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IMPACTS OF CYPERMETHRIN ON HISTOPATHOLOGY OF LIVER AND GILLS OF FRESH WATER FISH *Anabas testudineus*

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. Author AKJ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AKJ and ANU managed the analyses of the study. Author KCM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Synthetic pyrethroids are very potent insecticides that have gained strong market share during recent years. Pyrethroids are known for its low mammalian toxicity and short environmental persistence due to their rapid decomposition on exposure to the metabolizing systems. The present study was carried out to investigate the histopathological changes in liver and gills of a fresh water fish *Anabas testudineus* under exposure of a pyrethroid insecticide cypermethrin. Acute toxicity of cypermethrin to the fish was determined for 24, 48, 72 and 96 hours by regression equation. The LC_{50} value were calculated 0.15 ppm, 0.20 ppm, 0.25 ppm and 0.30 ppm respectively. The sublethal concentration was 0.106 ppm during present work. After exposure period of 30 days significant changes were reported in liver and gills of cypermethrin exposed fishes. Hyperamia, liquefactive necrosis, dilation of sinusoidal spaces and splitting of hepatocytes were reported in liver. Liquefaction, breakage of gill lamella and hypertrophy of mucous cells were observed in the gills. In the present investigation it was reported that the cypermethrin badly affects the liver and gills of fish even in low dose.

Keywords: *Anabas testudineus;* cypermethrin; gills; histopathological; liver.

1. INTRODUCTION

Excessive and injudicious use of pesticides has contaminated almost every part of our environment. Pesticides are used in agriculture to prevent the crop damage from pests. These pesticides through surface run off reach the aquatic resources like ponds and rivers and alter the physico-chemical properties of

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water and consequently affecting the aquatic organisms including fishes [1].

Fish is an affordable source of protein in the developing countries. Protein content in fish meat varies from 16% to 21% [2]. Fish represent the largest and most diverse group of vertebrates and are excellent experimental models for toxicological research [3].

Fishes are important component of food chain so, any effect of toxicant may have adverse influence on the nutritive values of fish and on the human beings due to their consumption [4]. Pesticides can be circulated into different ecosystems by different agents [5]. Review of available literature on fish and environmental pollutants including persticides indicate that the sublethal dose of different pesticides cause histopathological alterations of varying extent in the different organs of fish and the alterations are usually dependent on dose, duration of exposure and composition of pesticides [6,7]. Histopathological alterations in Liver, Gills and other organs of fishes under exposure of various pesticides were reported by other workers also [8,9,10].

In the present experiment an attempt was made to observe the effect of cypermethrin, a fourth generation pyrethroid on the liver and gills of a fresh water fish *Anabas testudineus* which is commonly found in wetlands of this region and are prone to be affected by widely used pesticides.

2. MATERIALS AND METHODS

The adult living species of *Anabas testudineus* were collected from a local fish pond and were brought to the laboratory in wide mouthed large earthen pots half filled with natural water and covered with a piece of mosquito net. Every effort was taken to give less stress to the fishes during transportation. The fishes were washed with 0.1% $KMnO_4$ solution to remove dermal infections if any. Healthy fishes of average length 12-16 cm and weight 80-100 gm were transferred one by one with the help of small hand net to 40 litre rectangular glass aquarium and acclimatized in the laboratory conditions for a fortnight. Running tap water was used in all the experiments and no aeration was done. They were not given food for the first three days of acclimation & after that fed with chopped goat liver once a day. Bioassay was conducted for the determination of LC_{50} values cypermethrin for 24, 48, 72 and 96 hours following the methods of APHA, AWWA and WPCF [11]. The LC_{50} values for these periods were determined 0.15 ppm, 0.20 ppm, 0.25 ppm and 0.30 ppm respectively. The sublethal dose determined was 0.106 ppm by the formula of Hart et al. At the end of exposure period (day 30) the control and exposed fishes were first individually weighed and then dissected in ringer's saline and the Liver and gills were taken out, fixed in aqueous Bouin's and 10% neutral formalin fixatives for 24 hours and in Carnoy's fixative for four hours. After fixation the tissues fixed in the former two fixatives were thoroughly washed in running tap water and dehydrated in graded alcoholic series, cleansed in benzene and processed for embedding in the paraffin wax. Serial sections of each of the test tissues were cut at 5 μ and stained with Haemotoxylin – Eosin. Selected slides were subjected to routine histological examination and photomicrography.

3. RESULTS AND DISCUSSION

3.1 Liver

Liver is always an organ of interest on account of its involvement in vital metabolic processes of the body. It has role in detoxification also. Any damage to the liver may cause adverse effect on the physiology of fish. In the liver of control fish the hepatocytes were polyhedral in shape and nuclei were centrally placed. Blood capillaries for nutrient supply and sinusoids were normal (Fig – 1).

