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PYRETHROID INDUCED RESPIRATORY CHANGES IN *LABEO ROHITA*

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ABSTRACT

The acute (96 hrs) effects on exposure to sublethal and lethal concentrations of synthetic pyrethroids, fenvalerate 20 EC and cypermethrin 25 EC were studied by a static bioassay method on the fingerlings of a freshwater carp, *Labeo rohita. The* sublethal concentrations of fenvalerate and cypermethrin were 2.7 ppb and 3 ppb while lethal concentrations were 4.8 ppb and 5 ppb respectively. The rate of oxygen consumption was determined at these concentrations after every 24 hours. It was found that, as compared to the control, there was change in the rate of oxygen consumption. In general, there was increase in the rate of oxygen consumption due to the effect of both the pyrethroids.

INTRODUCTION

Pesticides are widely used in agriculture to control pests. Synthetic pyrethroids are used primarily to control agriculture pests and household pests. They are also used for protection of industrial products, stored products and for veterinary applications (Smith & Stratton 1986). Majority of synthetic substances like pesticides are nondegradable. Sometimes, half life of such substances may be up to 10 years (Brooks 1976). The chances of these pesticides to enter in different water bodies are increased during rainy season. They enter the water bodies through surface runoff and get concentrated.

Effects of different pesticides and toxicants on oxygen consumption and rate of respiration in different aquatic organisms have been studied (Freeman 1950, Mane et al. 1984, Sarkar 1999). Few reports on oxygen consumption in fishes, exposed to pyrethroids are available. Kumaraguru & Beamish (1983) reported increased respiration of *Salmo gairdneri* exposed to premethrin. Bradbury et al. (1991) worked on cypermethrin, fenvalerate and three other pesticides and reported increased cough frequency as the most striking change in respiratory-cardiovascular parameters in rainbow trout *Salmo gairdneri* at acute concentrations. Jabade & Ansari (1993) reported decrease in oxygen consumption up to 48 hours and an increase in oxygen consumption after 72 hours in *Noemacheilus aureus* exposed to acute toxic concentrations of cypermethrin.

The present study was undertaken to study the effects of synthetic pyrethroids, fenvalerate and cypermethrin on rate of respiration in fingerling stages of *Labeo rohita* after every 24 hours, when exposed to 96 hours acute toxic concentrations.

MATERIALS AND METHODS

The fingerlings (6± 0.2 cm in length) of the freshwater carp *Labeo rohita* were collected from local government fish rearing centre. Fish collected were kept in glass aquaria for one week acclimatization. The water was changed every 24 hours. The fish were fed with fixed diet comprising, water soaked groundnut oil cake and crustacean food powder. Feeding was stopped one day prior to the experimentation.

Acute toxicity (96 h) experiments were conducted using static bioassay tests. For the tests 10 well acclimatized fish were kept in container having 10 litres of water. Commercial grade cypermethrin (25 EC) and fenvalerate (20 EC) were used to prepare stock solutions. The sublethal concentrations of fenvalerate and cypermethrin were 2.7 ppb and 3 ppb while lethal concentrations were 4.8 ppb and 5 ppb respectively.

Oxygen consumption experiments were conducted in a specially designed respiratory glass jar of one litre capacity, fitted with rubber cork having inlet and outlet connected with rubber tubes. Five marked fishes were transferred to the separate jars and water was filled through the siphon. The rubber tubes were then pinched off. The fish were kept in the jar for one hour. After one hour 100 mL of water was siphoned out from the respiratory jar in a stopper bottle and oxygen content was determined using Winkler's modified titration method. The experiment was repeated for fishes from control, LC_0 and LC_{50} groups belonging to both the pesticides after 24 h interval starting from zero hours. The difference between oxygen content prior to experiment and one hour after the experiment was taken as mg of oxygen consumed/h/g body weight of fish. Comparing the results with control, the changes in the rate of oxygen consumption from LC_0 and LC_{50} groups were statistically calculated. The experiment was repeated three times for each pesticide.

RESULTS AND DISCUSSION

The changes in the rate of oxygen consumption in fish during 96 h acute exposure to pyrethroids along with control are given in Table 1.

From the observations, it is clear that the rate of oxygen consumption fluctuated between 0.175 and 0.216 mg/h/g weight of body during 0 to 96 h. In fish exposed to cypermethrin the rate of oxygen consumption in LC_0 group fluctuated from 0.208 to 0.361 mg/h/g weight of body. The

Table 1: The changes in the rate of oxygen consumption in fish during 96 h acute exposure to pyrethroids.

