Int. J. Adv. Res. Biol. Sci. 2(10): (2015): 203–206

International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
Coden: IJARQG(USA)

Research Article

Toxicity of Linear Alkylbenzene Sulphonate (LAS) Detergent, to *Tillapia mossambica* Fingerlings.

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Abstract

The acute toxicity of Linear Alkylbenzene Sulphonate (LAS) detergent to *Tillapia mossambica* fingerlings was investigated using static bioassay's and continuous aeration over a period of 9617. The 96h LC_{50} was determined as 24,00 mgL^{-1}. During tl7e exposure period, the test fish exhibited several behavioural changes before death such as restlessness, rapid swimming, loss of balance, respiratory distress and haemorrhaging of gill filaments amongst others. Opercula ventilation rate as well as visual examination of dead fish indicates lethal effects of the detergent On the fish. Water quality examination showed increase in pH from 6.55 to the alkaline death point of 10.55. There was also a remarkable rise of alkalinity from 20.00mgL^{-1} to 52.50mgL^{-1}.

Keywords: Toxicity, *Tillapia mossambica*, fingerlings bioassays and detergent.

Introduction

Detergents are common household products used for the cleaning of domestic materials. The "after wash" of these detergents are either deliberately drained into the aquatic environment such as pond, lakes, rivers, streams etc or find their way into the aquatic environment by natural seepage.

Toxicity is a function of concentration and the duration of exposure of an organism to a toxicant. The validity of a detergent as a toxicant depends on the response of the test animal, their mode of action and the toxicity of the substance in relation to their chemical and physical structures (Moss *et. al*, 1980).

Fish is of one of the most important non-target aquatic organism affected by detergent pollution. Abel, (1974) documented that synthetic detergents are acutely toxic to fish of concentrations between 0.4 and 40mg/L,

Okwuosa and Osuala, (1993) reported that considerable amount of detergent have been found to exist in Nigerian freshwater systems where they generally affect several aquatic organisms-Communal washing, a common practice in many water bodies in Nigeria could lead to a build up of detergent level in natural waters.

Materials and Methods

Linear Alkylbenzene Sulphonate (LAS) detergent with the trade name surfactant in India was used for this investigation. The test concentration were prepared with reference to the Manual of Method in Aquatic Environment Research, FAO Fisheries Technology paper volume 247 by dissolving 220mg of the powder in two litres of distilled water. From the stock solution, the following concentrations were prepared along the

principle of serial dilution method of Warner,(1962) into 60.00 mg/L, 30 mg/L, 15.00mg/L, 7.50mg/L, 3.75 mg/L while dechlorinated tap water formed the control at 0.00mg/L. Healthy unsexed *Tillapia mossambica* fingerlings, mean body weight (12+1g) were collected from the Hatchery complex the Central Institute of Brackishwater Aquaculture, Chennai*;* in a plastic bucket to the Fish Biology Laboratory of Govt Arts College, Nandanam, Chennai, where they were acclimated to laboratory conditions for two weeks in glass aquaria containing dechlorinated municipal tap water. The holding aquaria were cleaned daily and the water changed during cleaning. During the period of acclimation, the fish were fed 40% crude protein diet. Mortality did not exceed 5% during acclimation.

During the exposure period, ten fishes were introduced into twelve glass aquaria (60x30x30crn3) containing ten litres of well-aerated dechlorinated municipal tap water. The prepared concentrations of the detergent were introduced into the twelve well aerated aquaria tanks, labelled T_1 R_1, T_2 R_2, T_3 R_3, T_4 R_4, 1_5 R_5 and T_6 R_6 respectively with T_1 R_1 serving as the control.

The fish were not fed twenty-four prior to the commencement of the experiment. The 96-hour LC_{50} was determined using graphical method. Mortality was recorded every 24 hours though the aquaria were inspected every three hours for dead fish, which were immediately removed behavioural responses o the exposed fish were observed every hour. During the exposure period Temperature, pH and Dissolve oxygen, Carbonioxide and Alkalinity were monitored using mercury in glass thermometer. Kent pH meter and Dissolved Oxygen meter respectively. Results obtained. from this investigation were subjected to statistical analysis using the analysis of variance (ANOVA) method to test for significance at 0.05 probability level.

