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Effect of pesticide on the freshwater on air breathing fish

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Abstract

The fish exposed to sub-lethal concentration (1-5ppm) for 4 days and the changes in the biochemical constituents were studied. Significant changes in respiratory haematological, biochemical and enzymological parameters in fish were observed. Several behavioural changes during the period of exposure were also observed and noted. The results obtained were discussed at length with the available literature.

Keywords Pesticide, freshwater, air breathing fish

Introduction

The oxygen consumption (biotic) is a very sensitive physiological process and the change in respiratory activity has been used as an indicator of stress in animals exposed to toxicants. A number of investigations on the effect of pesticides on the Oxygen Consumption of fish have been reported [1-8]. A reduction in haemoglobin content and erythrocyte population resulting in anaemia have also been suggested as reason for drop in Oxygen uptake in fish *Channa punctata* exposed to lethal Concentration of Deltamethrin. Though, the biochemical, Physiological and enzymatic parameters are the common biomarkers of exposed fish to toxicity of pollutant. Since blood glucose level is an important parameter to assess the stress condition of fish by pesticides. Enzymes play a significant role in food Utilization and Metabolism. Phosphatase plays an important role in synthesis and transport of metabolites across the membrane, secretory activity, and protein synthesis and glycogen metabolism. Pesticide pollution also affects the activity of enzymes and produce metabolic changes at cellular levels. The toxic effects of organophosphorous compounds on the activity of alkaline phosphatase in various tissues of fishes have been worked out by various workers, reported significant inhibition of alkaline Phosphatase in liver, intestine and muscle tissues of *Clarias batrachus* when exposed to Dimethoate. The decrease in acid phosphatase in liver suggested the uncoupling of phosphorylation by toxicity. Acid phosphatase were significant decrease in liver tissue when compared to those of muscle and gills in the fish *Labeo rohita* collected from Industrial polluted lake. The effect of Rogor on the activity of alkaline phosphatase was studied by Borah and Yadav (1996). In view of the paucity of information regarding the effects of pesticide, Phosalone on Respiratory, haematological, Biochemical and enzymological parameters in *Labeo rohita* (Hamilton), were made in this investigation.

Material and Methods:

The length and weight of the fishes ranged between 10-15 cm and 25-30 g, respectively, were acclimatized to laboratory conditions for 10 days and separated into groups (10 each). During the acclimatized period fishes were fed ad-libitum with rice bran (or) powdered oil cakes. The median lethal concentration (LC₅₀) and sub lethal concentrations were found out by exposing the fish to different concentrations of Phosalone (1.5, 2, and 2.5 PPM) for 4 days and control group was also maintained separately. Pesticide, organophosphate represent one of the most widely used classes of pesticide with high potential for human exposure in field of cultivated area. Phosalone (C₁₂H₁₅ClNO₄PS₂) is a broad spectrum organophosphate pesticide widely used to control pests in agricultural crops. It is commercially available organophosphate pesticide and is more toxic to living beings.

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Before starting the experiment the Oxygen content of water used in the animal chamber was estimated by Winkler's method. Blood sample was collected from the control and experimental fishes by cardinal vein puncture using an insulin syringe containing 0.1ml of 0.2% EDTA of each group at 1st, 2nd, 3rd and 4th day of experiment. Haemoglobin was estimated by Darbkin's method (Suganthi *et al.* 2015a). The blood sugar was estimated by O - toluidine method. The alkaline phosphatase was estimated by using the method of Bergmeyer (1963) as modified by Butterworth and Probert (1970) [5].

Results and Discussions

The sub lethal concentration is 1.5 PPM, median lethal concentration (LC₅₀) is 2.5PPM and the lethal concentration

is 4 PPM for 96 hrs exposure. The LC₅₀ value differs from species to species for the same pesticide as well as for different pesticides due to their mode of action on fish. Estimated LC₅₀ value for Quinolphos and Phenthoate and were found to be 7.5 PPM and 2.5 PPM respectively for 96 hours of exposure in *Channa punctata*. Malathion was found to be highly toxic to minnows (LC₅₀ 8.6 ppm) and murels (LC₅₀ 5.93ppm) as summarized. The present findings gain support from the work of Anoop *et al.*, (2010) [7] who also recorded LC₅₀ values of Dimethoate in *Heteropeunistic fossilis*. The median lethal concentration (LC₅₀) was calculated by means of probit analysis (Finney 1981) as shown in Table 1.

Table 1: Statistical analysis (Log-dose / probit regression line) of the LC₅₀ value of Phosalone on *Labeo rohita* for 96 hours and Chi - Square for LC₅₀ Value

Concentration PPM	Log conc. (X)	No. of fishes used (n)	Mortality rate (r)	P	Exp. Y	W	X	Y	95% CL	
									Upper	Lower
2.000	0.3010	100	30	0.3000	4.4056	0.559008	0.3010	4.3999	4.6284	4.1714
2.500	0.3979	100	50	0.5000	5.1524	0.631005	0.3979	5.1445	5.2845	5.0046
3.000	0.4771	100	80	0.8000	5.7626	0.513448	0.4771	5.7530	5.9212	5.5848
3.500	0.5441	100	90	0.9000	6.2785	0.343638	0.5441	6.2674	6.5130	6.0216

