Research Paper

Volume : 2 | Issue : 6 | June 2013 • ISSN No 2277 - 8179

Acute Toxicity of Detrergent 'Tide' In the Snail, Bellamya Bengalensis (Lamarck)

Zoology

KEYWORDS : - Bellamya bengalensis, TIDE detergent, LC50 concentrations, Histopathological alterations

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ABSTRACT

Acute toxicity studies were carried out in the freshwater snail (Bellamya bengalensis) exposed to sub-lethal concentrations of detergent Tide. Mortality was assessed and concentrations (LC50) were calculated. LC50 increased with the decrease in mean exposure concentrations and times, respectively. The LC50 values obtained with the snails exposed to detergent (Tide) are 213.7 ppm for 24 hrs, 134.896 ppm for 48 hrs, 104.71 ppm for 72 hrs and 69.18 ppm for 96 hrs. The effects of sub-lethal concentrations of Tide on histology of foot and digestive gland have been studied in detail. The exposure of the snails to sub-lethal concentrations of the detergent caused desquamation of the epithelial cells, disruption of glandular cells and atrophy of the columnar muscle fibres in the foot, disintegration of basement membrane, disruption of hepatic tubules, and occurrence of cell debris in between the tissue in digestive gland at 69.18 ppm for 96 hrs.

INTRODUCTION

Toxicity testing is an essential tool for assessing the effect and fate of toxicants in aquatic ecosystems. To evaluate the acute toxicity of a particular pollutant to a representative species in terms of mortality and time in a laboratory is necessary. This is useful to develop a tolerance level of pollution and to establish limits and levels of acceptability by the biotic components. The results of acute toxicity are generally expressed as a lethal concentration (LC) value. The LC_{50} effective dose is a concentration of which 50% mortality of exposed organisms occurs. The period of exposure for study of short term toxicity test is usually 24, 48, 72 and 96 hrs. This is a convenient way of expressing acute lethal toxicity of a given pollutant to the average individual. The exposure time plays an important role in LC_{50} values. The LC_{50} values derived from acute toxicity tests are best used to assess the margins of safety (Lloyd, 1977). The LC_{50} values decrease with an increase in exposure time (Belanger et al., 1993 & Gupta et al., 1981). Studies on the acute toxicological effects of the various pollutants were undertaken in the nineteenth century. Carpenter (1924) published the first of her important papers reporting the lethal action of heavy metals on fish. Sprague (1969) determined the measurement of the toxicity of pollutants and bioassay method for acute toxicity. Detergents are common pollutants found in natural water ways. According to Glaister (1986) structural changes caused by detergent may occur at any level of the biological organizations literally from molecule to mammals. The aquatic toxicology of surfactants on fishes has been studied for many years (Palanichamy, 1991 & Chellan et al., 2003). There is still scarce on the acute toxicity of detergent on histopathology of fresh water gastropods. Most of the studies were on the accumulation of metals and pesticides on various snails (Heng, 2004 & Radwan et al., 2008). Exposure to moderate concentration of detergents can produce a variety of recognizable effects without actually killing an organism and these have been divided into morphological changes, inhibitory effects and behavioural changes (John, 1970). In a previous work we found that the Lymnaea peregra is highly sensitive to the anionic surfactants, sodium lauryl sulfate (SLS) with a 96 hrs LC_{50} of 0.54mg/L (Jose and Oliva, 1987). No information exists in the literatures concerning the toxic effects of detergents for this snail. Therefore, the purpose of this study was to determine the acute toxicity of detergent to the freshwater mollusc B. bengalensis and to examine the histopathology of the detergent in the body after four days of exposure.

MATERIALS AND METHODS

Acute toxicity of detergent:

Snails, B. bengalensis were collected from river Godavari in Rajahmundry, East Godavari District, Andhra Pradesh, India. Prior to toxicity testing, the snails were acclimatized for one week under laboratory conditions and aerated through an air stone. The stock solutions were prepared with deionized water in 1 L volumetric flasks. Acute detergent toxicity experiments were performed for a four-day period using adult snails. Detergent solutions were prepared by dilution of a stock solution with dechlorinated tap water. The tests were carried out under static conditions with renewal of the solution every day. Control and detergent treated groups each consisted of 10 groups of snails. The experimental study was carried out in the laboratory at room temperature of 27.8°C. Each toxicity test ended 96 hours and mortality was recorded at 24, 48, 72, and 96 hours. The concentration of a detergent which caused 50% mortality to test organisms during a specified time expressed in terms of LC_{50}. The lethal concentrations were calculated using probit analysis (Finney, 1971).

