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RESEARCH ARTICLE

ACUTE TOXICITY OF ARIEL DETERGENT ON THE SURVIVAL OF FINGERLINGS OF NILE TILAPIA (*OREOCHROMIS NILOTICUS)*

***,[1]George Ubong, [2]Etim, Ini-Ibehe Nabuk, [2]M.P. Ekanim and [2]Otu, Ubong**

[1]Department of Fisheries and Aquaculture, Institute of Oceanography University of Calabar, Calabar
[2]Department of Marine Biology, Akwa Ibom State University, P.M.B 1167 Uyo

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ABSTRACT

The Effect of Ariel detergent on hatchery-reared *Oreochromis niloticus* fingerlings obtained from University of Calabar fish farm was investigated in duplicates (A, and B) using the water soluble fraction of the toxicant under laboratory conditions for 96 hours. Six concentrations (0, 1, 2, 3, 4 and 5mg/l) were prepared from the water soluble fraction of Ariel detergent for the toxicity test. The experimental animals exhibited different percentage mortalities with toxicant concentrations. The 96 hours LC_{50} for *O. niloticus* in both batches (A and B) was 0.301mg/l. There was no significant difference in mortality between the both batches of *O. niloticus* ($P>0.05$), leading to the conclusion that the WSF of the toxicant had same toxic effects on the test organisms. However, it was observed that the WSF of Ariel detergent had severe impacts on the test water resulting in alterations of the Physico-chemical parameters. The results of the present study suggest that the water soluble fraction of Ariel detergent had severe impacts on the test organism resulting in mortality.

INTRODUCTION

More recently, in Nigeria, and other developing nations, pollution of water resources has become a serious problem. Apparently, human and ecological disorder experienced in industrial settlements as a result of improper disposal of chemicals such as detergent effluent calls for careful surveillance on the state of the environment. Only few chemicals have been ecologically tested in Nigeria for safety in spite of their environmental and ecological impacts. Recently, the Federal Government of Nigeria is emphasizing in any technological and socio-economic development or endeavours by strictly asking industrial operators to sustainably manage the disposal of chemical into natural environment (DPR, 2002). Detergents are cleaning products derived from synthetic organic chemicals. The cheapest of detergents is produced from petrochemical sources. Its ability to foam when used in acid or hard water gives it an advantage over soaps (Okpokwasill and Nwabuzor, 1988). Surfactants are the components mainly responsible for cleaning action of detergents. In commercial detergents, the surfactant component is between 10 and 20%. The other component include bleach, filler, foam stabilizer, builders, perfume, soil-suspending agents, enzyme dyes, optical brighteners and other materials designed to enhance the cleaning action of the surfactant (Swisher, 1975; Okpokwasill and Nwabuzor, 1988). Generally, detergents are xenobiotic compounds which are usually washed into water bodies and are made up of several compounds of which the active components are the surface active agents or surfactants (Huang *et al*, 2000).Detergents are widely used in both industrial and domestic premises to wash equipment installations, heavy duty machines, vehicle and oil soiled materials. Detergent is a persistent environmental contaminant probably due to its use in the dispensing of oil spills at sea, so the use, production and exposure of detergents is unavoidable. Therefore, the application of environmental toxicological studies on non-mammalian vertebrates is rapidly expanding for the evaluation of the effects of noxious compounds (Ayoola, 2008 a,b). Indiscriminate discharge of such compounds that contain mixture of heavy metals such as herbicides, pesticides, detergents etc,into natural water ways have harmful effects on the fish population and other forms of aquatic life and may contribute long term effects in the environment (Akhtar, 1986; Olojo *et al.*, 2005 and Ayoola a and b, 2008). Toxic chemicals cause tissue damage and histopathological degradations as the fish show haematological responses to toxicants, and generally, such degradation of histological origin occurs in the gills, livers, heart, kidney and epidermis of animals. This will ultimately result in depletion of stock as a result of massive fish mortalities and other aquatic fauna.

Corresponding author: George Ubong,
Department of Fisheries and Aquaculture, Institute of Oceanography University of Calabar, Calabar.

The nile tilapia, *Oreochromis niloticus* is an important cultured fish in Nigeria. The main advantage of tilapia is relatively low cost of production, mainly for fish and seed, and the quality of its flesh.It is apparent that if mankind must survive in its present form, greater attention and maximum precaution must be the guiding principles of waste management. This research findings on the acute toxicity of water soluble fraction (WSF) of arieldetergents on nile tilapia (*Oreochromis niloticus*) will observe the environmental problem associated with it and possible management method for controlling or remediating such problem in future.

MATERIALS AND METHODS

Collection of Ariel detergent

Ariel detergent was bought from Watt market in Calabar, froma store dealing on toiletries.

