

Acute Toxicity of Alkylbenzene Sulphonate (LAS) Detergent to *Oreochromis niloticus* Fingerlings

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Abstract

The lethal effects of Linear alkylbenzene sulphonate (LAS) detergent with trade name "ZIP" to *Oreochromis niloticus* fingerlings was investigated via exposure in flow through and continuous aeration system over a period of 96 hours. The LC_{50} of this detergent was determined to be 79.43 mg/L^{-1} . During the exposure period, the fingerlings exhibited some behavioural changes including loss of balance, restlessness, rapid swimming and later mortality. Water quality measured during the experimental period showed high pH value which may be responsible for increased mortality at low concentration of the toxicant.

Key words: Detergent, fingerlings, mortality, exposure.

Introduction

The aquatic environment has long been considered as "sink" for dumping wastes which could explain why most of our water courses are not in their "natural" state in terms of viscosity, purity and seasonal variation of flow rate.

Over the years as a result of individual development and subsequent urbanization, there have been significant changes in the river water chemistry. Umoh and Ijah, (1997) reported eight major water pollutants in Nigeria: Erosion sediments, sewage, nitrogen and phosphorus loading from agricultural fertilizer and industrial run-offs, mining wastes, thermal discharge from industries, industrial and household chemicals, radioactive waste from industries, oil spills and other bio-degradable wastes.

Pollutants can have effects on the neuro-physiology and reproductive physiology of aquatic organisms (Abel 1974). The toxicity of a toxicant on a target organism or a community depends on the concentration of the compound and the time of exposure to it. The effect could be acute (rapidly causing death) or chronic (after long exposure and may ultimately cause death).

Fish is one of the most important non-targets organisms affected by detergent pollution. Discharge of effluents from industries, wastes, agricultural fields and also detergent disposal during communal washing are common practice along several river banks in Nigeria. These lead to a build up of detergent level leading to oxygen depletion, reduction in water quality and damage to fishing interests.

Linear alkylbenzene sulphonate (LAS) detergent with trademark (Zip®) is a synthetic detergent which is widely used in so many textile industries and effluents are discharged into the environment. They are also used in washing clothes as well as for so many other domestic activities. Okwuosa and Omeregic (1995) documented that synthetic detergents are toxic to fish at concentration between 0.4 and 40mg/l as obtained in Ofojekwu *et al.*, (1999).

Materials and Method

Oreochromis niloticus (12.05 – 22.3g) used as the test organisms for this experiment was collected from Jummic farm along Gidan Kwanu, Minna. The fish were transported to the Fish farm, Federal University of Technology, Minna in a portable well aerated polythene bag containing clean water. The fish were kept in indoor hatchery tank at temperature range of 25-26°C for acclimatization for 2 weeks. During this period, the fish were fed with 40% protein diet in clean water.

The test concentrations of alkylbenzene sulphate detergent with trade name 'zip®' were prepared according to Donald and Philip (1987), by dissolving 100mg of the powder in 1 litre of distilled water. From the stock solution the following concentration were prepared alongside the principle of serial dilution method of Warner (1962); 10.00mg/l, 8.00mg/l, 6.00mg/l, 4.00mg/l, 2.00mg/l. Dechlorinated tap water formed the control at 0.00mg/l. Flow through system was used during the experimental period, Ten (10) fish each were introduced into 12 glass aquaria of 33cm × 60cm × 20cm capacity with over head tanks (60cm × 50cm × 40cm) with water holding capacity of 200litres containing the different concentrations. Feeding was discontinued 24 hours before the commencement of the experiment through the experimental period. Mortality was recorded every 24 hours, though the aquaria were inspected every 3 hours for dead fish which were immediately removed. During exposure period, the temperature, dissolved oxygen, alkalinity and conductivity. Dissolved oxygen and alkalinity were monitored using the method of APHA, (1995). Conductivity was measured with conductivity meter while temperature was measured in situ with thermometer. The 96h LC₅₀ was determined by graphical method.

Results and Discussions

Table 1: Mortality and probit scale of *Oreochromis niloticus* fingerlings exposed to different of the detergent over 96 hours.