Histopathologic study:

Mortal animals were removed promptly. For histopathology studies both the control group and those of experimental groups that survived at the end of 96 hrs exposure were fixed in Susa, dehydrated in alcohol grades and were embedded in paraffin wax. The animals were cut at 6 - 8µ and take serial sections of the animal and stained with PAS (Periodic acid-Schiff). Sections were examined for abnormality under a light microscope.

RESULTS

Acute toxicity tests were performed under static conditions to determine the toxicity. The behaviour of the control snails was normal. After the introduction of detergent in different aquaria at different concentration levels, avoidance behaviour is clearly observed as the snails tended to move to the walls of the glass troughs and secrete excess of mucous. After sometime, they become weak and mortality was recorded when the animals became detached from the walls of the troughs and showed no reaction when gently probed by a glass rod. From the mortality data LC_{50} values have been determined for 96 hrs. The LC_{50} values along with standard error, 95% fiducial limits of the snail, B. bengalensis for 24, 48, 72 and 96 hrs have been calculated and shown in Fig. 1. The LC_{50} values obtained with the snails exposed to detergent (Tide) are 213.7 ppm for 24 hrs, 134.896 ppm for 48 hrs, 104.71 ppm for 72 hrs and 69.18 ppm for 96 hrs. According to this data, it is clear that there was linear relationship between percent or probit mortality and detergent concentration (Fig. 2). Thus the percent or probit mortality increased with the increasing detergent concentration. The data also reveal that mortality to the pollutant increases with increase in time of exposure period. To have reproducible results and to increase the accuracy of experiment, the bioassay experiments were conducted in triplicates.

DISCUSSION

Pollution is the chief wrecker of the declining of molluscan population. At the bank of river Godavari much of the detergent thus let into the water due to washer men activity make a study of the sub-lethal effects on B.bengalensis. The present study has shown the LC_{50} values in various exposure periods and several degenerative changes in the histological structure of the foot and digestive gland of B. bengalensis exposed to detergent Tide. The acute toxicity of detergent to freshwater invertebrates is generally less than that of metals and pesticides. Acute toxic effects of lead have been recorded at concentrations between 10.50– 30.00mg/L in Babylonia areolata (Supanopas et al., 2005). The median lethal cadmium concentration (LC_{50}) and 95% confidence limits in Babylonia areolata at 24, 48, 72 and 96 hrs were 0, 13.86, 4.39 and 3.35 mg/L respectively. The LC_{50} of cadmium in B. areolata progressively decreased as the exposure time was increased. The highest accumulation of cadmium was found in the digestive gland than foot (Tanhan et al., 2005). Based on theseLC_{50} values, B. bengalensis seemed to have a high tolerance to detergent because their LC_{50} values for 24, 48, 72 and 96 hrs were 213.7, 134.896, 104.71 and 69.18 ppm respectively. Another marine prosobranch, Nerita saxitilis, an efficient biologic monitor to heavy metal pollution in the Red sea had much higher LC_{50} values (300.35µg/L) (Abd Allah and Moustafa, 2002). Comparatively the freshwater prosobranch, Filopaludina martensi martensi also had a high 96 hrs LC_{50} value of (191. 69 mg/L) (Jantataemae et al., 1996). Generally prosobranch snails have opercula to protect themselves when surrounding water becomes hazardous to them. Hence, they are more tolerant to pollutants than opisthobranchs and pulmonates. Kamble and potdar (2010) reported the histopathological changes after the exposure of Bellamya bengalensis to lead acetate up to 96 hrs are swelling and rupturing of digestive absorptive cells, degeneration of calciferous cells, atrophy in the muscular layer, and hypertrophy in cells in digestive gland of snail. Similar reports were observed in the digestive gland of Gafrarium divaricatum exposed to xylene, benzene and gear oil-WSF (Agwuocha et al., 2011).

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