In the cypermethrin treated fish, the liver exhibited marked changes. Hyperamia, liquefactive necrosis, extensive cytoplasmic vacuolization and splitting of hepatocytes were reported. Moderate dilation sinusoidal spaces and degeneration of Blood capillaries were also observed (Fig. 2, 3 & 4). The present findings are similar with Cadmium chloride exposure to the liver of *Channa punctatus* causing destruction of cytoplasmic as well as nuclear materials [12]. Damage of liver cells due to malathion exposure was reported in *Heteropneustes fossils* [13]. Hyperamia, liquefactive necrosis and displacement of nuclei were reported also in *Heteropneustes fossilis* under Nuvan exposure [14]. Similar results were reported in the liver of *Anabas testudineus* under chronic exposure of Nickel chloride [15].

3.2 Gills

Gills are one of the most exposed organ to a toxicant present in water. Gills are selected in the present experiment due to adaptive compensatory mechanism are developed by the fish to meet the high energy demand. In the control fish, the gills were supported by Inter-branchial septum. Either sides of septum has gill filaments arranged in rows. The outermost layer of gill filaments made up of epithelial tissue. Primary and secondary lamellae were observed normally arranged (Fig. 5).

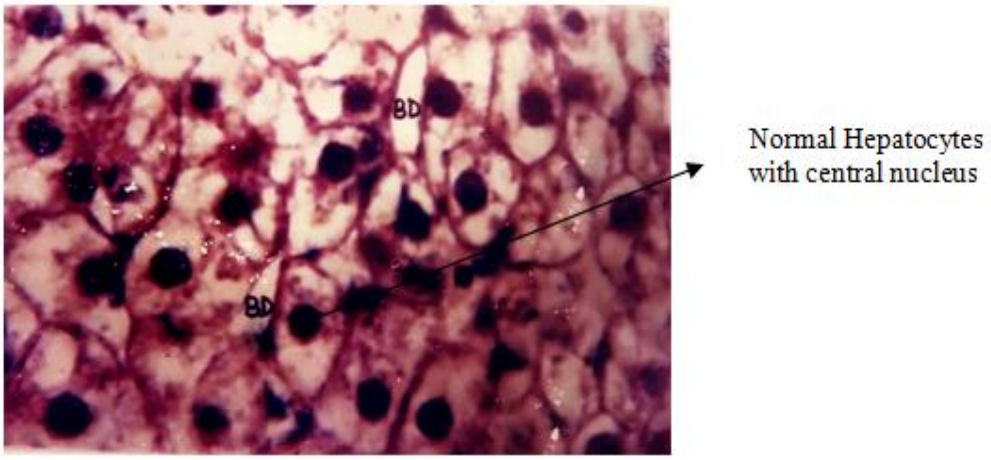

Fig. 1. Histology of liver of control fish H. & E. x 1500

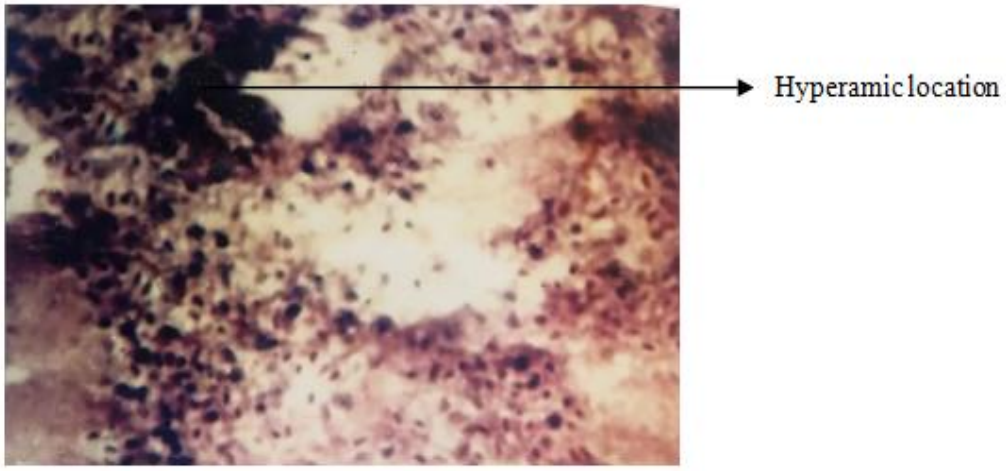

Fig. 2. Hyperamia in liver of cyptermethrin exposed fish. H. & E. x 1500