Collection and Transportation of Test Organism

A total of 120 healthy *Oreochromisniloticus* fingerlings were used for this study. The fingerlings were in the range of 2.5 – 4.5cm in size. The fish were bought from the University of Calabar Fish Farm, Cross River State located within the University of Calabar at latitude $04^0$5, 020'N and longitude $008^0$20' 450' E, respectively. (Asuquo and Bassey, 1999 and Akpan *et al*., 2002), and was transported to the Research Laboratory of the Institute of Oceanography (IOC), University of Calabar, where they were acclimatized.

Acclimatization and Maintenance of Study Organisms

In the laboratory, *Oreochromis niloticus* fingerlings were allowed to acclimatize to laboratory conditions for 24 hours in the glass tank and aerated with air stone connected to electrically powered aquarium pumps.

Preparation of toxicant solution

The water soluble fraction (WSF) of Ariel detergent was prepared with reference to the manual method in Aquatic Environment Research, FAO Technical paper. 220mg of the powder was dissolve in two (2) litres of distilled water in aseparatory funnel. The system was allowed to stand for six hours to effect complete phase separation, after which the lower aqueous layer containing the WSF was collected for the toxicity test. From the stock solution, the following concentrations were prepared along the principle of serial dilution into 1 mg/l, 2 mg/l, 3 mg/l, 4 mg/l, 5 mg/l while dechlorinated tab water formed the control at 0 mg/l.

Stocking of Specimens

The *Oreochromis niloticus* fingerlings were gently caught using a hand net in order to avoid stress, into glass tanks measuring 25 X 10 X 15cm from an acclimatized tank. The glass tank was filled with 2 liters of dechlorinated water.

Monitoring of Water Quality Parameters

Water quality parameters were monitored before start of experiment, and also specify (daily) according to standard method (APHA, 1992). Parameters that were monitored include; Dissolved Oxygen (DO), pH, temperature (^{o}C), Nitrite (NO^-_2) and Ammonia (NH_3).

Monitoring of Specimen for Mortality

Test animals were taken as dead if failed to move their bodies. They float or sink into bottom when probed gently with a glass rod. During assessment for mortality each fish was removed from a test medium with a pair of forceps, placed in a clean empty petri dish and recorded.

Definitive Test

The concentration ranges chosen for the WSF of ariel detergent for the toxicity test on *Oreochromis niloticus* fingerlings were 0, 1, 2, 3, 4 and 5mg/l. The duration of the experiment was 96hours. After 96 hours the LC_{50} determination was calculated using a modified method (Finney 1971; Stephan, 1977). The fish were starved in order to minimize waste production. The distress behaviour and the deaths were closely monitored and recorded from the onset of the experiment 3h, 6h, 12h, 24h, 48h, 72h and 96h, respectively. The initial water parameter and daily water parameter dissolved oxygen, temperature; pH, nitrite and ammonia were monitored using mercury – in – glass thermometer, and Lurton Do and pH meters. The battery operated meters were calibrated according to manufacturer's instructions before being used for measurement (Boyd, 1989; 1990).

Statistical Analysis

The number of dead organisms between control and experimental group were analyzed using ANOVA at ($P < 0.05$) to test for Significance difference. Statistical analysis was powered by SPSS 18.0 (SPSS Inc; Chicago, USA).

RESULTS

The test organism (*Oreochromis niloticus*) showed behavioural changes and mortalities. Behavioural changes observed were restlessness, loss of balance, attempt at jumping out, respiratory difficulties, erratic swimming behavior, excess mucus secretion during the 96th hour and mortalities were observed in the WSF exposure groups but not in the control. The means (± SD) water parameters of the test medium were 29.8 ± 2.1^0c (temperature), 7.47 ± 0.02 (pH), 0.1 ± 0.0 mg/l (Nitrite), 4.5± 0.01 mg/l (DO) and 0.0 ±0.0 mg/l (Ammonia) (Table 1).

Table 1. Mean Water Quality Parameter of the Test Medium

Parameter	Min	Max	Mean	SD
Temperature (^{0}c)	29.8	31.9	30.9	1.1
Ph	7.47	7.49	7.48	0.01
Nitrite (mg/l)	0.1	0.1	0.1	0.0
Dissolve oxygen (mgll)	4.5	4.51	4.51	0.01
Ammonia (mgll)	0.0	0.0	0.0	0.0

Table 2. Summary of the Percentage Mortality and survivors of *Oreochromis niloticus* in the toxicant at the end of the experiment (96 hours)

Conc. Of Toxicant (mg/l)	Batch A				Batch B			
	Mortality M	% M	Survivor (s)	% S	Mortality M	% M	Survivor (s)	% S
0	0	0	10	100	0	0	10	100
1	2	20	8	80	2	20	8	80
2	5	50	5	50	5	50	5	50
3	7	70	3	30	7	70	3	30
4	10	100	0	0	10	100	0	0
5	10	100	0	0	10	100	0	0

The percentage mortality and survivors of *Oreochromis niloticus* fingerlings at the end of the test period in each of the concentration are shown in Table 2 for the three batches of the experiment. In the 0mg/l of toxicant, no mortality was recorded throughout the test period. In the 1 mg/l of toxicant 20% mortality was recorded leaving 80% survivors; in the 2 mg/l of the toxicant 50% mortality was recorded leaving 50% survivors. In the 3 mg/l of toxicant, 70% mortality and 30% survivors were recorded; in the 4 mg/l and 5 mg/l of the toxicant, all test organisms were observed dead, leaving 0% survivors in both batches (Table 2).

