



IMPACT OF PESTICIDE CHLORPHYRIFOS ON PROTEIN ALTERATIONS IN A FRESHWATER FISH, *Channa striatus*

Revathi.T and Krishnamurthy.R*

P.G. and Research Department, Department of Advanced Zoology and Biotechnology, Government Arts College, Nanthanam, Chennai Tamil Nadu, India - 600 035.

*Corresponding Author Email: professorkrishnamurth@gmail.com

ABSTRACT

Impact of pesticides is common pollutants of freshwater ecosystems where they induce adverse effects on the aquatic biota. Freshwater fish, *Channa striatus* is an important fish species in Tamil Nadu region having good nutritional values. Fishes living in close association with may accumulate pesticides. In the present observation, the toxic effects of the pesticide chlorpyrifos LC₅₀ 0.18 ppm on some biochemical characteristics (total protein in gill, liver and muscles) of the freshwater fish, *Channa striatus* were estimated. There is decreased in all tissues on comparison with control. The results indicated the toxic nature of the pesticide chlorpyrifos.

KEY WORDS

Freshwater fish, *Channa striatus*, chlorpyrifos, protein

INTRODUCTION

Pesticides are extensively used in intensive agricultural production and fish farms to control the pest population. These pesticides can reach natural waters either via transfer of the chemicals from the soil or by direct spraying on the target organisms. The pesticides affect non-target organisms, such as fish and prawn, which are of great economic importance to humans. [1] Organophosphate pesticides are widely used in agriculture and public health and account for approximately 50% of the global insecticidal use. [2] Chlorpyrifos is a broadspectrum organophosphate pesticide that is used heavily throughout the world for agriculture and domestic purposes. [3] The toxic effects of chlorpyrifos are increasingly threatening the health of humans and aquatic animals. [4] Chlorpyrifos is a known acetylcholinesterase inhibitor. [5] It may induce oxidative stress and inhibit antioxidative and physiological activities. [6, 7]

Around the world, approximately three million acute poisoning and 220000 deaths from pesticide exposure

have been reported annually. In addition, farmers with prolonged exposure, such as, neurobehavioral abnormalities and increased cancer incidence, e. g., leukemia, nonhodgkin, Lymphoma and multiple myeloma. The potential utility of biomarkers for monitoring both environmental quality and the health of organism inhabiting in the polluted ecosystems has received increasing attention during this decade. [8,9, 10] Accumulation of pesticides in tissues produces many physiological and biochemical changes in the fishes and freshwater fauna by influencing the activities of several enzymes and metabolites. [11] The alteration in biochemical contents in different tissues of fish due to toxic effects of different heavy metals and pesticides have been reported by a number of workers. Palanichamy *et al.* [12] reported sublethal effects of malathion, thiodon and carbaryl on the total protein content of muscle, liver, gill and intestine in the fresh water catfish, *Mystus vittatus*.

Sherekar and Kulkarni [13] analysed the protein content in the liver, muscle and gills of *Channa orientalis*

exposed to methyl parathion. Tripathi and Verma ^[14] treated the fresh water fish, *Clarias batrachus* with endosulfan and studied the changes in protein, glycogen and lipid in the liver and muscle tissues. Shivakumar ^[15] reported changes in protein metabolic activity under severe physiological and pathological stress due to endosulfan in the fresh water fish, *Catla catla*.

MATERIALS AND METHODS

The freshwater fish, *Channa striatus* were collected from Kanchipuram area and were brought to the laboratory in large plastic troughs and acclimatized for one week. Healthy, fish having equal size (length 10 to 12 cm) and weight (50 to 100 g) were used for experimentation. Stock solution of chlorpyrifos was prepared by dissolving appropriate amount of salt in distilled water. The physico-chemical characteristic of test water have analyzed regularly during the test periods following the standard method describe. ^[16] Batches of 10 healthy fishes were exposed to different concentrations of insecticide chlorpyrifos to calculate the medium lethal concentration LC₅₀ value (0.18 ppm) using probit analysis. ^[17] The fishes (Four groups) were exposed to the two sub lethal concentrations (1/10th and 1/30th mg/L) of chlorpyrifos for 5, 10 and 15 days respectively. Another group was maintained as control. At the end of each exposure period, fishes were sacrificed and tissues such as gill, liver and muscle were dissected and removed. The tissues (10 mg) were homogenized in 80% methanol, centrifuged at 3500 rpm for 15 minutes and the clear supernatant was used for the analysis of total proteins. Total protein concentration was estimated by the method. ^[18]

RESULT

The changes in biochemical composition of gills, liver, and muscles of freshwater fish, *Channa striatus* exposed to acute concentrations of chlorpyrifos were studied along with control fish. The data was supported by various statistical analyses and the standard deviation of the mean was calculated. The changes in the total

protein in different tissues such as gills, liver, and muscles of *Channa striatus* exposed to two sublethal concentrations of chlorpyrifos for 5, 10 and 15 days (Table 1 and Figure 1 to 3). Freshwater fish *Channa striatus* kept as control protein content was highest in muscle 11.31 mg/g followed by liver 9.44, while low protein levels were seen in gills 3.05 mg/g for 15 days.