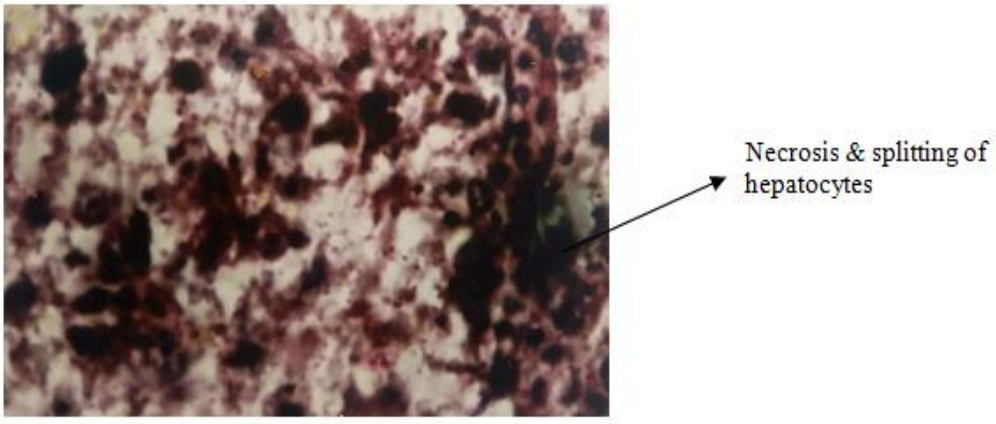

Fig. 3. Liquefactive necrosis and splitting of hepatocytes in cypermethrin exposed fish. H. & E. x 1500

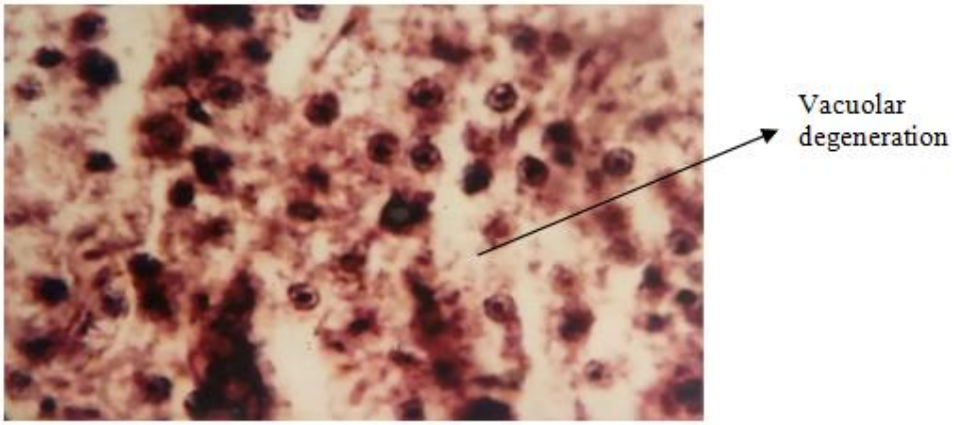

Fig. 4. Cypermethrin exposed liver of fish showing edema and vacuolar degeneration H. & E. x 1500

The cypermethrin treated fish showed damage the gills. Hypertrophy of mucous cells and mucous wrapped gill filaments were observed. Degenerated epithelial lining of gill filaments & secondary lamellae, haemorrhage were the main changes observed during present study (Fig. 6). Reports on haemorrhage in primary gill lamellae and degeneration of secondary gill lamellae and other similar results after the exposure of various pesticides are available [16,17,18].

Fig. 5. Gill of control fish showing normal gill filaments H. & E. x 1500

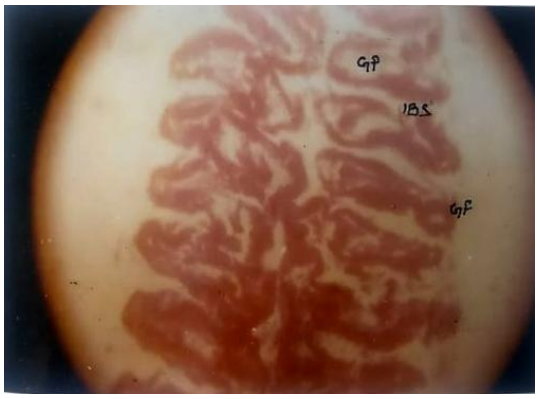

Fig. 6. Cypermethrin exposed gill of fish showing damage in the gill filaments and hypertrophy of mucus cells H. & E. x 1500

4. CONCLUSION

Liver and gills are vital organs of fish and hence, any adverse impact of pesticide on these organs will adversely affect the fish health and if affected fish become the part of our food it will pose risk to the human health also. The present study concluded that cypermethrin has wide range of adverse impacts on the histopathology of liver & gills and hence, judicious use of pesticide is suggested.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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