

Acute toxicity of sumithion and its effects on liver morphology in common carp, *Cyprinus carpio*

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Abstract

An experiment was conducted to evaluate the acute toxicity of sumithion and its effects on liver morphology in common carp, *Cyprinus carpio*. The experiment was conducted with four treatments, each with two replications. Treatment one (T1) was used as control (0 ppm) and three concentrations, such as 0.8 ppm (10% of 96 h LC50), 1.6 ppm (20% of 96 h LC50), and 3.2 ppm (40% of 96 h LC50) were used as Treatment two (T2), Treatment three (T3), and Treatment four (T4), respectively. Liver was collected at 192 h after start of exposure. The LC50 value of common carp during the 96 h of exposure was 8.05 ppm. Histo-architectural changes of liver were observed after exposed to the sumithion. The hepatocytes and other cells of the liver were normal and systematically arranged in control (T1). In T2, no noticeable changes were observed, while hypertrophy of hepatocytes, mild to severe necrosis, blood spilling and minor vacuolation was observed in T3 and T4. The present investigation sufficiently emphasized that sumithion has adverse effects on the hematopoietic organs of fish. Thus, the use of sumithion in the field may also be a threat to fauna and flora of the environment.

INTRODUCTION

The contamination of water by pesticides used in agriculture is a problem of worldwide importance. In Bangladesh, more than 300 types of pesticides and insecticides are used for crop protection in agriculture (1). Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non target species, air, water, bottom sediments, and food (2). Sumithion, the O, O Dimethyl O-(3-methyl-4-nitrophenyl), is an organophosphates pesticide. It is also widely used in aquaculture ponds for eradication of aquatic insect (mainly tiger bug) prior to release of larvae. Sumithion is considered somewhat toxic to fish (3).

The common carp, *Cyprinus carpio* is an economically important freshwater fish, native to China and has been introduced all over the world to form a significant part of freshwater fishery. It is a highly palatable and preferred for culture due to its high growth rate and prolific breeding in confined water. In the present study, an effort was made to examine the toxicity of Sumithion to this fish species.

MATERIALS AND METHODS

A. Selection of test fish species

The common carp was collected from local fish farm and maintained in aquaria before start the experiment. The length and weight of collected fishes ranged from 17 to 19 cm and 75 to 90 g, respectively. The experiment was conducted in the wet laboratory of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh during January to June 2014.

B. Insecticide selection

Sumithion (50 E/C) was collected from retail pesticide shop at Mymensingh town.

C. Experimental procedure for acute and behavioral toxicity

Six different concentrations (2, 4, 6, 8, 10, and 12 ppm) of sumithion with three replicates were used in the test series. Control units with three replicates were also prepared. Mortality was assessed at 24, 48, 72, and 96 h after the start and dead fishes were removed immediately. Several behavioral changes, such as less activity, lost of equilibrium, abnormal swimming and staying motionless on the aquarium bottom were observed during the exposure periods.

D. Experimental design for liver histology

The experiment was conducted with four treatments, each with three replications. Treatment one (T1) was used as control (0 ppm) and three concentrations, such as 0.8 ppm (10% of 96 h LC50), 1.6 ppm (20% of 96 h LC50) and 3.2 ppm (40% of 96 h LC50) were used as Treatment two (T2), Treatment three (T3) and Treatment four (T4), respectively. Liver was collected at 192 h after start of exposure and fixed in 10% formalin until

for the use of histological analysis. Water and pesticide were renewed at every 24 hr.

E. Histology of liver

The dehydrated liver samples were embedded into paraffin. Sectioning was done using microtome machine. The liver sections were then stained with hematoxyline-eosin stain. Finally the liver sections were observed under microscope.

RESULTS

A. Acute and behavioral toxicity of sumithion in common carp

Table 1 summarizes the mortality patterns in relation to sumithion dosages. No mortality was taken place in control groups. The LC50 was calculated by probit analysis (Fig. 1). The LC50 value of common carp during the 96 h of exposure was 8.05 ppm. Abnormal behavior such as restlessness, sudden quick movement, rolling movements, swimming on the back (at higher dosages) was observed when the media started to act on test species. The affected fish became very weak, settled at the bottom and died in increasing numbers at the higher dosages.

Table 1. Mortality fish species exposed to different concentration of sumithion at different time intervals.

Concentration (mg/L)	Initial No. of fish	No. of dead fish after different exposure time (hrs)			
		24	48	72	96
Control	30	-	-	-	-
2.0	30	-	-	-	3
4.0	30	-	-	3	6
6.0	30	-	3	6	9
8.0	30	-	3	9	15
10.0	30	21	30	-	-
12.0	30	27	30	-	-

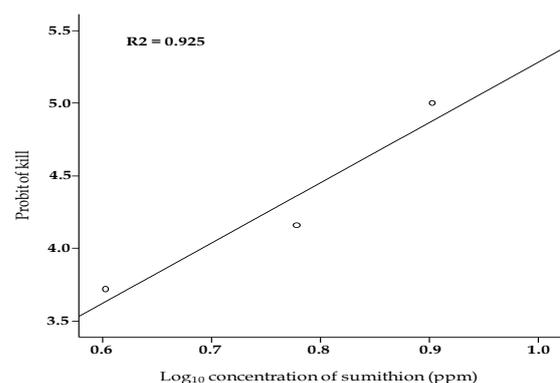


Fig. 1. Graph showing the relationship of probit of kill with log₁₀ concentration of sumithion used to deduce the LC50.

