



RESEARCH ARTICLE

ANTIOXIDANT SYSTEM UNDER THE INFLUENCE OF CYPERMETHRIN IN THE TISSUES OF *CYPRINUS CARPIO*

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ABSTRACT

Static bioassays were carried out to find the LC₅₀ 96 hr value of Cypermethrin to *Cyprinus carpio* and it was found to be 2.0 ppm. Then a group of fishes were recorded in a selected reared sub lethal concentration of the pesticide (0.2 ppm) for 4 weeks. From the control and treated fishes, serum and tissues like gill, liver, kidney and muscle were selected and used for the estimation of antioxidant parameters. There was an overall reduction of various antioxidant enzymes such as SOD, GSH, GR and GPX and an elevation of TBARS level. These results were indicative of occurrence of LPO with resultant ROS causing oxidative stress in the fishes by the pesticide.

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INTRODUCTION

Man is continuously in search of supplementary source of proteins to meet the existing protein deficiency. It is reported that the fishes are the cheapest source of animal protein in the diet of man (Alfa *et al.*, 2014). But the aquatic environments are mostly contaminated by the pollutants. As a result, the water bodies especially freshwaters become unhealthy with the disappearance of the fishes. In developing countries, there is an increasing indiscriminate use of pesticides in aquatic sector (Vijay Paul Sharma, 2012). More than 70 % chemical formulations are employed in agricultural practices in India and they find their way to freshwater courses and affect the non-target organisms (Naveed *et al.*, 2010) Paritha Bhanu,(2014) has reported that the pesticides, even with restricted usage, are washed and carried away to water bodies and alter the physicochemical nature of water. Cypermethrin is a synthetic pyrethroid pesticide and is widely used in all sectors of insect control. The usages of this pesticide in agriculture purposes pose a great threat to the aquatic fauna especially to the fishes. Seveikova (2011) have shown that the toxicants produce free radicals by the way of lipid per oxidation. To neutralize these

radicals, the animal's body possess a number of defensive antioxidant enzymes. These enzymes scavenge the free radicals generated in the body. Therefore the present study has been carried out to elucidate the impact of cypermethrin on the antioxidant system in the tissues of the freshwater fish *Cyprinus carpio*.

MATERIALS AND METHODS

In the present work, the fishes and the pesticide were procured and used. Bioassays were carried out to determine LC₅₀ 96 hr value of cypermethrin to the fishes with average body weight of 18-20gms and length of 13 cm). Cypermethrin in the form of wet table powder was made into different concentrations namely 1.2, 1.6, 2.0, 2.4 and 2.8 ppm by using de chlorinated tap water. A group of 10 fishes were reared in each concentration with suitable controls. The test fishes were not given food and the test solutions were changed daily with appropriate concentrations. After the determination of LC₅₀ 96 hr value, the fishes were exposed to a selected sub lethal concentration of the pesticide for 30 days. The sampling were carried out on days 4, 7, 14, 21 and 28. From the control and experimental fishes, the blood was collected by the cardiac puncture and tissues like gill, liver, kidney and muscle were removed by sacrificing the fishes by decapitation. The serum and tissues were used to estimate thiobarbituric acid reactive substances (Iqbal *et al.*, 1996), superoxide dismutase

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(Marklund and Marklund, 1974), reduced glutathione Jollow *et al.*, 1974) and glutathione reductase and glutathione peroxidases (Mohandas *et al.*, 1984). The results of TBARS were expressed as nmol TBARS/min/ mg of SOD as the amount of enzymes IU mg protein of GSH as nmol/mg protein, of GR and GPX as nmol/NADPH oxidized/min/mg protein.

Madhusudan Reddy *et al.* (2012) and Jindal and Kaur (2014). The increased TBARS level in the tissues of present test animals further strengthens the occurrence of excess lipid peroxidation and loss of cell function under oxidative stress. The overall reduction of antioxidant enzymes under the influence of cypermethrin would result in altered physiological condition. Ultimately leading to the mortality of fishes.

Table 1. Determination of LC₅₀ 96 hr value of cypermethrin to *Cyprinus carpio* on exposure 96 hrs

Concentration (ppm)	No. of fishes exposed	No. of fishes died	% Mortality	LC ₅₀ 96 hr value
1.2	10	0	0	
1.6	10	2	20	
2.0	10	5	50	
2.4	10	8	80	
2.8	10	10	100	2.0 ppm

Table 2. Ranges of percent changes in various parameters of antioxidant system tissue of *Cyprinus carpio* on exposure to cypermethrin during various periods

Antioxidant parameters					
Tissues	TABARS	SOD	GSH	GR	GPX
Serum	+6.67 to +23.81	-9.37 to -32.79	-6.93 to -54.74	-3.10 to -19.70	-13.80 to -49.61
Gills	+4.84 to +30.65	-11.00 to -42.20	-9.41 to -42.35	-7.45 to -39.36	-4.22 to -39.86
Muscle	+8.91 to +22.77	-12.99 to -44.20	-8.80 to -43.20	-4.57 to -20.29	-4.02 to -29.46
Liver	+2.70 to +18.92	-4.01 to -43.43	-9.74 to -51.49	-8.54 to -43.10	-3.45 to -27.10
Kidney	+4.17 to +27.08	-10.24 to -34.86	-6.66 to -45.33	-6.50 to -41.90	-4.54 to -42.03

-represents percent decrease from control

+represents percent increase over control

RESULTS AND DISCUSSION

From Table 1, it is clear the LC₅₀ 96 hr value of cypermethrin to *C. carpio* was 2.0 ppm. Then a selected sub lethal concentration namely 0.2 ppm of the pesticide (1/10 of LC₅₀ 96hr value) was chosen to assess chronic toxicity of the pesticide. After exposing the fishes in the sub lethal concentration for 4 weeks, blood and tissues were analyzed for antioxidant system. The pesticide was found to bring out major changes on the antioxidant parameters in the serum and tissues of the fishes as recorded in Table 2. Toxic chemicals are shown to produce reactive oxygen species (ROS) such as hydrogen peroxide (H₂O₂), superoxide anions (O₂⁻) and hydroxyl radicals (OH). It is observed by Seveikova *et al.* (2011) that the free radicals are generated by stimulating lipid peroxidation (LPO). The occurrence of LPO and over production of free radicals would result in oxidative stress in animals. The impact of cypermethrin on the freshwater fish in the present study provides a direct evidence of induced oxidative stress in the fishes because the antioxidant enzymes such as SOD, GSH, GR and GPX are found to decrease in the serum and tissues (Table 2). The decreased level of these enzymes clearly evidences the existence of marked LPO in the tissues and the utilization of antioxidant defense system against the impact of ROS. The results of the present work are in conformity with the earlier study made by Moraes *et al.*, 2011; Selamoglu Talas *et al.*, 2012; Orun *et al.*, 2014.

In the present study, the inhibited activity of the antioxidant enzymes would be either due to the production of ROS or due to direct action of the pesticide on the enzymes synthesis or due to direct inhibitory effect of cypermethrin on the activity levels of these enzymes as also reported by Seveikova *et al.* (2011),

Conclusion

The impact of cypermethrin on the freshwater fish in the present study provides a direct evidence of induced oxidative stress in the fishes because the antioxidant enzymes such as SOD, GSH, GR and GPX are found to decrease in the serum and tissues. Would result in altered physiological condition, ultimately leading to the mortality of fishes.

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