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STUDIES ON THE ACUTE TOXICITY OF ALDRIN ON *HETEROPNEUSTES FOSSILIS* (BLOCH) AND *CHANNA ORIENTALIS* (BLOCH AND SCHNEIDER)

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ABSTRACT

This paper deals with the toxicity of Aldrin to two freshwater fishes, *Heteropneustes fossilis* (Bloch) and *Channa orientalis* (Bloch and Schneider) to determine the acute toxicity. The LC50 values were obtained by using a static bioassay method for a period of 24, 48, 72 and 96-hour intervals. The LC50 values of Aldrin to *H. fossilis* were found to be 45, 35, 30 and 25.5 ppm and to *C. orientalis* to be 55, 35, 30 and 27 ppm for 24, 48, 72 and 96 hours, respectively. A profuse mucus secretion was evident at higher concentrations as compared to lower ones. In different test solutions, the fishes got excited showing frequent swimming, with increased opercular movements and frequent visit to water surface for gulping atmospheric air. The colour of the fish faded on gradually. Later, the fish became sluggish, settled down at the bottom and died.

Key words: Pesticide, LC50 value, mortality.

INTRODUCTION

Aldrin is a pesticide extensively used in cereal farms for the protection of plants against insects and pests. It is an organo-chlorine soil-insecticide manufactured by National Organic Chemical Industries Ltd. (NOCIL), Mumbai. It is commonly used to control soil insects such as termites, corn rootworm, wireworms, rice water weevil, and grasshoppers. However, the use of Aldrin is restricted in many countries, including Argentina, Austria, Canada, Chile, the European Union, Japan, New Zealand, the Philippines, USA, and Venezuela. It is heavily used for plant protection particularly in green vegetables in our country.

Several insecticides are widely used in agriculture on varieties of crops. These insecticides might ultimately pollute the surrounding water resources such as ponds and rivers, through run off of rain water. The constituents of insecticides and other chemicals create several problems for fishes and other aquatic organisms.

Acute toxicity tests are useful because they provide provisional results of realistic value within a very short period, so that the factors affecting, may easily be maintained during this period. The use of determination of LC50 values for measuring the toxicity of any toxicant is increasing in recent years to assess the toxicity of a toxicant for any organism within a specified period of time.

The toxicity of Aldrin to fishes has been reported by Ghosh and Konar (1979); and Ratnakar and Awasthy (1979). Singh and Singh (1981) have studied the effects of Parathion and Aldrin on survival, ovarian 32 uptake and gonadotrophic potency in *Heteropneustes fossilis*.

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MATERIALS AND METHODS

Study area and lab arrangement

Healthy, adult and alive 225 fishes, each of *Heteropneustes fossilis* (9-14 cm and 12-20 gm and *Channa orientalis* (10-13 cm and 20-25 gm were collected from local market of Janakpur in April, 2017 (Figure 1). The fishes were procured especially from ponds and rivers by local fishermen. All fishes were treated with 0.1 % solution of potassium permanganate and acclimatized for 14 days under laboratory conditions in a large glass aquarium measuring about 75cm x 30cm x 45cm in size containing tap water. Fishes were fed twice daily with fish-food during the period of acclimatization to avoid starvation. Twenty four hours before setting of the experiments, the food supply was stopped to clear off the alimentary canal from any food material. The physico-chemical characteristics of the water used are given in Table 1.

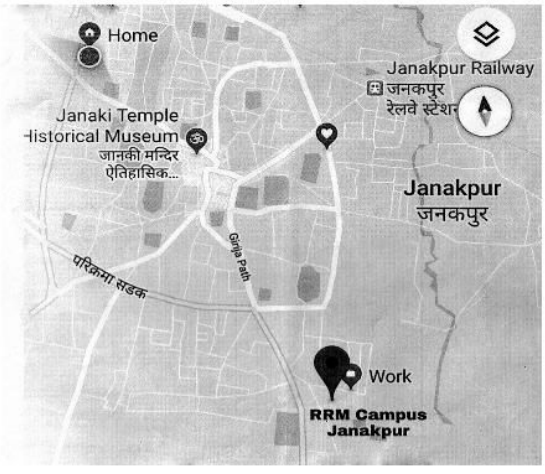

Figure 1. Location map of study area.

A stock solution of Aldrin was prepared with distilled water. Required concentrations of the solution were obtained by the appropriate dilution of the stock solution as per procedures described in Standard Methods (APHA, 1975).