1. Gill Protein

Freshwater fish *Channa striatus* treated with sublethal concentrations of chlorpyrifos on 10% & 30% showed a decreasing trend in the gill protein when compared to control (Table 1 and Figure 1). The control protein values were recorded from 6.21, 6.70 and 6.40 mg/g. The 10% sublethal concentration of gill protein values were recorded from 4.85, 4.64 and 4.48 mg/g, and the 30% sublethal concentration of gill protein values were recorded from 3.10, 3.24 and 3.05 mg/g after exposure of 5, 10 and 15 days respectively.

2. Liver Protein

Fish *Channa striatus* treated with sublethal concentrations of chlorpyrifos on (10% & 30%) showed a decreasing trend in the total liver protein compared to control (Table 1 and Figure 2). The 10% sublethal concentration of liver protein values were recorded from 5.70, 6.84 and 5.85 mg/g and the 30% sublethal concentration of liver protein values were recorded from 5.30, 6.13 and 5.14 mg/g respectively. The control protein of liver tissues was recorded from 8.43, 9.05 and 9.44 mg/g after exposure of 5, 10 and 15 days respectively.

3. Muscle Protein

A significant recession in the total muscle protein was noticed in the 10% and 30% sublethal concentrations of chlorpyrifos treated fish *Channa striatus* when compared to control (Table 1 and Figure 3). The control protein values were recorded from 10.68, 10.97 and 11.31 mg/g. The 10% sublethal concentration of muscle protein values were recorded from 6.77, 6.79 and 5.83 and the 30% chlorpyrifos sublethal concentration of muscle protein values were recorded from 6.15, 6.32 and 5.27 mg/g after exposure of 5, 10 and 15 days respectively.

Table 1: Total protein content (mg/g) in wet weight tissues of freshwater fish, *Channa striatus* exposed to two sublethal concentrations (10% and 30%) of chlorpyrifos.

Days	Exposure	Gill	Liver	Muscle
5 days	Control	6.21 ± 0.11	8.43 ± 0.10	10.68 ± 0.09
	Chlorpyrifos 10 % SLC	4.85 ± 0.08	5.70 ± 0.07	6.77 ± 0.07
	Chlorpyrifos 30 % SLC	3.10 ± 0.07	5.30 ± 0.06	6.15 ± 0.07
10 days	Control	6.70 ± 0.06	9.05 ± 0.06	10.97 ± 0.06
	Chlorpyrifos 10 % SLC	4.64 ± 0.11	6.84 ± 0.05	6.79 ± 0.09
	Chlorpyrifos 30 % SLC	3.24 ± 0.10	6.13 ± 0.09	6.32 ± 0.11
15 days	Control	6.40 ± 0.07	9.44 ± 0.07	11.31 ± 0.09
	Chlorpyrifos 10 % SLC	4.48 ± 0.06	5.85 ± 0.07	5.83 ± 0.04
	Chlorpyrifos 30 % SLC	3.05 ± 0.05	5.14 ± 0.11	5.27 ± 0.06

Values are Means ± SD four observations.

FIGURE:1 Total protein content in gill tissues of fish *Channa striatus* exposed to sublethal concentrations of chlorpyrifos pesticide.

