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The toxicity effect of Lamda Cyhalothrin on *Heteropneustes fossilis*

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Abstract
The LC_{50} value for *Heteropneustes fossilis* was calculated 6.88µg/l using lambda-cyhalothrin as toxicant Lethal concentration for 50% mortality is defined as LC_{50} value for a particular species against a particular pesticide. This can be calculated by using different doses against the organism and tested for mortality. Then after a massive statistical calculation, the final LC_{50} value has been estimated which is lethal up to 50% mortality of organism. Then the sub lethal concentrations are decided by dividing with 10 to minimize the risk of mortality for further studies if any.LC_{50} value for *Heteropneustes fossilis* were calculated as 6.93µg/l. The LC_{50} value in the present study is temperature regulated and also depends on water parameters. The concentrations 0.032 and 0.043 mg/kg were found lethal for *Heteropneustes fossilis* as mortality was observed within 5 days. At 0.03 mg/kg or below mortality was not observed even after 28 days of exposure. However, fish exhibited erratic movements due to the toxic effect of Lamda -cyhalothrin.

Keywords: *Heteropneustes fossilis*

Introduction
Pesticide usage is a critical concern which may have an adverse effect on the delicate ecosystem. The transport of pesticides to delicate ecosystem therefore creates a need to fully understand the effects in the resident biota. In many areas of the world these sensitive ecosystems are at a risk because of non - point source runoff of pesticides from agricultural and urban sources to aquatic ecosystems affecting aquatic biota. Pesticides are carried by wind or percolate through water where it is finally washed down to rivers and streams. Pesticides not only alter the physico-chemical properties of water but also adversely affect the aquatic organisms (Parma *et al*., 2007) [11]. Fish as a bioindicator species play an increasingly important role in monitoring water pollution because it responds with great sensitivity to changes in the aquatic environment. The sudden death of fish indicates heavy pollution of aquatic ecosystem. There are also responses specific to a single pollutant or a group of contaminants. In aquatic organisms, the pollutants percolate upto the cellular level through the cell membrane and interact with the cellular macromolecules to inhibit the essential cellular metabolism (Siroka and Drastichova, 2004) [15]. Fish and other aquatic species has been victim of pesticide poisoning. Keeping these views in front, this study is designed to assess the extent of toxicity of lambda-cyhalothrin to *Heteropneustes fossilis* and Channa punctatus in laboratory conditions.

Lamda Cyhalothrin belongs to a class of synthetic pyrethroids which are well known for their insecticidal activity and are being used worldwide for the last 40 years (Shafer *et al*., 2005). Several workers have also reported their effect on non target organisms including fish (Yap *et al*., 1975; Khan, 1983; Bradbury and Coats, 1989; Jeelani and Shaffi, 1989; Meister, 1992; Parthasarthi and Karuppasamy, 1998; Saxena and Seth, 2002; Saxena and Gupta, 2005) [8, 4]. Saxena and Gupta (2003) [14] have reported these compounds to be highly toxic to *Channa punctatus* and observed behavioral and haematological changes in this fish. It is also reported to cause biochemical changes in various fishes (David and Somasunderam, 1985) [5]. The present investigations were carried out to obtain further information about disturbances in protein and lipid metabolism in *Heteropneustes fossilis* due to exposure to Lamda -cyhalothrin.

Materials and Methods
In order to estimate the LC_{50} value, the fishes of different experimental sets have been treated with different concentrations of test compound as given in Tables. The mortality number of

fishes at different time intervals i.e. 24 hrs, 48 hrs, 72 hrs and 96 hrs and percentage mortality for 96 hrs have been calculated which was used as final mortality for calculation as per international standards for fishes. The mortality number showed a corresponding increase with the increasing concentrations of the test compounds. LC_{50} values have been calculated by the log dose/probit regression line method (Finney, 1971). The test doses have been converted to their logarithms for ease of calculation. Empirical probit values corresponding to the percentage mortality have been obtained from standard table (Finney, 1971) and tabulated in the appropriate columns of the respective tables. The empirical probit values have thereafter been plotted against log dose on the graph paper and a provisional line filling the points is drawn. From this line, expected probit values 'Y' are noted for the values of log dose 'X'. The working probit 'y' have been calculated using the following formula:

$$y = y_0 + kp$$

Where y_0 and k are noted from the table for the expected probit Y and p is the percentage mortality.
The weighing coefficient 'n' for each point is also noted from the table (Finney 1971). Each weighing coefficient is multiplied by the number of fishes used and the products have been taken as 'w'. After this, for each row, the products of wx, wy, wxy, wx^2, wy have been calculated and summed up as $\sum wx$, $\sum wy$, $\sum wxy$, $\sum wx^2$, $\sum wy^2$ respectively.