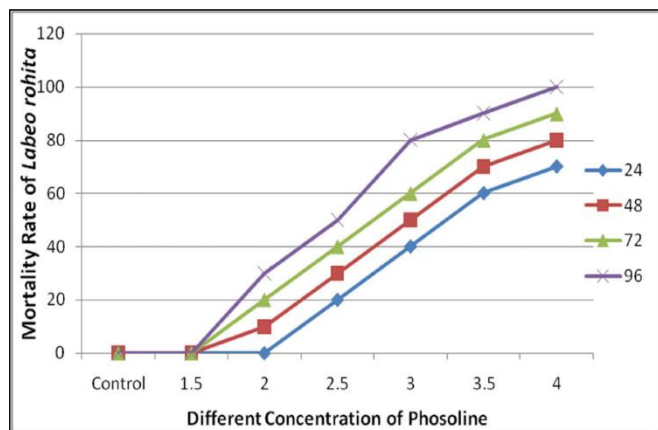


Fig 1: Mortality of *Labeo rohita* when exposed to different concentrations of Phosalone at different durations of exposure.

Fig 1, Shows that, the rate of Oxygen Consumption of *Labeo rohita* exposed to 0.5, 1 and 1.5 PPM concentration of Phosalone for a period of 24, 48, 72 and 96 hrs.

The fish treated with different concentration of Phosalone consumption at these increasing duration was decreased in the rate of Oxygen Consumption and it's found to be highly significant at $P < 0.01$ Level compare to control fishes. A similar decrease in oxygen uptake has been reported in *Labeo rohita* due to Monocrotophos exposure. Sublethal concentrations of deltamethrin, a pyrethroid, have decreased oxygen consumption in *O. mossambicus* (Nazeemul Khane *et al.*, 1992).

The results of this study confirm the earlier report (Saradhamani *et al.*, 2009) on oxygen consumption by fish in pesticide mixed water. Haemoglobin (Hb) content was estimated in the blood of *Labeo rohita* exposed to LC₅₀ value of Phosalone concentration and presented in table 2.

Table 2: Effect of LC₅₀ 2.5PPM of Phosalone on hemoglobin content and Blood glucose level of *Labeo rohita* at different durations of exposure.

Exposure Time (hr)	Haemoglobin Content g / dl		Blood Sugar level mg/ml	
	Control	Experiment LC ₅₀ (2.5 PPM)	Control	Experiment LC ₅₀ (2.5 PPM)
24	8.78±0.005	8.00±0.006	55.10±0.18	61.50±0.43
48	8.75±0.007	7.45±0.007	55.25±0.17	65.25±0.19
72	8.70±0.005	6.85±0.005	54.75±0.16	69.75±0.15
96	8.75±0.006	6.30±0.007	54.50±0.16	74.50±0.3

The Hb content of blood was 8.75 g/dl in control fish and it was decreased (6.30 g/dl) when exposed to LC₅₀ concentration of Phosalone. The Hb content was gradually reducing with increasing exposure period. The decreased haemoglobin concentration represents that the fish power to supply adequate oxygen to the tissues is limited considerably and this will result in decline of physical activities (Nussey *et al.*, 1995). The same trend was obtained Catla catla, sub lethal concentration of lead nitrate and Mercury chloride toxicity was significantly decreased in Hb content when compared to control fish at 96 hrs exposures (Kandeepan 2013) [2]. A clearcut evidence of reduction of Hb content has been reported by Bhatkar and Dhande (2000) in Labeo rohita, when exposed to Furadon. The reduction in Hb content of fish may be due to the effect of pollutant on haemopoietic system. The reduced level of haemoglobin content may be affecting the Oxygen consumption of the fish by way of reduced transportation of Oxygen and this fact can be confirmed in the present study also.

The total blood sugar content increased with increasing concentrations of Phosalone. The blood sugar level which was 54.50 mg/ml in control fish significantly increased to 74.50 mg/ml in LC₅₀ of Phosalone at 96 hrs exposure period as shown in Table 2.

The percentage (36.70) of blood sugar level increase is, as a function of exposure period. Such increase in blood sugar has been probably due to increased rate of utilization of blood sugar to meet the excess energy demands imposed by the severe stress of pesticide on the physiological activity of fish. This increase of blood sugar level i.e. hyperglycaemic condition may be due to conversion of stored glycogen into blood glucose (glycogenolysis) by the inducement of adrenal hormones namely glycocorticoids and Catacolamines by pesticides. Christobher *et al.* (2016) reported increased level of blood sugar when exposed to 1ppm concentration of Phosphamidon treated Labeo rohita fishes at 15 days intervals. The present findings were support from the work of Mohammad Illiyas *et al.*, (2015) in Dimethoate- treated Catla catla under insecticide toxicity.

Conclusion

The exposure of various concentrations (0.5 - 4ppm) Phosalone pesticide is toxic to aquatic organisms and severely affects the function of respiratory system, blood tissues, Liver and intestinal tissue of freshwater fish Labeo rohita which seriously affects the survivalist of fish in its habitat.

Therefore, it is concluded that Phosalone at sub lethal concentration, can cause considerable deterioration to fish health. For this reason, Phosalone use must be regulated otherwise contaminated runoff from agricultural fields can deteriorate fish health and significantly reduce fish and aquatic organisms productivity of water bodies.

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