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Toxic Effect of λ-Cyhalothrin on Biochemical Contents of Fresh Water Fish *Channa punctatus*

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Abstract: The effect of exposure to sub lethal concentrations of λ-cyhalothrin (0.010, 0.015 and 0.020 ppm) on biochemical contents (protein concentration and total lipids) in liver and muscles of *Channa punctatus* was studied up to 30 days at an interval of 5 days. The exposed fish exhibited significant changes in biochemical contents. During exposure period total lipids in both the tissues were decreased up to 5 days but after 5 days these contents were slightly recovered during next 25 days. Protein concentration in the liver and muscles of fish was also decreased. The changes were dependent on period of exposure and concentration of λ-cyhalothrin.

Key words: λ-cyhalothrin, fish, muscle, liver, protein, total lipids

Introduction

λ-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). Saxena and Gupta (2003) 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). The present investigations were carried out to obtain further information about disturbances in protein and lipid metabolism in *Channa puctatus* due to exposure to λ-cyhalothrin.

Materials and Methods

Channa punctatus were obtained from local water bodies and acclimated in the laboratory for 10 days and then divided in to four experimental and one control groups. Fish then transferred to different aquaria containing various doses of λ-cyhalothrin and maintained up to their death or a maximum period of 30 days. During this period fish were sacrificed after 5, 10, 15, 20, 25 and 30 days for the study of the changes in biochemical parameters due to exposure to this synthetic pyrethroid. The tissues were collected, weighed and homogenized in glass homogeniser using 10 mL distilled water and then centrifuged in Zenetzki K-24. Total lipids were measured by method given in Oser (1965)

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and protein content of the tissue homogenates were determined as per the method of Lowry *et al*. (1951) using bovine albumin as standard. Each experiment was repeated at least three times and the standard mean error was calculated. Statistical significance of difference between control and experimental values was calculated by student t-test (Fisher, 1950).

Results

In the present experiments, the concentrations 0.030 and 0.040 ppm were found lethal for *Channa punctatus* as mortality was observed within 5 days. At 0.02 ppm or below mortality was not observed even after 30 days of exposure. However, fish exhibited erratic movements due to the toxic effect of λ-cyhalothrin.

Total lipids in control group fishes were 203.33 μg g^{-1} in liver and 218.66 μg g^{-1} in muscles (Table 1 and 2). In first 5 days of exposure total lipids were significantly ($p<0.05$) decreased in both the tissues. In liver this decrease was 59.27% and in muscles this decrease was 44.92% in comparison to their control values when the fishes were exposed to 0.02 ppm λ-cyhalothrin. After 5 days total lipids gradually recovered up to 30 days and after 30 days this reduction remained 21.60 and 18.20%, respectively at 0.02 ppm λ-cyhalothrin.

Table 1: Effect of λ-cyhalothrin on total lipids (μg g^{-1} wet weight) in liver of *Channa punctatus*

Concentration	Control	0.010 ppm	0.015 ppm	0.020 ppm
0 Days	203.33±0.881a	-	-	-
5 Days	201.33±0.333	166.00±1.000 (17.54)	160.33±0.881 (20.36)	82.00±2.000 (59.27)
10 Days	201.66±0.666	167.00±1.000 (17.18)	161.66±0.881 (19.83)	127.66±0.333 (36.69)
15 Days	202.66±0.0905	169.00±0.577 (16.60)	162.33±1.453 (19.90)	140.33±0.333 (30.75)
20 Days	202.00±2.000	170.66±0.333 (15.84)	164.33±0.333 (18.64)	150.66±2.333 (25.41)
25 Days	203.33±0.333	170.33±0.333 (16.30)	166.66±1.201 (18.03)	151.33±0.666 (25.57)
30 Days	203.66±0.666	174.00±1.000 (14.56)	170.33±0.881 (16.39)	159.66±1.207 (21.60)

a = Mean±SE (n>3), Values in parentheses represent % changes from control value

Table 2: Effect of λ-cyhalothrin on total lipids (μg g^{-1} wet weight) in muscles of *Channa punctatus*