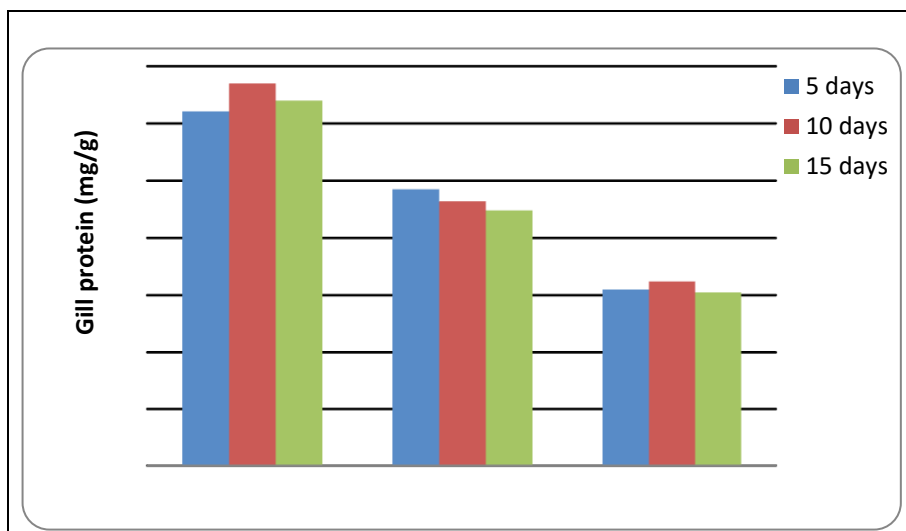


FIGURE:2 Total protein content in liver tissues of fish *Channa striatus* exposed to sublethal concentrations of chlorpyrifos pesticide.

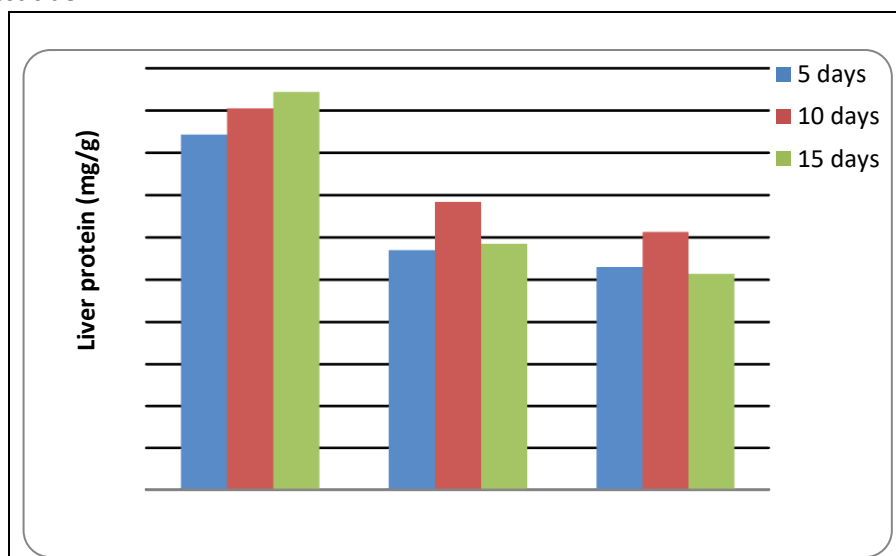
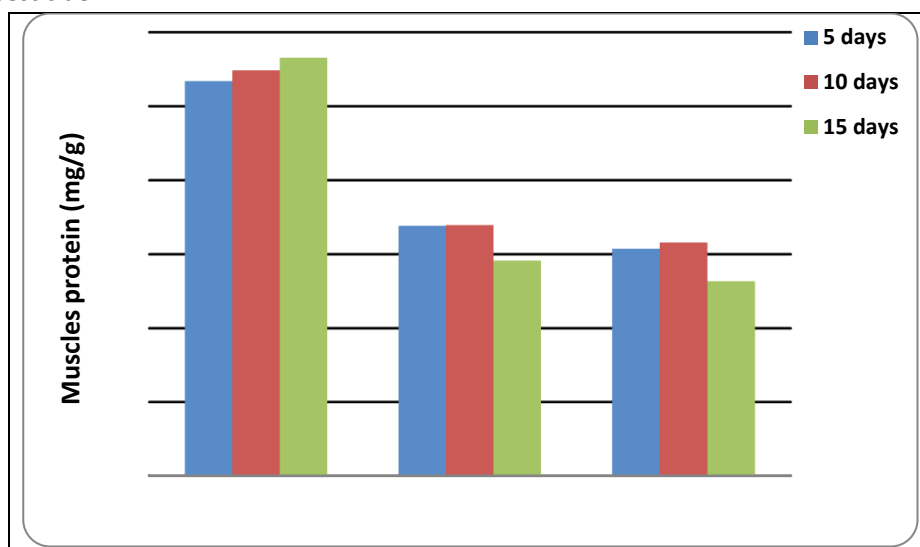


FIGURE:3 Total protein content in muscle tissues of fish *Channa striatus* exposed to sublethal concentrations of chlorpyrifos pesticide.