Toxicant Conc (mg l ⁻¹)	log Conc (mg l ⁻¹)	Mortality rate in 2 replicate				mean mort (%)	mean probit
		24hrs	48hrs	72hrs	96hrs		
10.00	1.00	1 0	1 0	3 1	2 1	45	4.87
8.00	0.90	1 2	3 2	3 0	2 0	65	4.61
6.00	0.78	0 0	2 2	2 1	1 1	45	4.87
4.00	0.60	3 2	1 1	1 1	0 0	45	4.87
2.00	0.30	1 1	1 0	0 0	0 0	15	3.96
0.00	0.00	0 0	0 0	0 0	0 0	0	-

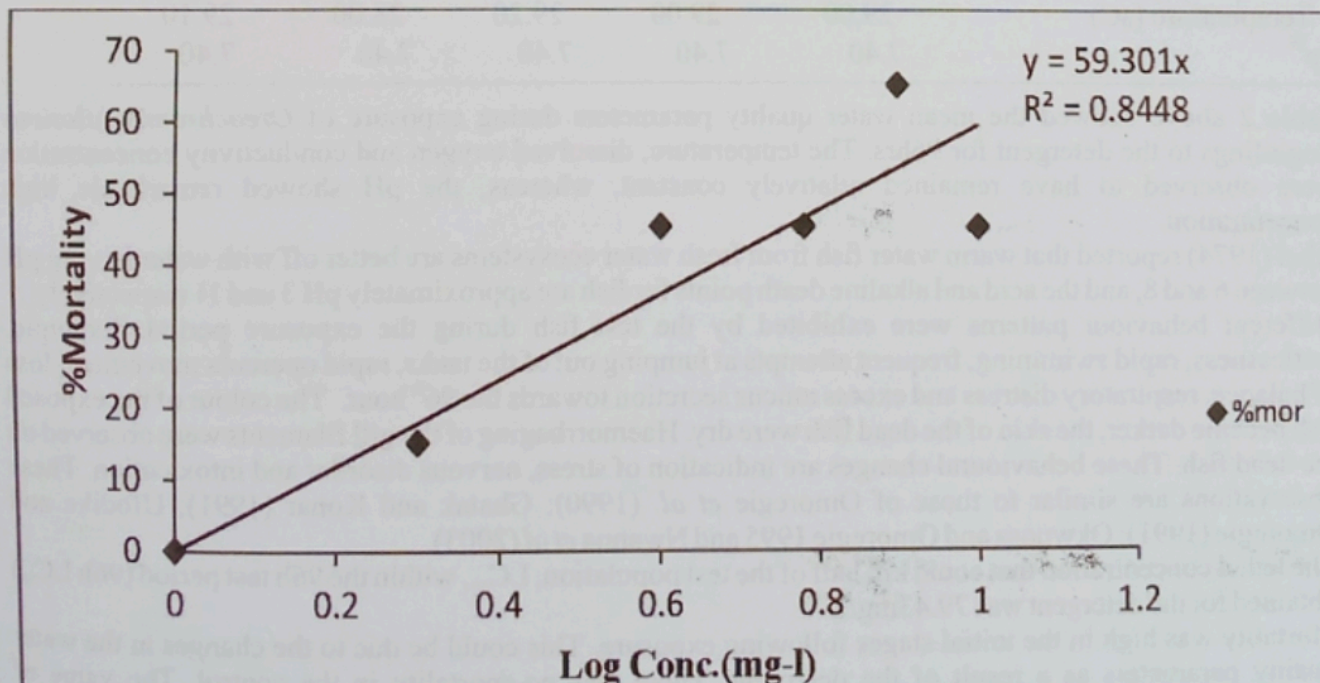


Fig. 1 Graph of *Oreochromis niloticus* exposed to different concentrations of LAS showing log concentration and mortality.