Concentration	Control	0.010 ppm	0.015 ppm	0.020 ppm
0 days	218.66±1.855a	-	-	-
5 days	216.66±0.881	175.66±0.893 (18.92)	163.33±1.201 (24.61)	119.33±1.666 (44.92)
10 days	217.33±0.333	181.66±0.333 (16.41)	171.33±1.855 (21.16)	127.67±0.881 (41.25)
15 days	217.66±0.333	188.33±1.201 (13.47)	177.33±3.711 (18.52)	130.67±1.763 (39.96)
20 days	219.00±0.577	195.33±2.728 (10.95)	188.00±1.000 (14.15)	143.33±2.185 (34.55)
25 days	218.00±0.577	207.00±1.154 (5.04)	197.33±1.201 (9.48)	152.33±2.603 (30.12)
30 days	219.66±0.881	213.33±1.201 (2.88)	211.33±1.855 (3.79)	179.67±1.201 (18.20)

a = Mean±SE (n>3), Values in parentheses represent % changes from control value

Table 3: Effect of λ-cyhalothrin on protein concentration (μg g^{-1} wet weight) in liver of *Channa punctatus*

Concentration	Control	0.010 ppm	0.015 ppm	0.020 ppm
0 days	728.35±1.667a	-	-	-
5 days	725.00±5.00	671.67±4.409 (7.35)	591.67±1.667 (18.39)	586.66±1.667 (19.08)
10 days	721.67±6.00	658.35±4.410 (8.77)	580.00±2.886 (19.63)	546.67±4.40 (24.25
15 days	716.67±1.667	635.00±2.89 (11.39)	570.00±2.886 (20.46)	530.00±2.887 (26.04)
20 days	718.35±3.35	611.67±7.26 (14.94)	548.34±6.00 (23.67)	510.00±5.773 (29.00)
25 days	720.00±2.88	601.68±4.40 (16.43)	538.35±4.410 (25.22)	508.33±6.00 (29.39)
30 days	723.35±4.410	588.34±4.41 (18.67)	511.67±7.265 (29.26)	496.98±4.410 (31.34)

a = Mean±SE (n>3), Values in parentheses represent % changes from control value

Table 4: Effect of λ-cyhalothrin on protein concentration (μg g^{-1} wet weight) in muscles of *Channa punctatus*

Concentration	Control	0.010 ppm	0.015 ppm	0.020 ppm
0 Days	758.33±8.33a	-	-	-
5 Days	755.00±0.5776	688.35±4.410 (8.82)	608.34±3.33 (19.42)	495.00±2.88 (34.43)
10 Days	746.67±1.66	678.33±4.409 (9.15)	583.34±1.667 (21.87)	461.67±3.34 (38.16)
15 Days	74834.00±1.67	651.67±1.667 (12.9)	561.67±4.409 (24.94)	441.66±4.409 (40.98)
20 Days	743.34±1.70	633.34±1.67 (14.79)	536.67±4.410 (27.80)	418.34±3.34 (43.72)
25 Days	740.00±2.886	616.66±4.410 (16.66)	511.66±3.33 (30.85)	393.33±1.667 (46.17)
30 Days	741.67±3.34	600.00±2.887 (19.10)	496.67±4.41 (33.03)	357.367±6.009 (52.58)

a = Mean±SE (n>3), Values in parentheses represent % changes from control value

Changes in protein concentration in liver and muscles of experimental fishes due to λ-cyhalothrin exposure are given in Table 3 and 4, respectively. Initial values of proteins in liver and muscles of *Channa punctatus* were 728.35 and 758.33 μg/100 mg, respectively. Exposure to λ-cyhalothrin resulted in significant ($p<0.05$) reduction in protein concentration in both the tissues. Maximum reduction in protein concentration was observed in liver (31.34%) and in muscles (32.58%) compared to the control after exposure to 0.02 ppm λ-cyhalothrin for 30 days.

Non-significant changes were observed in total lipids and protein contents in control group fishes during exposure period of 30 days.

Discussion

λ-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).

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 *Channa punctatus* were decreased due to exposure to λ-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 λ-cyhalothrin.

Depletion of tissue protein in fishes exposed to toxicants has been reported by several workers (Dubale and Awasthi, 1984; Ghosh and Chatterjee, 1988; Saxena and Gupta, 2003). Studies carried out by Ramalingam and Ramalingam (1982) 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). The depletion in protein contents in the present investigations is parallel with the findings of previous workers. In long term exposure to λ-cyhalothrin much of the energy must have been used up to compensate the stress, hence the depletion in the protein content is observed.

The present study indicates significant biochemical changes in *Channa punctatus* due to exposure to λ-cyhalothrin, which may be harmful for the survival of this fish.

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References

Bardbury, S.P. and J.R. Coats, 1989. Comparative toxicology of pyrethriod insecticides. Rev. Environ. Contam. Toxicol., 108: 132-177.

