The Bioscan 7(1) : 153-155, 2012
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

IMPACT OF DIMETHOATE ON PROTEIN CONTENT IN THE FRESHWATER FISH *PUNTIUS TICTO* (HAM)

R. M. GANESHWADE* P. B. ROKADE [1]AND S. R. SONWANE[2]
Department of Zoology, P.D.V.P. College, Tasgoan, - 431 401, Maharashtra
[1]Balbhim College, Beed - 431 122, Maharashtra
[2]Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad - 431001 Maharashtra
E-mail: rmganeshwade@gmail.com

KEY WORDS
Acute toxicity
Chronic toxicity
Dimethoate
Pesticide
Puntius ticto

Received on :
19.10.2011

Accepted on :
22.12.2011

***Corresponding author**

ABSTRACT
Puntius ticto, a freshwater fish exposed to lethal (5.012 ppm) and two sublethal concentrations of dimethoate (2.506 ppm and 1.253 ppm) for 96h and 60 days and protein content was observed from different tissues after the exposure period. Acute exposure (5.012 ppm) results in significant decrease in the level of protein in testis, ovary and brain and slight decrease in intestine, muscles, liver and gills; whereas increased protein level was observed in kidney. Chronic toxicity results showed decrease in the level of protein content in ovary, brain, intestine, muscles, gills and liver to 2.506 and 1.253 ppm exposure; whereas in testis protein level was increased to 1.253 ppm and decrease protein content was observed in 2.506 ppm exposure.

INTRODUCTION

Modern agricultural pesticides result in indiscriminate use of various agrochemicals, which usually enter into the aquatic environment and adversely affect the non target organisms. Pesticides in water cause damage to biotic life especially to fish. Fishes are very sensitive to a wide variety of toxicants in water. Various species of fish show uptake and accumulation of many contaminants or toxicants such as pesticides, polychlorinated biphenyls and heavy metals. Among these, pesticides have been found to be highly toxic not only to fishes but also to fish food organisms. Pesticides produce many physiological and biochemical changes in the freshwater fauna by influencing the activities of several enzymes and metabolites (Koundinya and Ramamurthy, 1978). It has also been reported that acute and chronic toxicities of pesticides caused biochemical alterations in organs (Rojik *et al.,* 1983; Szabu and Nemcsok, 1992; Balint *et al.*, 1995; Das *et al.,* 1999; Rawat *et al.,* 2002).

The alterations in biochemical contents in different tissues of fish due to toxic effects of different heavy metals and pesticides have been reported by many workers, some of them are Grant and Mehrle (1973); Verma *et al.,* (1983); Kamble (1983); Gupta *et al.* (1987); Khan *et al.* (1992); James and Sampath (1995); Das *et al.* (1999), Choudhary and Gaur (2001) Khare and Singh (2002). Extensive work has been done on the toxic effects of pesticides on protein, carbohydrate and lipid contents of fishes, but very little work have been done on biochemical changes in *P. ticto.* Therefore the present work has been an attempt to assess the extent of alteration in protein content in *P. ticto* under dimethoate toxicity.

MATERIALS AND METHODS

The freshwater fish *P. ticto* were collected from the freshwater sources around Aurangabad city. Fishes were acclimatized in aged, dechlorinated and well aerated water for two weeks. During acclimatization they were fed on alternate days with pieces of live earthworms. The LC_{50} values are determined by following the guidelines given on committee of toxicity tests with aquatic organisms (Anon, 1975). The LC_{50} values are calculated by Probit Analysis Method Finney (1971).

The acclimatized fishes were exposed to lethal concentration (5.012 ppm) for 96h and two sublethal concentrations (2.506 and 1.253 ppm) for 60 days. Simultaneously a control group of healthy fishes were maintained under identical conditions. The fishes were sacrificed immediately at the end of exposure period and different tissues viz. gill, liver, gonads, brain, kidney, intestine and muscles were processed for the biochemical estimations. Protein content was estimated by Follin phenol reagent method (Lowry *et al.,* 1951).