Results

The LC_{50} value for *Heteropneustes fossilis* was calculated 6.88µg/l using lambda-cyhalothrin as toxicant Lethal concentration for 50% mortality is defined as LC_{50} value for a particular species against a particular pesticide. This can be calculated by using different doses against the organism and tested for mortality. Then after a massive statistical calculation, the final LC_{50} value has been estimated which is lethal up to 50% mortality of organism. Then the sub lethal concentrations are decided by dividing with 10 to minimize the risk of mortality for further studies if any.LC_{50}value for *Heteropneustes fossilis* were calculated as 6.93µg/l.
The LC_{50} values differ from genus to genus and species to species for the same or different pesticides because of different mode of action and physiology of organism. Environmental factors may also affect the LC_{50} value. Many studies have been done in this regard as Raizada and Rana (1998) [13] reported an LC_{50} value of 0.86mg/L to be highly toxic at 96 hrs exposure of Clarias batrachus (Linn.) to malachite green. Subramanian *et al*., (2007) [16] studied the toxic effect of heavy metal; chromium on Clarias batrachus (Linn.) and reported an LC_{50} value of 2.3401mg/L at 96 hrs exposure to be highly toxic. Venkatesan and Subramanian (2007) [16] observed an LC_{50} value of 0.253mg/L at 96 hrs exposure of Oreochromis mossambicus (Peters) to copper sulphate. The LC_{50} value in the present study is temperature regulated and also depends on water parameters. The concentrations 0.032 and 0.043 mg/kg were found lethal for *Heteropneustes fossilis* as mortality was observed within 5 days. At 0.03 mg/kg or below mortality was not observed even after 28 days of exposure. However, fish exhibited erratic movements due to the toxic effect of Lamda -cyhalothrin.
Total lipids in control group fishes were 212.36 µg g^{-1} in liver and 216.43 µg g^{-1} in muscles. In first 5 days of exposure total lipids were significantly (p<0.05) decreased in both the tissues. In liver this decrease was 58.48% and in muscles this decrease was 43.86% in comparison to their control values when the fishes were exposed to 0.02 mg/kg Lamda -cyhalothrin. After 5 days total lipids gradually recovered up to 30 days and after 30 days this reduction remained 22.56 and 17.26%, respectively at 0.02 mg/kg Lamda-cyhalothrin.
Analysis of variance (ANOVA) results of sub-lethal exposure to lambda-cyhalothrin indicated significant (p<0.05) dose dependent elevations in glucose, triglyceride and GPT levels in the serum On the other hand there was a significant (p<0.06) dose dependent inhibition in protein and ALP. No significant difference was recorded for GOT across concentrations. Cholesterol significantly increased (p<0.06) in concentrations 0.0008 and 0.0012 mg L^{-1}, but was significantly inhibited in 0.0016 mg L^{-1}. Also GPT activity was significantly (p<0.05) elevated in 0.0004 and 0.0008 mg L^{-1} exposed fish. There were time dependent elevations in the serum values of glucose, protein and ALP. On the other hand and within the same time period, there was time dependent significant inhibition in cholesterol, triglyceride, GOT and GPT seral enzymes.

Discussion

The Lamda cyhalothrin is separated to be highly toxic to fishes because it is strongly absorbed by the gills even at very low concentration in water due to its high lipophilicity (Elliott, 1989). This compound is also reported to cause biochemical and haematological changes in fishes (Varley *et al*., 1980; Krishnappa *et al*., 2000) [9].
The Changes in total lipids in fish have been reported (Katti and Sathyanesan, 1983; Ramos and Herrera, 1996) due to exposure to various insecticides. In the present studies total lipids in muscles and liver of *Heteropneustes fossilis* were decreased due to exposure to Lamda -cyhalothrin. It can be correlated with the changes in the lipid digesting enzymes like lipase. Since lipids constitute very rich energy reserve, its decrease indicates the changes in energy demands of fish during exposure to Lamda -cyhalothrin.
Depletion of tissue protein in fishes exposed to toxicants has been reported by several workers (Ghosh and Chatterjee, 1988; Saxena and Gupta, 2003) [14]. Studies carried out by Ramalingam and Ramalingam (1982) [12] suggested that the pesticide stress influences the conversion of tissue protein into soluble fraction reaching in the blood for utilization. The reduction in proteins may be due to increased energy demand during stress or it could be due to altered enzymatic activities (Lett *et al*., 1976) [10]. The depletion in protein contents in the present investigations is parallel with the findings of previous workers. In long term exposure to Lamda -cyhalothrin much of the energy must have been used up to compensate the stress, hence the depletion in the protein content is observed.
The significant (p<0.05) increase in glucose which was dose and time dependent may be considered to be manifestation of stress induced by lambda-cyhalothrin.

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