Range finding test

The range finding tests were used to determine an approximate range for the definitive tests. For this purpose, six solutions of different concentrations of Aldrin as 1, 20, 30, 40, 50 and 60 ppm were selected and six groups of five fish each were introduced separately. The seventh group was kept in tap water as control. After every 24 hours the fish were transferred to fresh test solutions and tap water in case of control. After 96 hours, the approximate range for both the fishes was worked out.

Definitive test

A suitable range of 1-60 ppm was found for the species, *H. fossilis* and *C. orientalis* from range finding test (Table 2). In 1 ppm no mortality was recorded but in 50 ppm of Aldrin, all the fishes died within 96 hours.

Table 1 Physico-chemical characteristics of water

SN	Parameters	Values
1.	Temperature	15 -18° C
2.	pH	7.3 – 7.9
3.	Dissolved Oxygen	6.8 – 7.5 ppm
4.	Free Carbon-dioxide	2 – 4 ppm
5.	Total alkalinity	144 ppm

Table 2. Showing range-finding test of Aldrin on *H. fossilis* and *C. orientalis*

Species	Number of fish	Concentration in ppm	Mortality in percentage	Selected range
Heteropneustes fossilis	5	0	Nil	1 ppm To 50 ppm
	5	1	Nil	
	5	20	40	
	5	30	60	
	5	40	80	
	5	50	100	
	5	60	100	

Channa orientalis	5	0	Nil	1 ppm To 40 ppm
	5	1	Nil	
	5	20	20	
	5	30	60	
	5	40	100	
	5	50	100	
	5	60	100	

For determining the LC50 values, five test solutions of different concentrations as 20, 30, 40, 50 and 60 ppm of Aldrin were prepared each for *H. fossilis* and *C. orientalis*. Sixty well-acclimatized fish, each of *H. fossilis* and *C. orientalis* were divided into six groups of ten fish each. Then each group of 10 fish was introduced in the above concentrations separately. A control group of each was kept in tap water.

During all experiments, the test solution was changed after every 24 hours. The food supply was stopped for 96-hours in all the control and experimental groups. The number of opercular movements was counted at first, third and fifth hours of the experiments with the help of stop-watch. The mortality rate was observed carefully after every 24 hours up to 96 hours of experimentation. The LC50 values were calculated graphically. Three replicates were done in order to confirm the results.

RESULTS

When the acclimatized fishes were introduced in the test solutions of different concentrations of Aldrin, they became much more active and excited. They swam swiftly in the water. They exhibited a short period of high excitability followed by muscular spasm causing jerky and violent movements. The fishes showed sign of irritation and fast opercular movements (Tables 3 and 4). The fish reached the surface of water time to time to gulp atmospheric air. They jumped frequently above the water surface and tried to leap out of the containers. Later, the fish settled at the bottom, became sluggish and profuse mucus secretion was observed. Mucus secretion increased with the increasing concentration of test solutions, changing the water colour into more turbid yellowish. After death, the fish overturned at the bottom, then came at the surface and did not respond to physical touch. The mortality was observed from 24 hours up to 96 hours in different concentrations of Aldrin (Tables 5 and 6). The LC 50 values of Aldrin for *H. fossilis* were found to be 45, 35, 30 and 25.5 ppm for 24, 48, 72 and 96 hours, respectively (Figure 2). For *C. orientalis,* these values were 55, 35, 30 and 27 ppm for 24, 48, 72 and 96 hours, respectively (Figure 3).

Table 3. Opercular movements of *Heteropneustes fossilis* in different solutions of Aldrin.

Concentration in ppm	Number of Opercular movements per minute in different hours		
	1st	3rd	5th
Control	39	39	39
20	48	43	40
30	49	47	42
40	51	49	44
50	53	51	45
60	56	54	46

Table 4. Opercular movements of *Channa orientalis* in different solutions of Aldrin.