Results

The mean water quality parameters of temperature, dissolved oxygen and alkalinity of various concentrations did not vary significantly ($P>0.05$) from those of the control. The mean values recorded for the various concentrations compared with those of the control aquaria are presented in Table 1. The 96 hour LC_{50} determined graphically during this investigation was 24.00mg/L as shown in Fig. 1

Percentage mortality increased significantly ($P<0.05$) with increase in the detergent concentration. Fingerlings exposed to 0.00mg/L and 3.75mg/L had 0% and 5% mortality respectively: while 20%, 35%, 60% and 100% mortality were observed in aquaria with concentrations 7.50mg/L, 15.00 mg/L, 30.00mg/L and 60.0mg/L respectively as shown in Table 2. The following behavioural responses were exhibited by the test organism fish during the exposure period: restlessness, erratic swimming, frequent attempts at jumping out of the aquaria, loss of balance, rapid opercula movement, and excess mucus, secretion towards the ninety-six hour. The colour of exposed fish became darker, the skins of the dead fish were dry and had lost their mucus lining. Haemorrhaging of the gill filament were also observed on the dead fish. These responses were not observed in the control experiment.

Okwuosa and Osuala (1993) observed that a considerable amount of detergent has been recorded from tropical freshwater systems where it generally affects several aquatic organisms. However, detailed laboratory reports of the effects on tropical freshwater fishes is scarce, hence the rationale for this investigation. *Tillapia mossambica* is a good aquaculture candidate having a greyish black colour above, creamy white below with a moderately distinct blackish stripe on either side of their head. This species have high potential for culture because of their high fecundity, ability to grow and thrive well in adverse pond condition tolerance of low dissolved oxygen level due to the possession of accessory air breathing organ, high feed conversion ratio and omnivorous feeding, Olaosebikan and Raji (1999).

The aim of this investigation was to determine the 96 hours LC_{50} of Linear Alkyulbenzene Sulphonate detergent on this highly important aquacultural candidate and as possible indicator of the environmental effect o the compound.

Discussion

Results obtained from this investigation showed that the percentage mortality of *Tillapia mossambica* fingerlings increased significantly ($P<0.05$) with increase in the concentrations of Linear Alkylbenzene Sulphonate. This is in consonance with a similar investigation by Okwuosa and Omoregie (1995) and Okoli-Anunobi *et. al*. (2002).

The value of 24.00mg/L as the 96 hours LC50 recorded in this investigation makes the toxicant highly lethal for fish, this value is within the range of 0.4 to 40.00rng/L reported by Abel, (1974) on synthetic detergents to be acutely toxic to fish.

Table 1: Water quality parameters during exposure of ***Tillapia mossambica*** fingerlings to Linear Alkylbenzene Su!phonate detergent for 96 hours.

Toxicant Concentration mg /L.

Parameters	60.00	30.00	15.00	7.50	3.75	00.00
Temperature	28.00	28.10	28.00	28.00	28.00	28.00
Dissolved O2	7.30	7.30	7.20	7.30	7.10	7.10
Co2 mg/L	2.44	2.45	2.46	2.46.	2.45.	2.48
Alkalinity mg/L	52.50	40.40	40.40	30.30	29.90	20.00
pH	10.50	.10.30	9.45.	9.40	8.54.	6.55

