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Acute toxicity of detergent to Indian major carps *Catla catla* and *Labeo rohita*

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ABSTRACT

In the present study, short term (96hrs) toxicity of Surf excel detergent to two freshwater teleost fishes Catla catla and Labeo rohita has been investigated using static bioassay. The fingerlings of Catla and Rohu were exposed to five different concentrations (10, 12, 14, 16 and 18ppm) of Surf excel for 24, 48, 72 and 96hrs. Data on mortality (%) were analyzed using Grafpad software based on Finney's Probit statistical method. The 24, 48, 72 and 96 hrs LC_{50} *values of Surf excel to Catla fingerlings were 23.79, 17.87, 15.84 and 14.20 ppm, respectively; whereas for Rohu fingerlings the corresponding values were 17.26, 14.79, 12.74 and 11.06 ppm, respectively. The differences observed in the mortalities of C. catla and L. rohita fingerlings at different concentrations of Surf excel were significant (*$P < 0.001$*) and suggestive that mortality could be an important factor of concentration and time of exposure. Of the two organisms tested, the fingerlings of L. rohita were found to be more sensitive than that of C. catla. This study provides further proof for the acute toxicity of detergent pollution on the early stages of economically important freshwater fishes. The results are discussed in the light of available literature.*

Keywords: Acute Toxicity test, Detergent, *Catla catla*, *Labeo rohita*.

INTRODUCTION

Of the various freshwater pollutants, detergents have attracted special attention. They are widely used in both industrial and domestic premises as soaps and detergents to wash vehicles. The 'after wash' of the detergents are either drained into the aquatic environments such as ponds, lakes, rivers, streams etc. or they find their way into the aquatic environment by natural sewage.

Detergents are the parts of a large group of chemical compounds, collectively referred as surface-active agents or surfactants because they act upon surfaces [1]. Detergents are of three types namely anionic, cationic and non-ionic detergents. Based on the characteristics features, the detergents are broadly classified into two types namely phosphate detergents and surfactant detergents. Phosphate detergents are highly caustic, used to soften hard water and help to suspend dirt in the water. The phosphates present in the detergents are one of the important contributing factors for eutrophication in water bodies. The surfactant detergents, Linear alkylbenzene sulfonate (LAS) and Sodium dodecyl sulfates (SDS) are very toxic to bacteria, microalgae, crustaceans, echinoderms and fish [2, 3]. In commercial detergent the composition of surfactant component ranges between 10% and 20%. The other components include bleach, filler, foam, stabilizer, builders, perfume, soil suspending agents, enzymes, dyes, optical brighteners and other materials designed to enhance the cleaning action of the surfactant [4, 5]. Studies indicated that detergents have toxic effects on all types of aquatic life.

Fish is generally considered very sensitive to all kind of environmental changes to which it is exposed as they are exclusively aquatic with external mode of fertilization [3]. Fish is one of the most important non-target aquatic organisms affected by detergent pollution. The toxic effect of detergents to aquatic organisms in general and fish in particular has been reported by many workers [3, 6, 7, 8, 9, 10, 11, 12, 13, 14]. In the present study an attempt has been made to determine the short term (96hrs) toxic effects of detergent to the fingerlings of economically important freshwater fishes *Catla catla* and *Labeo rohita*. An important consideration for studying the toxicity of detergents on the fingerlings of these two species was the paucity of information on the younger developmental stages which are considered to be more susceptible and vulnerable to toxicants than those of adult stages [15].

MATERIALS AND METHODS

Fingerlings of *C. catla* and *L. rohita* measuring about 4.0±0.25 cm in length, weighing approximately about 5-6g were procured from Poondi, Thiruvallur district, Tamil Nadu, India. The test organisms were transferred to the laboratory in the plastic bags and were washed with 0.1% $KMNO_4$ solution to get rid of dermal infection. Healthy fingerlings were selected and acclimated in dechlorinated tap water for 15 days; during this period they were fed with oilcake (1 g), thrice a day by dissolving in 10 mL of dechlorinated tap water. Water was replenished 100% on daily basis with routine cleaning of aquaria leaving no faecal matter and unconsumed food.