Concentration in ppm	Number of Opercular movements per minute in different hours		
	1st	3rd	5th
Control	42	42	42
20	45	40	25
30	35	24	17
40	31	23	15
50	25	19	12
60	19	15	11

Table 5. Mortality of *Heteropneustes fossilis* in different concentrations of Aldrin

Concentration in ppm.	Percentage mortality in different hours			
	24hrs	48hrs	72hrs	96hrs
20	00	20	30	40
30	20	40	50	60
40	40	60	70	80
50	50	60	100	100
60	80	100	100	100
Control	00	00	00	00

Table 6. Mortality of *Channa orientalis* in different concentrations of Aldrin

Concentration in ppm.	Percentage mortality in different hours			
	24hrs	48hrs	72hrs	96hrs
20	00	20	20	20
30	00	40	50	60
40	20	40	60	100
50	40	100	100	100
60	60	100	100	100
Control	00	00	00	00

DISCUSSION

When a fish or any other organism is kept into the toxic environment, physiological problems concerning with the mode of entry of the toxic materials into the organism and its movements within the tissues have to be considered (Dalela *et al.,* 1979). In the present study, each group of experimental fishes exhibited certain physical reactions when introduced into the test solutions of different concentrations of Aldrin. They exhibited high excitability followed by muscular spasm causing jerky and violent movements. In the beginning, the opercular movements increased in the first hour while in the third and fifth hours, it decreased gradually. They came to the surface to gulp atmospheric air directly and tried to leap out of the containers.

Wong *et al.* (1977) reported that the cause of death was partly the result of asphyxiation, brought about by the dissolved solids reacting with some constituents of the mucus secreted by the gills, and partly it was due to the blockage of metabolism. Due to the mucus coating over the gills the release of ammonia from the gills may be inhibited, too. These views also provide the conformity to the present study. Wallen *et al.* (1957) found the 96 hour LC 50 value of Aldrin as 5 mg/l NO_2 (7.5 mg/l $NaNO_2$) for *Gambusia affinis* in warm water. In the present study, the 96 hour LC 50 values of Aldrin for *H. fossilis* and *C. orientalis* were 25.5 ppm and 27 ppm, respectively. Thus, this shows that the toxicity of Aldrin is species specific and also more toxic to *H. fossilis* in comparison to *C. orientalis*.

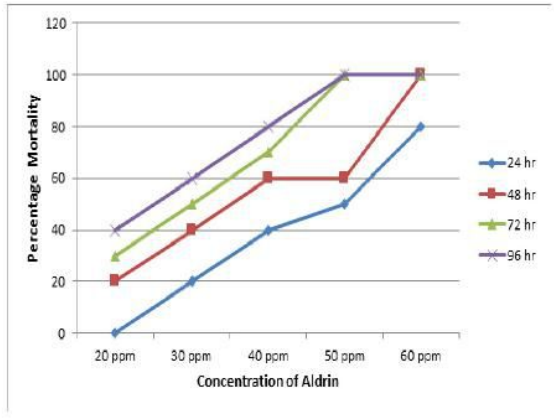

Figure 2. LC50 value of Aldrin for *H. fossilis.*

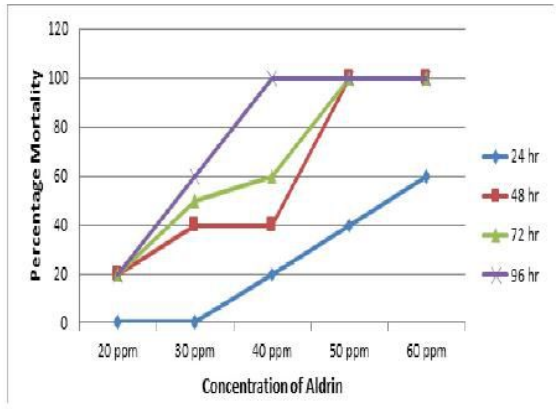

Figure 3. LC50 value of Aldrin for *C. orientalis*

CONCLUSION

The present work is an attempt to study the effects of Aldrin to two freshwater air-breathing fishes, *H. fossilis* and *C. orientalis,* which are known for their highly nutritive and medicinal qualities. Aldrin is a soil-insecticide extensively used throughout the country in agricultural fields to protect crops. Due to the toxic effects of Aldrin, several behavioral and physiological changes were seen causing ultimate death of the fishes. In the present study, the 96 h LC50 values of Aldrin for *H. fossilis* and *C. orientalis* were 25.5 ppm and 27ppm, respectively. Thus, it becomes evident that the toxicity of Aldrin is species specific and it is more toxic to *H. fossilis* in comparison to *C. orientalis.* There is a need for further research to study the effects of Aldrin on limnological parameters and on various organs of the body at different levels.

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