RESULTS AND DISCUSSION

Acute exposure (5.012 ppm) resulted in significant decrease in the level of protein in testis, ovary and brain and least decrease in intestine, liver, gills and muscles. Whereas increased protein level was observed in kidney. The two

Table 1: Fluctuations in protein content in *Puntius ticto* to dimethoate toxicity exposure

Tissues	Control	Lethal(5.012 ppm)	% change	Sub-lethal (2.506 ppm)	% change	Sub-lethal(1.253 ppm)	% change
Ovary	19.6082± 0.1753	8.6263***± 0.0945	- 56.006	10.18950***± 0.2316	- 48.034	10.6526***± 0.1158	- 45.6730
Testis	16.0947± 0.3063	6.9474***± 0.1158	- 56.834	10.9999***± 0.2895	- 31.655	16.2105± 0.895	0.7195
Intestine	11.4632± 0.3063	9.6105***± 0.1158	- 16.162	9.9579**± 0.2316	- 13.131	10.4210**± 0.1158	- 9.0917
Muscles	11.9649±0.0884	10.0158***± 0.0579	- 16.290	8.2210***± 0.0579	- 31.291	7.5118***± 0.1523	- 37.218
Gills	12.6509± 0.2397	11.5017**± 0.1769	- 9.0839	9.1474***± 0.1158	-27.694	9.610***± 0.1158	- 24.037
Kidney	22.6947± 0.2316	40.5263± 0.5789	78.572	32.9999± 0.5789	45.4079	28.9473± 0.2316	27.551
Brain	32.6526± 0.6127	12.9684***± 0.1158	-60.284	17.3684***± 0.2895	- 46.808	24.5473***± 0.2316	- 24. 823
Liver	23.9298± 1.0942	21.5368*± 0.4632	- 10.000	18.2368***± 0.2895	- 23.790	20.3017**± 0.3537	- 15.126

The values are expressed in mg/100 mg dry weight (mean S.D.) * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$.

sublethal exposure (2.506 and 1.253 ppm) results show that there is decrease in the level of protein content in ovary, brain, intestine, muscles, gills and liver. Whereas in testis protein level increases at 1.253 ppm and decreases in 2.506 ppm exposure.

Sublethal exposure result when compared, we find, the protein level increases with decrease in the pesticide concentration *i.e.* increased protein level in ovary, testis, intestine, gills, brain and liver, whereas decreased amount of protein in muscles and kidney were observed at low concentration (1.253 ppm).

Decrease in protein content after exposure to dimethoate may be attributed to the improvement of protein synthesis and or increase in the rate of its degradation to amino acids which may be fed to TCA cycle through aminotransferases probably to cope up with high energy demands in order to meet the stress condition. The decrease in protein content suggests an increase in proteolytic activity and possible utilization of its products for metabolic purpose. Depletion of protein as a result of toxicity stress has already been reported by a number of workers (Swami *et al.,* 1983; Borah and Yadav, 1995; Rao and Ramneshwari, 2000; Choudhary and Gaur, 2001 and Shinde *et al.,* 2002). Yogana *et al.,* (1981) reported decrease in protein content of muscles after DDT treatment in the fish *Clarias batrachus*. Saxena *et al.,* (1989) observed decreased level of protein in gonads of *Channa punctatus* after fenitrothion and carbofuran exposure. Reddy *et al.,* (1991) observed decreased level of protein in brain, liver and muscles of fenvalerate exposed fish *Cyprinus carpio*. Singh and Bhati (1994) reported progressive decrease in the protein content with increase in exposure time in liver of *Channa punctatus* under 2, 4-D stress. Similar results were observed during present investigation. The changes in protein content may be due to damage caused to hepatic tissue and increased proteolysis. Ghousia and Vijayaraghavan (1995) reported decrease in protein content of dimethoate intoxicated fish (*Clarias batrachus*) indicated physiological adaptability of the fish to compensate for pesticide stress. To overcome the stress the animals require high energy, this energy demand might have led to the stimulation of protein catabolism. Rajyashree (1996) also observed decline in protein level in liver, muscles, gills and brain during carbamide exposure of *Labeo rohita*. Das *et al*. (1999) observed marked decrease in the protein content of various tissues like kidney and muscles and slight increase in the protein content of brain and gills in cypermethrin treated fish, *Channa punctata*. Susan *et al.,* (1999) have also reported a significant decrease in protein content under sublethal concentrations of pyrethroid fenvalerate in the gills of *Catla catla*.