Exposure Period (h)	Control	Cypermethrin		Fenvalerate	
		LC_0	LC_{50}	LC_0	LC_{50}
0	0.216 ± 0.003	0.277 ± 0.005	0.289 ± 0.007	0.293 ± 0.001	0.283 ± 0.003
24	0.202 ± 0.003	0.319 ± 0.004 (± 57.92) * *	0.276 ± 0.001 (± 36.64) *	0.266 ± 0.002 (± 31.68) *	0.270 ± 0.001 (± 33.36) *
48	0.189 ± 0.006	0.222 ± 0.001 (± 17.46) *	0.236 ± 0.001 (± 24.86) **	0.240 ± 0.004 (± 26.94) *	0.270 ± 0.001 (± 42.85) **
72	0.175 ± 0.001	0.208 ± 0.003 (± 18.85) *	0.210 ± 0.001 (± 20.00) *	0.280 ± 0.001 (± 60.00) **	0.310 ± 0.003 (± 77.14) **
96	0.202 ± 0.001	0.361 ± 0.001 (± 78.21) *	0.355 ± 0.007 (± 78.74) *	0.320 ± 0.003 (± 58.41) **	0.351 ± 0.001 (± 73.76) *

* = $P < 0.005$; ** = $P < 0.001$; Values in parentheses are percentages; ± S.D. of 5 animals.

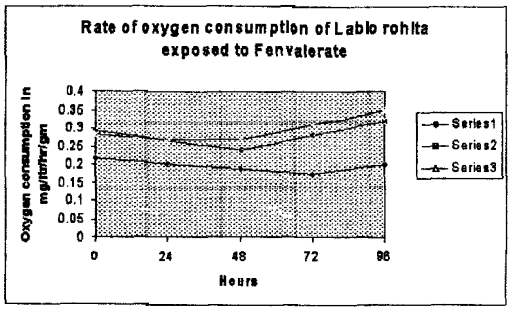

Fig. 1: Rate of oxygen consumption of the fish exposed to fenvalerate.

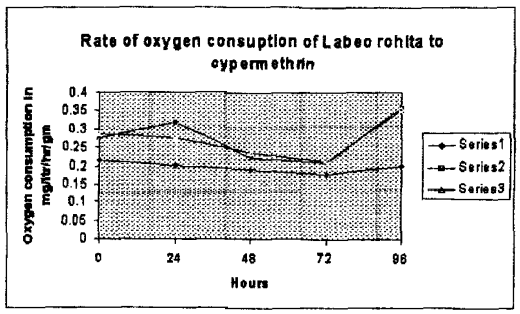

Fig. 2: Rate of oxygen consumption of the fish exposed to cypermethrin.

increase in rate of oxygen uptake was more at 24 h followed by a slight increase at 48 h and 72 h with maximum increase at 96 h. In LC_{50} group, the rate of oxygen consumption fluctuated between 0.210 and 0.355 mg/h/g body weight. The increase in the rate of oxygen consumption was less in LC_{50} than LC_0 group, but follows a similar trend being more at 24 h, comparatively less at 48 h and 72 h and maximum at 96 h.

In fish exposed to fenvalerate, the rate of oxygen consumption in LC_0 group fluctuated from 0.240 to 0.320 mg/h/g body weight. The increase in the rate was more at 24 h and is comparatively less at 48 h. Maximum increase in the rate of oxygen uptake was observed at 72 h and 96 h. In the LC_{50} group, the rate of oxygen consumption fluctuated between 0.27 and 0.351 mg/h/mg body weight. The rate of oxygen consumption increased at 0 h, 24 h, and 48 h and was observed to be maximum at 72 h. At 96 h this increase was slightly less as compared to increase at 72 h.

Respiration represents an important physiological index of any aerobic organism because respiratory rates reflect the metabolism of an animal and its overall functional well being. Rate of oxygen consumption is an intricate index, as it can be affected by a variety of physico-chemical parameters and other substances. Peer Mohammed et al. (1979) showed that the rate of oxygen consumption was increased in the fish, *Labeo rohita* exposed to 0.02 ppm ethyl parathion due to increase in temperature from 20 to 30°C. Chanchal et al. (1990) reported increased oxygen uptake by *Puntius sophore* on exposure to malathion. Kamble (1999) reported increased rate of oxygen consumption in cichlid fish, *Sarotherodon mossambicus* exposed to lethal and sublethal concentrations of endosulfan and chlorpyriphos.

Pyrethroid induced respiratory fluctuations have been reported by many workers. Kumaraguru & Beamish (1983) reported increase in respiration of Rainbow trout, *Salmo gairdneri* exposed to permethrin for 42 days. The authors reported higher basal metabolic rates compared to control during the experiment. Bradbury et al. (1987) reported increased cough rate, while studying respiratory cardiovascular responses of rainbow trout, *Salmo gairdneri* exposed to 1µmol/L of fenvalerate. Jabde & Ansari (1993) reported increased rate of oxygen consumption for 2 h after exposure of *Nomacheilus aureus* to cypermethrin (0.06 ppm). The authors reported a sudden decrease in rate of oxygen consumption at 24 h at 0.06 ppm of cypermethrin and an increase at 72 h and 96 h at 0.04 ppm of cypermethrin as compared to rate of oxygen consumption at 48 h.