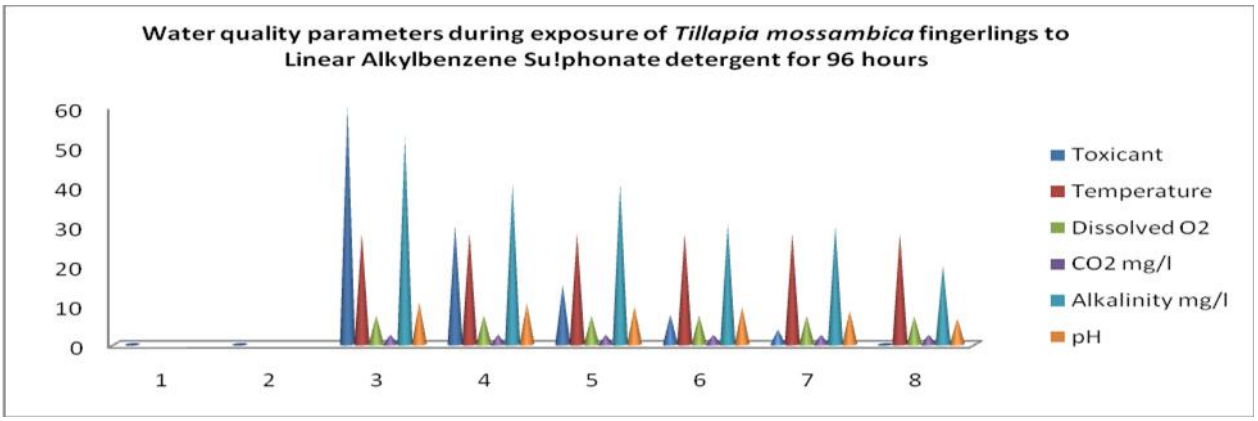
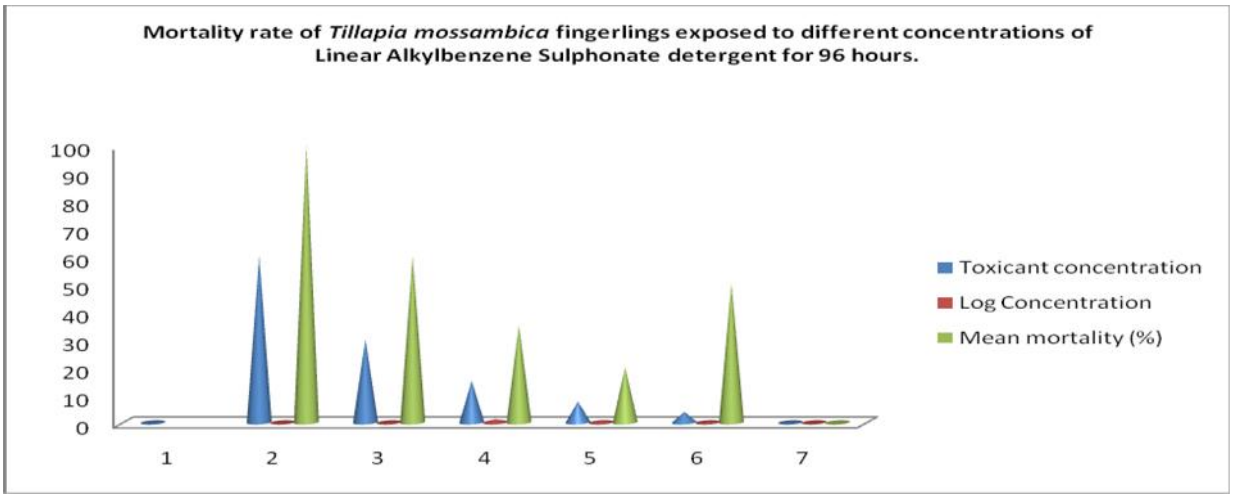


Table 2. Mortality rate of ***Tillapia mossambica*** fingerlings exposed to different concentrations of Linear Alkylbenzene Sulphonate detergent for 96 hours.

Toxicant concentration mg/L	Log Concentration	24hrs		48hrs		72hrs		96hrs		Mean mortality (%)
60.00	1.78.	4	3.	3.	3	2	3	1	1	100
30.00	1.48.	3	2.	2.	1	2	1	0	1	60
15.00	1.18	2	2.	1	0	0	1	1	0	35
7.50	0.88	0	1.	0	1	1	1	0	0	20
3.75	0.57	1	0	0	0	0	0	0	0	50
00.00	00.00	0	0	0	0	0	0	0	0	0



The rapid opercula movement, erratic swimming, loss of balance observed in this experimental set -up suggested various nervous disorders and haemorrhaging of the gills when the test fish were exposed to the detergent. These observations are in agreement with earlier reports by Omoregie *et. al*. (1990), Ghatak and Konar (1991) and Okoli-Anunbi, *et al*. (2002).

The disruption of activities of mucus secreting gland is a clear indication of the poisoning effect of the detergent on organs glands and tissue. Okoli Anunobi *et. al*. (2002) also reported similar observation in their investigation on glands, organs and tissues of *Oreochrotnis niloticus* fingerlings_ It is likely that the toxic effect of the detergent coupled with fatigue resulted in the death of the fish, according to Abel, (1976), alkylbenzene sulphonate progressively destroyed the effectiveness of the gills of brown trout *Salmo trutta* at concentrations of 5mg/L.

The use of detergents cannot be discontinued however, better methods of disposing the 'after wash' needs to be worked out. If the present rate at which they are introduced into our aquatic environment is not checked, the continuous. existence of aquatic fauna including many important aquaculture fish species such as *Tillapia mossambica* would be seriously threatened.

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