DISCUSSION

In the present study LC_{50} values of chlorpyrifos of fish *Channa striatus* at 96 hours LC_{50} were 0.18 ppm and sublethal concentrations namely 10% and 30% values were selected, studying their effects on biochemical aspects. Protein content in the gill, liver and muscle tissues of fish *Channa striatus* was found to be abating in the pesticide infected fishes with the dependence of concentration and span of exposure of chlorpyrifos for 5, 10 and 15 days showed decreasing trend when compared to control. Similar findings had been recorded. ^[19] Anita *et al.* ^[20] reported decrease in protein content in freshwater fishes due to contaminated environment condition. The depletion of protein fraction in liver, brain and kidney might have been due to their degradation and possible utilization for metabolic purposes. Similar results were also documented. ^[21]

Proteins are prime importance of the living world and only because of their peculiarity but also due to the fact that they appear to confer their biological specificity among various types of cells. ^[22] The decreased levels of proteins in gills, testis, ovaries and muscles of freshwater carp *Catla catla* exposed to acute and chronic levels of chlorpyrifos was reported. ^[23]

Saxena *et al.* ^[24] attributed the decrease in protein content due to decreased protein synthesizing capacity of liver of *Channa punctatus* exposed to carbaryl and malathion. Decrease in the protein content was observed throughout the exposure period. The two

sublethal exposure results show the decrease in protein content and it depend upon the concentration. The toxicity of dimethoate also showed a direct correlation with the concentration and time exposure. Similarly, this was also observed. ^[25]

Das *et al.* ^[26] noted the effect of cypermethrin 25% EC on biochemical composition and observed marked decrease in glycogen content in the gills of *Channa punctatus*. Rao and Ramaneshwari ^[27] observed decrease in protein content in the gill of *Labeo rohita*, *Mystus vittatus* and *C. punctata* under endosulfan and monocrotophos toxicity. Khare and Singh ^[28] have reported the gradual decrease in protein content in the gills of *C. batrachus* under malathion toxicity.

It can be concluded that present investigation paraphrased the awareness of the toxic pollutants in aquatic environment while practicing fresh water fish aquaculture. Thus, the findings and knowledge acquired in the present study could have been beneficial towards monitoring and management of insecticide applications in agriculture and to cuttail contamination of aquatic ecosystem.

ACKNOWLEDGEMENTS

Author is grateful thanks to the Principal, Head of the Department and other staff members of P.G. & Research Department, Department of Advanced Zoology and Biotechnology, Govt. Arts College,

Nanthanam, Chennai, India for providing necessary facilities.