David, B.V. and L. Somasundaram, 1985. Synthetic pyrethroids an evaluation of their potential effects on non target organisms. Pesticides, pp: 9-12.

Dubale and Awasthi, 1984. Biochemical changes in the liver and kidney of a catfish *Heteropneustes fossils* exposed to dimethoate. Comp. Physiol. Ecol., 7: 111-114.

Elliott, M., 1989. The pyrethroids early discovery, recent advances and the future. Pestic. Sci., 27: 337-351.

Fisher, R.A., 1950. Statistical methods for research workers, (11th Edn.), Oliver and Boyd, London.

Ghosh, T.K. and S.K. Chatterjee, 1988. Toxic effect of fenvalerate on organic components of *Anabas testudinus*. Ad. Bios., 7: 203-208.

Jeelani, S. and S.A. Shaffi, 1989. Biochemical compartmentation of fish tissues chronic toxicity of mercuric nitrate on visceral phosphomonoesterases in *Channa punctatus* (Bloch). Acta Physiol. Hung., 73: 477-482.

Katti, S.R. and A.G. Sathyanesan, 1983. Lead nitrate induced changes in lipid and cholesterol levels in the freshwater fish *Clarias batrachus*. Toxicol. Lett., 19: 93-96.

Khan, N.V., 1983. An Assessment of the Hazard of Synthetic Pyrethroid Insecticides to Fish and Fish Habitat. In: Mode of Action, Metabolism and Toxicology. (Miyamoto, J. and P.C. Kearney, Eds.). Pest. Chem. Human Welfare and the Environment. Pergamon Press, New York, 3: 437.

Krishnappa, H., T. Honnegowda, P. Suresh, K. Jayakumar and K. Narayana, 2000. Effect of lambda cyhalothrin, a pyrethroid insecticide on biochemical parameters in male rats. Ind. J. Toxicol., 7: 91-94.

Lett, P.F., G.J. Farmers and F.W.H. Beamish, 1976. Effect of copper on some aspect of the bioenrgetics of Rainbow trout (*Salmo gairdeneri*). J. Fish Res. Board Can., 33: 1335-1342.

Lowry, O.H., W.J. Rosebrough, A.C. Farr and R.J. Randall, 1951. Protein measurement with the folin phenol reagent. J. Biol. Chem., 193: 265-275.

Meister, R.T., 1992. Farm Chemical Handbook "92", Meister Publishing Company, Willoughby, OH.

Oser, B.L., 1965. Hawk's Physiological Chemistry. McGraw Hill Book Company NY.

Parthasarthi, K. and R. Karuppasamy, 1998. Fenvelarate impact on tissue acid and alkaline phosphatase activity of the fish *Channa punctatus*. Poll. Res., 17: 281-285.

Ramalingam, K. and K. Ramalingam, 1982. Effects of sub lethal levels of DDT, malathion and mercury on tissue proteins of *Saratherodon mosambicus* (Peters). Proc. Ind. Acad. Sci., 91: 501-506.

Ramos, G.B. and A.A. Herrera, 1996. Changes in the total lipid and total protein levels of the muscles, liver and brain of *Oreochromis niloticus* chronically exposed to a fenvalerate containing synthetic pyrethroids. Asia Life Sci., 5: 113-124.

Saxena, K.K. and P. Gupta, 2003. Effect of permethrin on the activities of acid and alkaline phosphomonoesterases in a fresh water fish *Channa punctatus*. Proc. Natl. Symp. Biochem. Sci. Health Environ. Aspects, pp: 477-479.

Saxena, K.K. and P. Gupta, 2005. Impact of carbamates on glycogen contents in the muscles of fresh water fish *Channa punctatus*. Poll. Res., 24: 669-670.

Saxena, K.K. and N. Seth, 2002. Toxic effects of cypermethrin on certain haematological aspects of fresh water fish *Channa punctatus*. Bull. Environ. Contam. Toxicol., 69: 364-369.

Shafer, T.J., D.A. Meyer and K.M. Crofton, 2005. Developmental neurotoxicity of pyrethroid insecticides: Critical review and future research needs. Environ. Health Perspect., 113: 123-136.

Varley, H., A.H. Gowenlock and M. Bell, 1980. Practical Clinical Biochemistry-I. Wiliam Heineman Medical Books Ltd., London.

Yap, A.M., D. Desiah, L.K. Cutkomp and R.B. Koch, 1975. *In vitro* inhibition of fish brain ATPase activity by cyclordiene insecticides and related compounds. Bull. Environ. Contam. Toxicol., 14: 163-167.