Into 5 liter plastic tubs containing 1L of test solution, ten test animals were introduced in a static bioassay system. Experiments were carried out in replicates and a separate control was maintained. The fingerlings were not fed during the period of exposure. After conducting range finding tests, five different concentrations namely 10, 12, 14, 16, and 18 ppm were selected to determine the LC_{50} values.

Statistical Analysis

The mortality (%) data obtained were used to calculate the 24, 48, 72 and 96hr LC_{50} values by Probit analysis method, using a statistical package (Grafpad software). ANOVA was used to compare the LC_{50} values of Surf excel to test organisms after 96 hrs.

RESULTS

The 24, 48, 72, and 96hrs LC_{50} values for Surf excel to Catla and Rohu fingerlings were presented in Table 1. The 24, 48, 72 and 96hrs LC_{50} values of detergent to Catla fingerlings were 23.79, 17.87, 15.84 and 14.20 ppm, respectively, and those for Rohu were 17.26, 14.79, 12.74 and 11.06 ppm, respectively.

Table: 1 The LC_{50} values of Surf Excel detergent to Catla and Rohu fingerlings after 24, 48, 72 and 96hrs exposure

S. no	Test organisms	LC_{50}			
		24hr	48hr	72hr	96hr
1.	*Catla catla*	23.79 ppm	17.87 ppm	15.84 ppm	14.20ppm
2.	*Labeo rohita*	17.26ppm	14.79ppm	12.74ppm	11.06ppm

Table: 2 Effect of Surf excel on the mortality (%) of *C. catla* fingerlings (ANOVA)

Variable	Source	Sum of Squares	df	Mean square	F	Sig
Surf excel detergent Vs *C. catla* fingerlings	Between groups	520.236	5	104.047	28.250	.000*
	Within groups	243.083	66	3.683	--	--
	Total	763.319	71	--	--	--

**Significant (P< 0.001)*

Table: 3 Effect of Surf excel on the mortality (%) of *L. rohita* fingerlings (ANOVA)

Variable	Source	Sum of Squares	df	Mean square	F	Sig
Surf excel detergent Vs *L .rohita* fingerlings	Between groups	518.944	5	103.789	12.258	.000*
	Within groups	558.833	66	8.467	--	--
	Total	763.319	71	--	--	--

**Significant (P< 0.001)*

An overall significant effect of detergent on the mortality of fingerlings of both the test organisms was revealed ($P < 0.001$; Tables 2 & 3). Different concentrations of Surf excel also had significant effect ($P < 0.001$). The calculated 96hr LC_{50} values to *C. catla* and *L. rohita* fingerlings were found to be 14.20 and 11.06 ppm, respectively (Fig. 1).

