxicant. The values at 6.00mg were greater than 5.00>4.00>3.00mg (Figures1 and 2). At 72 and 96 hours, the values for the species exposed to the toxicant were lower than at 24 hrs. The controls maintained constant opercular ventilation and tail fin beats from initial period to 96th hour. The effect of the toxicant was more reflected on the opercular ventilation rates (OVR) than on the tail fin beats (TFB).

Table 1: Opercular and Tail Fin Beat of *Oreochromis niloticus* Exposed to Acute Level of Sniper 1000EC for 96hrs

Parameters	Exposure Periods (Hours)				
	0	24	48	72	96
Opercula Beats	100.00 ± 1.83^a	105.20 ± 3.79^b	102.00 ± 3.02^c	101.50 ± 2.28^c	102.00 ± 3.27^c
Tail Fin Beats	96.00 ± 2.29^a	97.60 ± 3.97^a	96.80 ± 4.24^a	98.25 ± 3.11^a	97.00 ± 2.73^a

Means with the same superscripts along the row are not significantly different at (P>0.05)

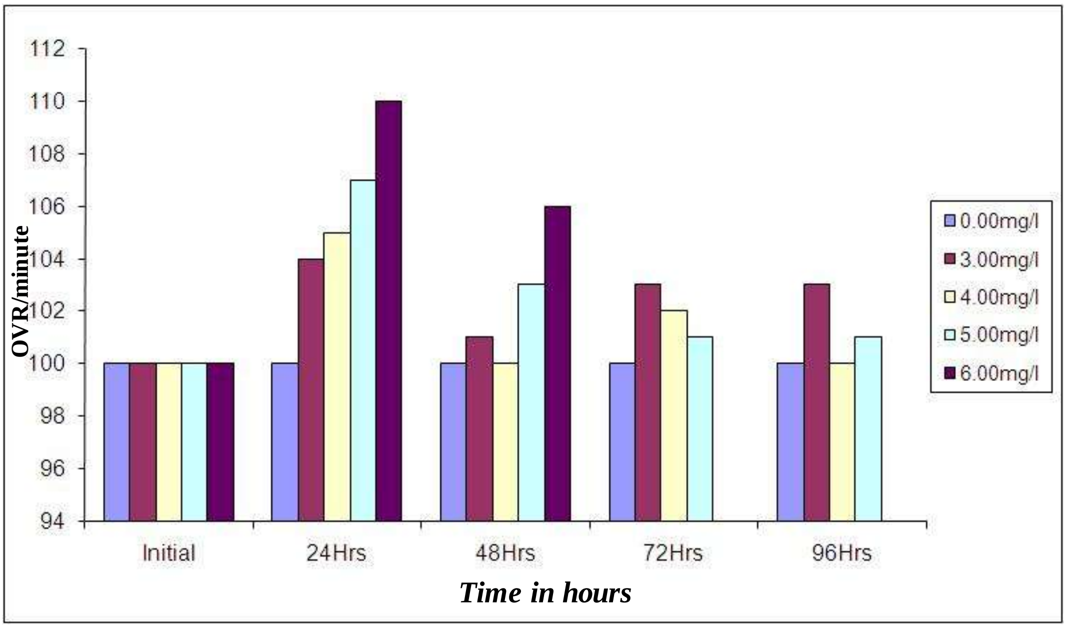

Fig 1: Trends in Opercula Ventilation Rate of *Oreochromis niloticus* Exposed to Various Concentrations of Sniper 1000EC for 96 hrs.

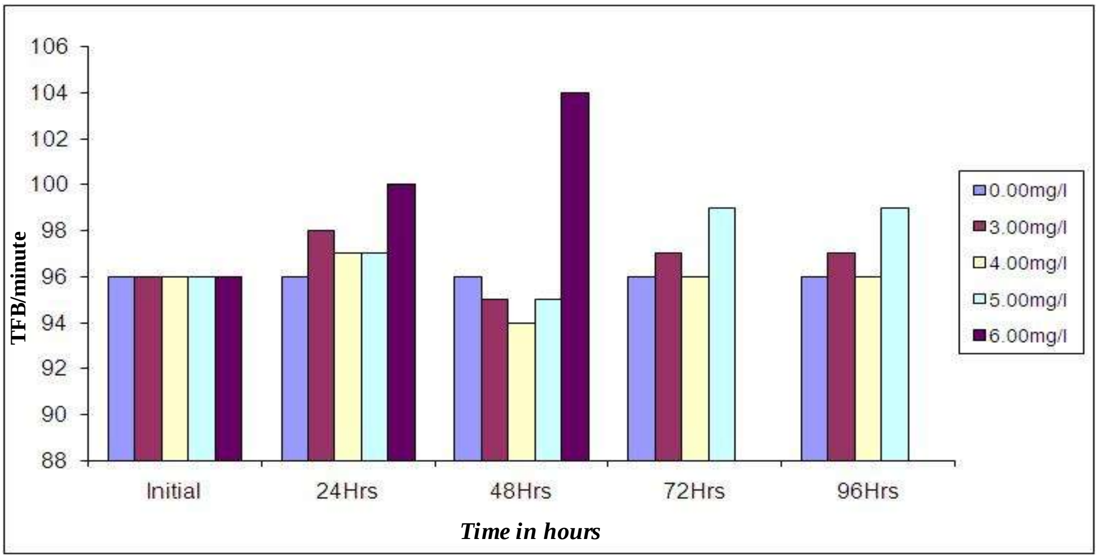

Fig 2: Trends in Tail Fin Beat of *Oreochromis niloticus* Exposed to Various Concentrations of Sniper 1000EC for 96 hrs.

DISCUSION

The results concerning the opercular ventilation rate and tail fin beat suggest that fish exposed to the toxicants tended to exhibit avoidance syndrome. Respiratory irregularity noticed in the exposed fish species could have been caused by mucus precipitation on the gill epithelia in response to the toxicant which resulted in abnormal behavior as earlier documented by Banerjee (2007) and Abubakar, (2013). Ufodike and Omoregie (1990), in their investigation of acute toxicity of gammalin 20 (lindane) to *Oreochromis niloticus* reported that the opercular ventilation rate and tail fin beat followed the same pattern as observed in this study. The high level of opercular/tail fin beat at 24^{th} and 48^{th} hours especially at the highest concentration level (6mg/L) indicate that the beat/movement rates are affected by both concentration (dose-dependent) and duration of exposure. Opercular hyperventilation has been reported to be an index of stress when fish is in unfavourable environment (Sprague, 1973). The opercular/tail fin beat increased as the fish swam faster so as to escape from the toxicant and also because of the need for more oxygen for the increased metabolic rate. However, as the whole medium was equally toxic, the fish became fatigued. Hence, the subsequent drop in the opercular ventilation and tail fin beat at 72-96 hours. The combined effect of fatigue and effect of sniper 1000EC on the body tissues led to subsequent drop in beat and death. Even if the action of the pesticide was associated with the central nervous system as reported by Omoregie and Ufodike (1994), the role played by fatigue in the exposed fish is very important.

CONCLUSION

In this study, respiratory dynamics in *O. niloticus* were associated with the effects of acute concentrations of sniper 1000EC. By this context, the toxicant has to be taken into more consideration as an environmental contaminant.

RECOMMENDATION

The use of Sniper 1000EC by fishermen should be banned to save the aquatic ecosystem and more studies recommended for further evaluation of this toxicant.

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