REFERENCES

1. Saravanan M, Kumar KP, a Ramesh M. Haematological and biochemical responses of freshwater teleost fish *Cyprinus carpio* (Actinopterygii: Cypriniformes) during acute and sublethal exposure to lindane. *Pestic. Biochem. Physiol.* 2010; 100: 206–211.
2. Shittu M, Ayo JO, Ambali SF, Fatihu MY, Onyeansi BI, Kawu MU. Chronic chlorpyrifos-induced oxidative changes in the testes and pituitary gland of Wistar rats: ameliorative effects of vitamin C. *Pestic. Biochem. Physiol.* 2012; 102: 79–85.
3. Ali D, Nagpure NS, Kumar S, Kumar R, Kushwaha B, Lakra WS. Assessment of genotoxic and mutagenic effects of chlorpyrifos in freshwater fish *Channa punctatus* (Bloch) using micronucleus assay and alkaline single-cell gel electrophoresis. *Food Chem. Toxicol.* 2009; 47: 650–656.
4. Xing H, Wanga X, Sun G, Gao X, Xu, S, Wang X. Effects of atrazine and chlorpyrifos on activity and transcription of glutathione S-transferase in common carp (*Cyprinus carpio* L.). *Environ. Toxicol. Pharmacol.* 2012; 33: 233–244.
5. Oruc EO. Oxidative stress, steroid hormone concentrations and acetylcholinesterase activity in *Oreochromis niloticus* exposed to chlorpyrifos. *Pestic. Biochem. Physiol.* 2010; 96: 160–166.
6. Giron-Perez MI, Barcelós-García R, Vidal-Chavez ZG, Romero-Bañuelos CA, Robledo-Marengo ML. Effect of chlorpyrifos on the hematology and phagocytic activity of Nile tilapia cells (*Oreochromis niloticus*). *Toxicol. Mech. Methods.*, 2006; 16: 495–499.
7. Tripathi G, Shasmal J. Reparation of chlorpyrifos-induced impairment by thyroxine and vitamin C in fish. *Ecotoxicol. Environ. Saf.* 2010; 73: 1397–1401.
8. Torre FR, Fenari L, Salibian A. Biomarkers of a native fish application to the water toxicity assessment of a peri-urban polluted river of Argentina, *Chemosphere.* 2005; 59: 577 - 583.
9. Mdegela R, Myburgli J, Correia D, Braathen M, Ejobi F, Botha C, Sandvik M, Skaare JU. Evaluation of the gill filament-based EROD assay in African sharp tooth catfish (*Clarus gariepinus*) as a monitoring tool for waterborne PAH-type contaminants. *Ecotoxicol.* 2006; 15: 51–59.
10. Minier C, Abarnou A, Jaouen-Madoulet A, Le Guellec AM. A pollution monitoring pilot study involving contaminant and biomarker measurements in the Seine Estuary, France, using zebra mussels. *Environ. Toxicol. Chem.* 2006; 25: 112–119.
11. Gupta AK, Rai V, Agrawal SM. Effect of starvation on total protein and free amino acid in some organs of the fish *Channa punctatus*. *Geobios*, 1987; 14: 108–110.
12. Palanichamy S, Arunachalam S, Baskaran P. Effect of pesticides on protein metabolism in the fresh water Cat fish. *Mystus vittatus*. *J. Ecobiol.*, 1989; 1(2): 90–97.
13. Sherekar PY, Kulkarni KM. Protein changes in the fish, *Channa orientalis* exposed to methyl Parathion. *J. Ecobiol.*, 1989; 1(2): 103–108.
14. Tripathi G, Verma P. Endosulfan mediated bio-chemical changes in the fresh water fish *Clarias batrachus*. *Biomed. Environ. Sci.*, 2004; 17: 47–56.
15. Shivakumar R. Endosulfan induced metabolic alteration in fresh water fish, *Catla catla*. Ph.D Thesis, Karnataka University, Dharwad, Karnataka, India. 2005.
16. APHA. Standard methods for the examination of water and waste water, 20th Edition, Washington, DC. 1998.
17. Finney DJ. Probit analysis, 3rd (Ed.), Cambridge University Press, London, 1971; 333.
18. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin phenol reagent. *J. Biol. Chem.* 1951; 193: 265–275.
19. Malla Reddy P. Modulation in protein profiles of white muscles of *Cyprinus carpio* under malathion stress. *Biomed.* 1988; 7: 12 – 24.
20. Anita ST, Sobha K, Veeraiah K, Tilak KS. Studies on biochemical changes in the tissues of *Labeo rohita* and *Cirrhinus mrigala* exposed to fenvalerate technical grade. *J. Toxicol. Environ. Health Sci.* 2010; 2(5): 53 – 62.
21. Veeraiah KS. Toxicity and effect of chlorpyrifos to the freshwater fish, *Labeo rohita*. *Tilak. Poll. Res.* 2001; 20(3): 443 – 445.
22. Anusha Amali A, Cyril Arun Kumar L, Elizabeth Jayanthi F, Selvanayagam M. Quinolophos induced biochemical anomalies in *Cirrhinus mrigala*. *J. Environ. Biol.* 1996; 17(2): 121 – 124.
23. Tilak KS, Veeraiah K, Koteswara Rao DK. (2005). Biochemical changes induced by chlorpyrifos, an organophosphate compound in sublethal concentrations to the freshwater fish *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*. *J. Environ. Biol.* 26(2): 341 – 347.
24. Saxena PK, Singh VP, Kondal JK, Soni GL. Effect of some pesticides on *in vitro* lipid and protein synthesis by the liver of the freshwater teleost. *Channa punctatus* (Bloch.). *Environ. Poll.* 1989; 58: 273–276.
25. Singh S, Bhati DPS. Evaluation of liver protein due to stress under 2, 4-D. intoxication in *Channa punctatus* (Bloch). *Bull. Environ. Contam. Toxicol.*, 1994; 53: 149–152.
26. Das LV, Jeewapada PN, Veeraiah K. Toxicity and effect of cypermethrin on biochemical constituents of freshwater teleost *Channa punctata*. *J. Ecotoxicol. Environ. Monit.*, 1999; 9(3): 197–203.



27. Rao LM, Ramaneshwari K., Effect of sublethal stress of endosulfan and monocrotophos on the biochemical components of *Labeo rohita*, *Mystus vittatus* and *Channa punctata*. Ecol. Environ. Cons., 2000; 6(3): 289-296.
28. Khare A, Singh S. Impact of malathion on protein content in the freshwater fish *Clarius batrachus*. J. Ecotoxicol. Environ. Monit. 2002; 12(2): 129 – 132.

Received:06.05.18, Accepted: 06.06.18, Published:01.07.2018

***Corresponding Author:**

Krishnamurthy.R

Email: professorkrishnamurth@gmail.com