In the present study, there was increase in the rate of oxygen consumption at lethal and sublethal concentrations of both the pyrethroids as compared to control. This increase was more at 24 h and a

comparatively less increase was at 72 h for cypermethrin and at 48 h for fenvalerate at both the concentrations. The rate of oxygen consumption increased to maximum at 96 h in both the pyrethroids at lethal as wall as sublethal concentrations. The altered rate of oxygen consumption may be due to disruption of respiratory process caused by gill epithelium as stated by Skidmore (1970). It may also be due to increased production of mucus as stated by Holcombe et al. (1982). The high metabolic rate may be because of metabolic activity of brain which is a predominating factor governing the rate of oxygen consumption in fish (Freeman 1950). Excitement may be effective via central nervous system causing increased muscle tone and consequently increased rate of oxygen consumption (Reddy & Bashamohideen 1989, Chanchal et al. 1990). The increased rate of oxygen may be because of increased ventilation volume in order to compensate drop in oxygen due to reduction in permeability of gills.

REFERENCES

Bradbury, S. P., Mckim, J.M. and Coats, J.R. 1987. Physiological response of rainbow trout (*Salmo gairdneri*) to acute fenvalerate intoxication. Pestic. Biochem. Physiol., 27: 275-288.

Bradbury, S.P., Carlson, R.W., Niemi, G.J. and Henry, T.R. 1991. Use of respiratory cardiovascular responses of rainbow trout in identifying the acute toxicity syndromes in fish. Environ. Toxicol. and Chemistry, 10(1): 115-132.

Brooks, G.T. 1976. Chlorinated Insecticides. CRC Press Inc., Cleavland, Ohio.

Chanchal, A.K., Kumar, S., Rajan, N.K. and Pandey, B.N. 1990. Effect of pesticides on oxygen consumption of freshwater fish *Puntius sophore*. Env. Ecol., 8(2): 775-776.

Freeman, A. 1950. Oxygen consumption, brain metabolism and respiratory movements of gold fish during temperature acclimatization with special reference to lowered temperatures. Biol. Bull., 99: 416-424.

Holcombe, G.W., Phipps, G.O. and Tannes, D.K. 1982. The acute toxicity of Keltane, Dursban, Disulfoton, Pyridin and Permethrin to fathead minnows *Pimephales promelas* and rainbow trout *Salmo gairdneri*. Environ. Pollut., 29:169-178.

Jabde, P.V. and Ansari, Mumtaz 1993. Effect of acute exposure of Cypermethrin on the oxygen consumption of a freshwater fish *Nomacheilus aureus* (Day). Proc. Acad. Environ. Biol., 2(1): 95-98.

Kamble, G.B. 1999. Studies on the impact of endosulfan and chlorpyriphos on the freshwater fish *Sarotherodon mossambicus* (Peters), Ph.D. Thesis submitted to the Shivaji University, Kolhapur.

Kumaraguru, A.K. and Beamish, F.W.H. 1981. Lethal toxicity of permethrin (NRDC 143) to rainbow trout, *Salmo gairdneri*, in relation to body weight and water temperature. Water. Res., 15: 503-505.

Kumaraguru, A.K. and Beamish, F.W.H. 1983. Bioenergetic of acclimation to permethrin (NRDC-143) by rainbow trout. Com. Biochem. Physiol., 75C, 247-252.

Mane, U.H., Akarte, S.R. and Muley, D.V. 1984. Effect of Cyathion-Malathion on respiration in three freshwater bivalve mollusks from Godavary river near Paithan. J. Environ. Biol., 5(2):71-80.

Peer Mohammed, M., Gupta, R.A., Nath, D. and Srivastava, G.N. 1979. Influence of sublethal ethyl parathion on the activity metabolism in carp *Labeo rohita*. Proc. Symp. Environ. Biol., 89-95.

Reddy, P.M. and Bashamohideen, M. 1989. Toxicity of synthetic pyrethroid insecticides Fenvalerate and Cypermethrin to the fish *Cyprinus carpio*. Environ. Ecol., 4: 1016-1018.

Sarkar, S.K. 1999. Effects of two heavy metals on oxygen consumption of fish *cyprinus carpio*. U.P. J. of Zoology. 19(1): 13-16.

Skidmore, J.F. 1970. Respiration and osmoregulation in rainbow trout with gills damaged by zinc sulphate. J. Exp. Biol., 52: 481-494.

Smith, T.M. and Stratton, G.W. 1986. Effects of synthetic pyrethroids insecticides on nontarget organisms residue. Rev., 97: 93-120.