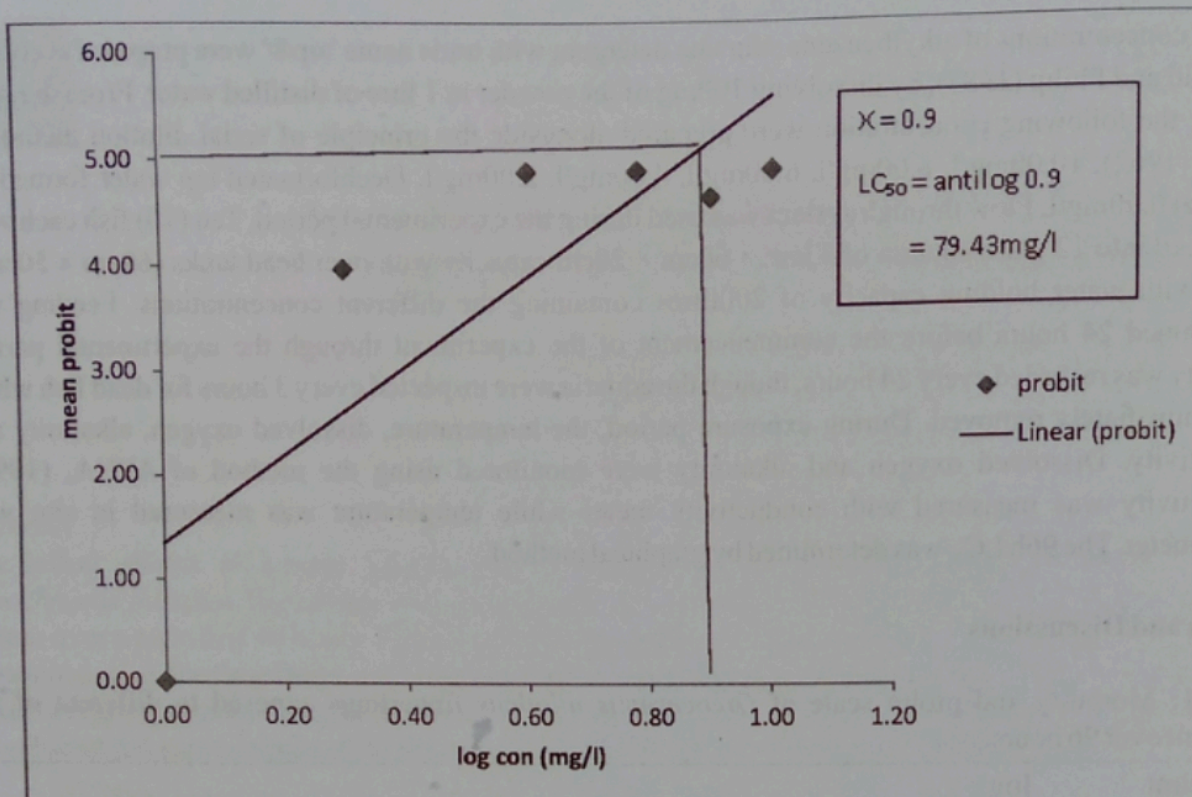


Fig 2: Determination of LC50 by graphical method Log_{10} conc. (mg/l) for *Oreochromis niloticus*

Table 2: water quality parameters recorded during the exposure of *Oreochromis niloticus* fingerlings to different concentrations of linear Alkylbenzene sulphonate detergent for 96hrs.

Parameters	10.00	8.00	6.00	4.00	2.00
Disolved Oxygen (mg l^{-1})	0.3	0.5	0.6	0.6	0.8
Alkalinity (unit)	7.40	7.40	7.40	7.40	7.40
Conductivity (μcm^{-1})	360	360	360	370	370
Temperature ($^{\circ}\text{C}$)	29.00	29.00	29.20	28.00	29.10
p^{H}	7.40	7.40	7.40	7.40	7.40

Table 2 above showed the mean water quality parameters during exposure of *Oreochromis niloticus* fingerlings to the detergent for 96hrs. The temperature, dissolved oxygen and conductivity concentration were observed to have remained relatively constant, whereas, the pH showed remarkable high concentration.

Abel (1974) reported that warm water fish from fresh water ecosystems are better off with water having pH between 6 and 8, and the acid and alkaline death points for fish are approximately pH 3 and 11 respectively. Different behaviour patterns were exhibited by the test fish during the exposure period. Example, restlessness, rapid swimming, frequent attempts at jumping out of the tanks, rapid opercula movement, loss of balance, respiratory distress and excess mucus secretion towards the 96th hour. The colour of the exposed fish became darker, the skin of the dead fish were dry. Haemorrhaging of the gill filaments were observed on the dead fish. These behavioural changes are indication of stress, nervous disorder and intoxication. These observations are similar to those of Omoregie *et al.* (1990); Ghatak and Konar (1991); Ufodike and Omoregie (1991); Okwuosa and Omoregie 1995 and Nwanna *et al.* (2003).

The lethal concentration that could kill half of the test population, LC_{50} , within the 96h test period (96h LC_{50}) obtained for the detergent was 79.43mg/L^{-1} .

Mortality was high in the initial stages following exposure. This could be due to the changes in the water quality parameters as a result of the detergent. There was no mortality in the control. The value of 79.43mg/L^{-1} as the 96hr LC_{50} for the detergent makes this toxicant highly lethal for fish in the aquatic medium. This figure is within the range of 0.4 - 40 mgL^{-1} reported by Abel (1974) of synthetic detergents to

be acutely toxic to fish.

Conclusively, alkylbenzene sulphonate detergent is toxic to *Oreochromis niloticus* fingerlings. This detergent also contributes to pollution of the water which leads to the mortality of the fish.

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