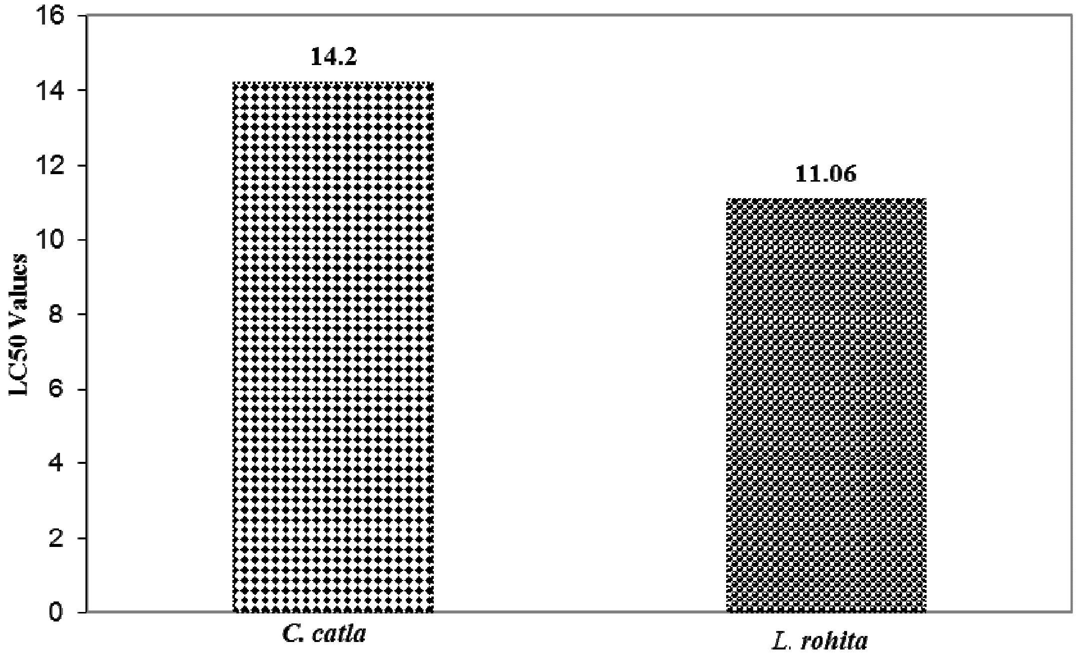

Fig. 1 The 96 hrs LC_{50} values of Surf excel to *C. Catla* and *L. Rohita* after 96hrs exposure

DISCUSSION

In the present study, an attempt has been made to document the short term toxicity of commonly used commercial detergent, Surf Excel to the fingerling stages of two economically important freshwater fishes, Catla and Rohu. Furthermore, these studies also aimed to compare the sensitivity of fingerling stages of two fishes.

As shown in Fig. 1, the 96 hrs LC_{50} values of Surf Excel detergent to Catla and Rohu fingerlings were 14.2 and 11.06 ppm, respectively. In another study [16], reported the 96hrs LC_{50} values for three different detergents namely Surf, Besto and Key as 12.7, 77.6 and 32.9 ppm, respectively to *Rasbora elonga*. The 48hr LC_{50} value of Ariel detergent to freshwater teleost *Oreochromis mossambicus* was found to be 35 ppm [17]. According to Maruthanayagam [18] the 24hrs LC_{50} value of a synthetic detergent, Linear alkylbenzene sulfonate was 0.5 ppm to *Macrobranchium lamarei*. Shingadia and Veena Sakthivel [19] recorded a 96hr LC_{50} value of 400 ppm for wheel detergent to *Lamellidans marginalis* (Lamarck). However, Eknath [12] determined the 96hrs LC_{50} values of the household detergents Det-I and Det-II as 20 and 23.5 ppm, respectively to *Mystus montanus.*

Asrar sheriff *et al.* [3] recorded 100% mortality in grass carp *Ctenopharyngodon idella* after 96hrs of exposure to 40 ppm of commercial detergent "Rin". At the same time, Omotoso and Fagbenro [20] observed 100% mortality when the fish *Oreochromis niloticus* was exposed to 100 ppm of detergent. Likewise, Prakash [21] has reported a mortality rate of 80% at 50 ppm of a detergent to *Tilapia sp*., whereas 100% mortality was noticed in 51 ppm of detergent water.

Of the two test organisms used, the fingerlings of *L. rohito* were sensitive to Surf excel detergent than that of the fingerlings of *C. catla* (Table 1). Lower 96 hour LC_{50} values of Surf excel detergent to *C. catla* (14.20 ppm) and *L. rohita* (11.06 ppm) fingerlings, which are reported in the present study (Fig.1) are in contrast to the higher values (20.0 ppm, and 23.5 ppm) obtained by [22] when the freshwater fish *Mystus montanus* was exposed to the detergents Surf excel and Nirma, respectively.

The detergent molecules can be easily absorbed from surrounding water either through by gills or intestinal epithelium, if it is present in the food than it can be easily absorbed by intestinal epithelium and circulated to various parts of the body. These can be accumulated in tissues and released into the blood stream. Detergents due to their potential toxicity produce histological and biochemical alterations in the organs of animals, these are act as one kind of stress, so the organisms can respond to it by developing necessary potential to counteract the toxicity stress [23, 24, 3].

CONCLUSION

From the results of the present study, it is clear that Surf excel is significantly more toxic to the fingerlings of *L. rohita* when compared to *C. catla*. The use of detergents in homes cannot be discontinued however, better methods of disposing the 'after wash' needs to be worked out. There is a need of developing "eco-friendly" detergents and soaps to conserve our aquatic environment from the consequences of pollution. If the present rate at which they are introduced into water bodies is not monitored, existences of aquatic organisms in water bodies are in serious threat. Fish may be considered as a suitable candidate to detect the toxicity of different chemicals drained or contaminated in the aquatic biota.

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