Table 3. Log –Transformation of the toxicant on *O. niloticus* for the determination of probit level of the toxicant at the end of experiment (96 hours)

Toxicant Conc. (mg/l)	Log Value conc.	Batch A	Batch B
0	0	0	0
1	0.0	20	20
2	0.30	50	50
3	0.48	70	70
4	0.60	100	100
5	0.70	100	100

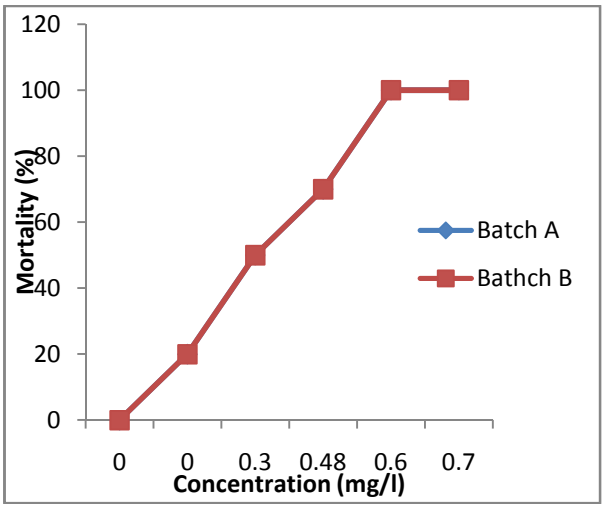

Fig. 1. Log-transformation of toxicant on *Oreochromis niloticus* juvenile for the determination of probit level at the end of the experiment (96 hours)

The 96 hours LC_{50} for *Oreochromis niloticus* is shown in Figure 1 for bothbatches. The 96 hour LC_{50} is given at log concentration of 0.30 a point were 50% of the organism would be killed at the end of the 96 hours if toxicant finds its way to the habitat of the fish. The log transformation of the different concentration of the toxicant is shown in Table 3 for both batches. Statistical analysis using ANOVA (SPSS 18.0) showed that there was no significant difference ($P > 0.05$) in mortality between bothbatches (A and B) of the test organism.

DISCUSSION

Results obtained from the investigation showed that the percentage mortality of *Oreochromis niloticus* fingerlings increase significantly ($P < 0.05$) with increase in the concentration of the toxicant. This is in agreement with a similar report by Okwuosa and Omoregie (1995) and Okoli-Anunobi *et al*. (2002). The 96th hour LC_{50} of Arieldetergents vary considerably when previous reports are compared. The 96th hour LC_{50} (0.30mg/l) of Ariel to *O. niloticus* obtained in this study is lower than the value (24.0 mg/l) reported in previous study by Ogundele *et al*., (2005) where the toxicity of linear alkyl benzene was also tested against *C. gariepinus* fingerlings. However, itfalls within the range value reported in previous studies for some other synthetic detergent; Abel, (1974) reported a 96th hour LC_{50} of 0.4 - 40 mg/l to be acutely toxic to fish. The differential toxicity of detergents to fish can be attributed to the differences in susceptibility and tolerance related to its accumulation, biotransformation and excretion (Omitoyin *et al*., 2006). Some of the early symptoms of Ariel detergent poisoning observed in this study are restlessness, loss of balance, attempt at jumping out, respiratory difficulties, erratic swimming behavior, excess mucus secretion during the 96th hour and mortalities. These behavioral signs were reported in study of the Toxicity of Linear Alkyl Benzene Sulphonate Detergent to *Clariasgariepinus* fingerlings by Ogundele *et al*., (2005). The secretion of mucus is a clear indication of the toxic effects of the detergent on organs glands and tissue which resulted in mortality. Similar report was presented by Abel, (1976) when investigating the toxic action of several lethal concentrations of an anionic detergents on the the gills of brown trout, *Salmotrutta*. Okoli-Anunobi *et al*, (2002) also reported similar observation in their studies on glands, organs and tissues of *Oreochromis niloticus* fingerlings.

Conclusion

The results of the research have shown that the detergent is toxic to the fish exposed. It is presumed that all other animals including man will suffer similar fate if exposed to the detergent solutions. Ordinarily, an adult will not ingest detergent except by accident but children especially toddlers who are not conscious of their actions are the endangered population. Detergents should be kept out of the reach of children and spilled detergent should be packed immediately.

Finally, it is hoped that the results of this investigation will enlighten people on health risks associatedwith detergent exposure. If the rate at which they are introduced into the environment is not checked may results in depletion of many important aquaculture species such as *Oreochromis niloticus.*

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