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A study of biochemical constituents of the freshwater fish, *Channa punctatus* (Bloch)

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Abstract

In the present study *Channa punctatus* is commonly known as snake head fish of carnivore feeding habit. The cypermethrin pesticide is widely used in agricultural field for the control of insect pests and is coming under synthetic pyrethroids which have shown strong pesticidal activity in freshwater teleost fish, *Channa punctatus*. The fishes were exposed to sub lethal concentration, 0.04 mg/L (1/10th of LC₅₀=0.4 mg/L) of cypermethrin for a period of 15, 30 and 45 days. It was found to be in a decreased trend. Whereas, the RNA content of all the tissues (gill, liver and kidney) have decreased significantly ($p < 0.05$) when compared to control with the increase in the period of exposure to the toxicant. Biochemical changes induced by pesticidal stress lead to metabolic disturbances, retardation of growth and reduction in the fecundity and longevity of the organism.

Keywords: Habitat loss, habitat fragmentation, conservation, population decline

Introduction

Pesticides usage in the agricultural fields to control pests is extremely toxic to non-target organisms like fish and affects fish health through impairment of metabolism, sometimes leading to mortality. Cypermethrin is a synthetic pyrethroid insecticide used to control many pests, such as moth pests attacking cotton, fruit and vegetable crops, including structural pest control, or landscape maintenance. Cypermethrin is highly potent and broad spectrum pyrethroid, used extensively for pest control. Fish are particularly highly sensitive to very low concentration of cypermethrin.

The physiological and biochemical alterations observed in an animal under any physiological stress can be correlated with the structural and functional changes of cellular proteins. Nucleic acids play a major role in growth and development. The amount of DNA, the carrier of genetic information, is Quasi-constant in somatic cell numbers. The amount of RNA in the cell is directly proportional to the amount of RNA in the synthesis occurring. The relationship between RNA and DNA is an index of the cell's metabolic intensity and has been used to measure recent growth in fishes. So the aim of this study is to examine the toxicity of cypermethrin to the freshwater fish, *Channa punctatus* and to evaluate the alterations in biochemical profiles.

The fishes were exposed to sub lethal concentration, 0.04 mg/L (1/10th of LC₅₀=0.4 mg/L) of cypermethrin for a period of 15, 30 and 45 days. Changes on the protein and nucleic acid levels of gill, liver and kidney tissues of *Channa punctatus* were observed. The results showed that, the protein content in all the tissues (gill, liver and kidney) have decreased significantly ($p < 0.05$) when compared to control with the increase in the period of exposure to the toxicant. In the case of nucleic acids, the DNA content was found to increase significantly ($p < 0.05$) in gill and liver tissues, but in the kidney, it was found to be in a decreased trend. Whereas, the RNA content of all the tissues (gill, liver and kidney) have decreased significantly ($p < 0.05$) when compared to control with the increase in the period of exposure to the toxicant. Biochemical changes induced by pesticidal stress lead to metabolic disturbances, retardation of growth and reduction in the fecundity and longevity of the organism.

Material and Method

The pesticide Cypermethrin (10% E.C.) was obtained and the stock solution was prepared by dissolving 10 mg of cypermethrin in 10 ml of analytical grade acetone. A required quantity of cypermethrin was drawn from this stock solution for further study. Preliminary tests were carried out to find out the median tolerance limit (LC₅₀) of the fish to cypermethrin for 96 hours

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by probit analysis method. The concentration of cypermethrin at which 50% mortality occurred was taken as the median lethal concentration (LC₅₀) for 96hrs, which was found to be 0.4 mg/L. One fifth of the LC₅₀ value (0.08 mg/L) was selected for sub lethal concentration studies.

Results

Table 1: Changes in nucleic acids and total protein levels in different tissues of *Channa punctatus* on exposure to a sublethal concentration (0.08 mg/L) of Cypermethrin

S. No.	Parameters	Tissues	Control	Experimental periods			
				15 days	30 days	45 days	
1	Nucleic acids	DNA	Gill	1.52 ± 0.07	1.68 ± 0.03*	1.87 ± 0.01*	1.92 ± 0.64*
			Liver	2.03 ± 0.01	3.33 ± 0.03*	4.97 ± 0.13*	5.24 ± 0.21*
			Kidney	2.27 ± 0.03	1.93 ± 0.06*	1.90 ± 0.38*	1.81 ± 0.10*
		RNA	Gill	4.22 ± 0.90	3.25 ± 0.64*	2.25 ± 0.12*	1.97 ± 0.01*
			Liver	14.75 ± 0.30	11.25 ± 0.14*	10.73 ± 0.19*	8.87 ± 0.01*
			Kidney	8.25 ± 0.26	7.52 ± 0.39*	6.83 ± 0.34*	5.54 ± 0.28*
3	Total Protein	Gill	16.32 ± 0.20	14.31 ± 0.29*	11.64 ± 0.19*	10.92 ± 0.14*	
		Liver	44.92 ± 0.94	38.84 ± 0.11*	35.82 ± 0.15*	31.43 ± 0.15*	
		Kidney	28.96 ± 0.12	24.94 ± 0.11*	23.42 ± 0.09*	21.26 ± 0.13*	

Values are expressed in mg/L (Mean ± SD); n=5; *=Significant ($P < 0.05$)

In nucleic acids, the DNA content in the gill and liver tissues of the study fish was found to increase significantly ($p < 0.05$), but, it got decreased significantly ($p < 0.05$). The RNA content got decreased significantly ($p < 0.05$) in all the tissues (gill, liver and kidney) when compared to control as shown in Table.

Discussion

In the present study, the maximum level of DNA was found in liver which is supported by earlier findings of administration of the various toxicants. The increase of DNA contents in gill region, in the present study was due to the hypertrophic nature of chloride cell, secreting cell leading to less transcription and the enlargement of nuclei in *Channa striata* exposed to metasytox, *Oreochromis mossambicus* to quinolphos and *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*. The DNA contents in kidney has decreased which may be due to reduction or absence of the essential factors controlling DNA synthesis which are the substrates (4-Deoxyribonucleoside triphosphates), enzymes (polymerase), template activity of deoxyribonucleic-protein and activators like Mg²⁺ and other divalent ions.

The synthesis of RNA plays an important role in protein synthesis. The inhibition of RNA synthesis in transcription level, thus may affect the protein level. In this study, a significant decline in the RNA level in exposed freshwater fish was observed. The decrease in the RNA concentration may also have been a cause of protein depletion. The decreasing level of RNA suggests a decrease in protein synthesis and further damage to the liver, which is the major metabolic organ of drug detoxification. The gradual decrease in the protein content of the treated fish suggests the disruption of carbohydrate metabolism, destruction of protein and inhibition of ATP synthesis. Significant decrease in RNA and DNA content in the fish.

Conclusion

In the present study, the significant decrease in both protein and nucleic acids levels would suggest that pollutant impair the process of protein synthesis in the tissues of fishes

In the present study, the freshwater fish *Channa punctatus* exposed to sub lethal concentration (0.08 mg/L) of cypermethrin showed a significant decreased ($P < 0.05$) level of protein in all the tissues (gill, liver and kidney) when compared to control with increasing the days of exposure as shown in Table.1.

exposed to cypermethrin. It may be suggested that cypermethrin tends to change the levels of macromolecular constituents in the tissues of the fish and in turn might be deposited by means of contaminated water bodies and it leads to harmful consequences in human beings on continuous consumption.

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