B. Effects of sumithion on Histo-architecture of liver

In the present study, effects of sumithion on histo-architecture of liver were analyzed by histology. The hepatocytes and other cells of the liver in control groups (T1) were normal and systematically arranged. In T2, no noticeable changes were observed, while hypertrophy of hepatocytes, mild to severe necrosis, blood spilling and minor vacuolation were found in T3 & T4 (Fig. 2).

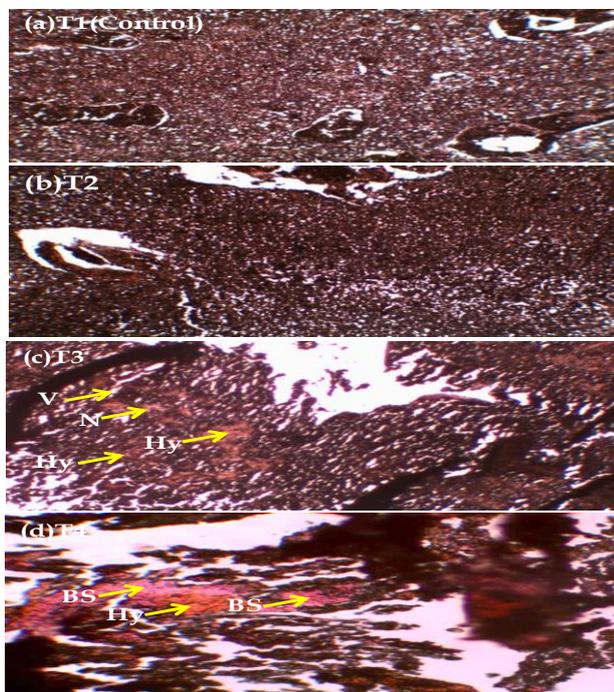


Fig. 2. Histo-architectural changes in liver exposed to sumithion; (a) Control (T1), (b) 0.8 ppm (T2), (c) 1.6 ppm (T3) and 3.2 ppm (T4). Arrowheads are indicating Hypertrophy (Hy), Blood Spilling (BS), Necrosis (N) and Vacuolation (V).

DISCUSSION

Present study was conducted to determine the acute toxicity of sumithion and its effects on liver morphology in common carp. The LC50 value (8.05 ppm) recorded for *C. carpio* is less than the values (9.14 ppm for *Ptychocheilus lucius*, 11.8 ppm for *Heteropneustes fossilis*, 15.3 ppm for *Gila elegance* and 17.0 ppm for *Ictalurus furcatus*) determined for different fish species (4-5). In contrast, lower 96 h LC50 value (2.2 ppm) was recorded for *Oreochromis niloticus* (6). The difference in the toxic potential of the pesticides may be attributed mainly to the susceptibility of the test animals and factors like pH and hardness of water.

Several abnormal behaviors such as restlessness, loss of equilibrium, increased opercular activities, surface to bottom movement, sudden quick movement, resting at the bottom, etc. were similar to the observations of other study (7). However, swelling in the abdominal region and gas-filled stomach were not observed, which is contrary to the findings of Kabir and Begum (9). It is an indication that the effect of pesticides is species-specific. Temperature, hardness, pH, alkalinity, sex, age and other physiological status of the test animals have profound effects on the toxicity of agro-chemicals (9-10). This might be one of the probable reasons for the decline of oxygen concentrations in the lower to higher concentration test media during the present work. As the recorded parameters had little variation, it is evident that physical and chemical properties of aquarium water were within the desirable range of fish culture (9).

Histopathological studies are useful tools to assess the effects of toxicants on fish (11). In the present study, Histo-architectural changes of liver were observed after exposed to the sumithion. Hypertrophy of hepatocytes, mild to

severe necrosis, blood spilling and minor vacuolation was found in liver of fish exposed to higher concentrations (T3 & T4). Similarly, cytoplasmic degeneration, pyknotic nuclei in liver tissues; vacuolation in hepatic cells and rupture of blood vessels; degenerative hepatic cells and necrotic nuclei were observed when *Heteroneustes fossilis* was exposed for 25 days to 5, 10 and 20 ppm Diazinon, respectively (8).

CONCLUSION

It is concluded that sumithion seems to be somewhat toxic to common carp (*C. carpio*). The present study provides the information that histopathological change in liver of fish due to sub-lethal exposure of sumithion. The data obtained in the present investigation amply emphasized that sumithion has adverse effects on the metabolism of macromolecule and hematopoietic organs of fish. Therefore, the use of pesticide in the field may be a threat to human, fauna and flora of the environment.

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