The fall in protein level during dimethoate exposure may be due to increased catabolism (Ghousia and Vijayaraghavan, 1995) and decreased anabolism of proteins (Khare and Singh, 2002). The reducing trend of protein content may be attributed to metabolic utilization of ketoacids to gluconeogenesis pathway for the synthesis of glucose or for the maintenance of osmotic and ionic regulations Schmidt (1975). The alteration in protein value in liver may also be related to some structural changes in the liver, the arrangement of hepatic cords leading to the alterations of liver metabolism. Decrease in protein content could possibly be due to protein breakdown and suggests decrease in protein is due to damage of hepatic tissue and an intensive proteolysis., this was also suggested by Rao and Rao (1984), Radhaiah *et al.,* (1987) and Hilmy *et al*. (1985). Thus, a decrease in the protein content during exposure to dimethoate naturally affects the nutritive value of fish.

ACKNOWLEDGEMENT

We are thankful to the Head, Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad for providing laboratory facilities for this research work.

REFERENCES

Anon, 1975. Recommendations of the committee on methods for toxicity tests with fish,macroinvertebrates and amphibians. *EPA, Oregon, P.* 61.

Balint, T., Szegletes, T., Szegletes, Z., Halasy, K. and Nemcsok, J. 1995. Biochemical and subcellular changes in carp exposed to the organophosphorus methidathion and pyrethroid deltramethrin. *Aquat. Toxicol*. **33(3-4):** 279-295.

Borah, S. and Yadav, R. N. S. 1995. Alteration in the protein, free amino acid, nucleic acids and carbohydrate contents of muscle and gills in rogor exposed freshwater fish *Heteropneustus fossilis*. *Pol. Res.* **14(1):** 99-103.

Choudhary, A. and Gaur, S. 2001. Effect of sodium fluoride on the muscle and liver of a freshwater fish *Cyprinus carpio. J. Aqua. Biol.* **16(2):** 67-68.

Das, L. V., Jeewaprada, P. N. and Veeraiah, K. 1999. Toxicity and effect of cypermethrin on biochemical constituents of freshwater teleost *Channa punctata. J. Ecotoxicol. Environ. Monit.* **9(3):** 197-203.

Finney, D. J. 1971. Probit analysis 3rd ed. *Cambridge University Press.* pp. 0-80.

Ghosia, B. and Vijayaraghavan, S. 1995. *In vivo* toxicity of dimethoate on proteins and transamines in the liver tissue of freshwater fish, *Clarias batrachus* (Linn). *Bull. Contam. Toxicol.* **54:** 370-375.

Grant, B. F. and Mehrle, P. M. 1973. Endrin toxicosis in rainbow trout (*Salmo gairdneri*). *J. Fish. Res. Bd. Canada.* **30:** 31-40.

Gupta, A. K., Rai, V. and Agrawal, S. M. 1987. Effect of starvation on total protein and free amino acids in some organs of the fish *Channa punctatus*. *Geobios*. **14:** 108-110.

Hilmy, A. M., Shabana, M. B. and Daabees, A. Y. 1985. Effect of cadmium upon *in vivo* and *in vitro* activity of protein and five enzymes in blood serum and tissue homogenate on *Mugil cephalus*. *Comp. Biochem. Physio. Comp. Pharacol. Toxicol.* **81(1):** 145-154.

James, R. and Sampath, K. 1995. Sublethal effects of mixtures of copper and ammonia on selected biochemical and physiological parameters in the catfish, *Heteropneustus fossilis* (Bloch). *Bull. Environ. Contam and Toxicol.* **55(2):** 187-194.

Kamble, S. B. 1983. Effect of pesticide on fresh water fish *Lepidocephalichthys thermalis* (C&V) from Marathwada region. *Ph.D. thesis, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.*

Khan, E. A., Sinha, M. P., Saxena, A. N. and Mehrotra, P. N. 1992. Biochemical effect of cadmium toxicity on a hill stream teleost *Garra mullya* (Skyes) during egg maturation I total protein, GSI, HIS. *Poll. Res.* **11(3):** 157-161.

Khare, A. and Singh, S. 2002. Impact of malathion on protein content in the freshwater fish *Clarias batrachus*. *J. Ecotoxicol. Environ. Monit.* **12(2):** 129-132.

Koundinya and Ramamurthy 1978. Hematological abnormalities of the fish, *S. mossambicus* exposed to sumithion and sevin. *Curr. Sci.* **48:** 877.

Lowry, O. M., Rosenbrough, N. J., Farr, A. C. and Randall, R. F. 1951. Protein estimation with Folin Phenol reagent. *J. Biol. Chem.* **193:** 265-275.

Radhaiah, V., Girija, M. and Jayantha Rao, K. 1987. Changes in selected biochemical parameters in the kidney and blood of the fish, *Tilapia mossambica* (Peters) exposed to heptachlor. *Bull. Environ. Contam. Toxicol.* **39:** 1006-1011.

Rajyashree, M. 1996. Carbamide induced alterations in some metabolic aspects of fish, *Labeo rohita*. *J. Ecotoxicol. Environ. Monit.* **6(1):** 41-44.

Rao, K. S. P. and Rao, K. V. R. 1984. Changes in the tissue lipid profile of fish *Oreochromis mossambica* during methyl parathion toxicity-a time course study. *Toxicol. Lett.* **23:** 147-153.

Rao, L. M. and Ramaneshwari, K. 2000. Effect of sublethal stress of endosulfan and monocrotophos on the biochemical components of *Labeo rohita, Mystus vittatus and Channa punctata*. *Ecol. Env. Cons.* **6(3):** 289-296.

Rawat, D. K., Bais, V. S. and Agrawal, N. C. 2002. A correlative study on liver glycogen and endosulfan toxicity in *Heterpneustes fossilis*. *J. Environ. Boil.* **23(2):** 205-207.

Reddy, P. M., Philip, G. H. and Bashamohideen, M. 1991. Fenvalerate induced biochemical changes in the selected tissue of freshwater fish, *Cyprinus carpio*. *Biochem. Int.* **23(6):** 1087-1096.

Rojik, J., Nemcsok, J. and Borross, L. 1983. Morphological and biochemical studies on liver, kidney and gill fish affected by pesticides. *Acta. Boil. Hung.* **34(1):** 81-92.

Saxena, P. K., Singh, V. P., Kondal, J. K. and Soni, G. L. 1989. Effect of some pesticides on *in vitro* lipid and protein synthesis by the liver of the freshwater teleost, *Channa punctatus*. *Environ. Pollut.* **58(4):** 273-280.

Schmidt, N. B. 1975. Osmoregulation effect of salinity and heavy metal. *Fed. Proc.* **33:** 2137-2146.

Shinde, V. R., Veeresh, M. U. and Kulkarni, R. S. 2002. Ovarian changes in response to heavy metals exposure to the fish *Notopterus notopterus* (Pallas). *J. Environ. Biol.* **23(2):** 137-141.

Singh, S. and Bhati, D. P. S. 1994. Evaluation of liver protein due to stress under 2,4-D intoxication in *Channa punctatus* (Bloch). *Bull. Eniron. Contam. Toxicol.* **3:** 149-152.

Susan, A. T., Veeraiah, K. and Tilak, K. S. 1999. Biochemical and enzymatic changes in the tissues of *Catla catla* exposed to the pyrithroid fenvalerate. *J. Ecobiol.* **11(2):** 109-116.

Swami, K. S., Rao, K. S. J., Reddy, K. S., Moorthy, R. S., Shetty, G. L. and Indira, K. 1983. The possible metabolic diversion adopted by the freshwater mussel to counter the toxic metabolic effects of selected pesticides. *Indian. J. Anim. Physiol.* **1:** 95-106.

Szabu, A. and Nemcsok, J. 1992. The effect of pesticides on carp (*Cyprinus carpio*) acetyl cholinesterase and its biochemical characterization. *Ecotoxicol. Environ. Saf.* **23(1):** 39-45.

Verma, S. R., Tonk, I. P. and Kumar, V. 1983. Effects of thiotax, malathion and their two combinations on tissues of freshwater fish, *Notopterus notopterus*. *J. Environ. Biol.* **4(1):** 27-33.

Yogana Bano., Shaikh, A. A. and Hameed, T. 1981. Effect of sublethal concentration of DDT on muscle constituents of an air breathing cat fish *Clarias batrachus*. *Proc. Indian. Acad. Sci.* **90(1):** 33-37.