ISSN 2250-3153

Impact of Chemathoate Nutritional Index of Freshwater Fish, *Cyprinus Carpio*

S. Janardana Reddy

Department of Fishery Science and Aquaculture, Sri Venkateswara University, Tirupati-517 502

Abstract- The freshwater fish, *Cyprinus carpio*, exposed to acute exposure period (Lethal concentration for 96 hours = 4.369 ppm) and ½ and 1/4th sub lethal concentrations (2.185 and 1.092 ppm) of chemathoate for 30 days. The protein content various tissues of fish was observed after exposure period. Acute exposure caused a significant decrease the protein content in testis, ovary and brain and insignificant decrease in intestine, muscles, liver and gills, whereas increased protein level was observed in kidney. The two sub lethal concentrations are caused to decrease of protein content in ovary, brain, intestine, muscles, gills and liver for over 30 days exposure period, whereas protein level in testis of fish was increased to 1/4th concentration of LC50 and decrease of protein content was noticed at ½ LC50 concentration of chemathoate.

Index Terms- Chemathoate, Cyprinus carpio, Protein content, Nutritive value

I. INTRODUCTION

Indiscriminate use of various agriculture pesticides and enter into the aquatic environment and adversely affect the non target organisms. Pesticides in water cause damage to biotic life especially to fish (Mance, 1987). 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 various pesticides 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 (Janardana Reddy, 2011). It has also been reported that acute and chronic toxicities of pesticides caused biochemical alterations in organs (Hatai et al. 2005; Rawat et al., 2002; Ikem et al. 2003; Janardana Reddy, 2012).

Beaumont et al. (2000); Almeida et al. (2001); Choudhary and Gaur (2001) and Janardana Reddy (2011, 2012, 2013) have discussed the variations in biochemical indices in various tissues of fishes with toxic effects of different heavy metals and pesticides. Therefore it is evident from the literature that the extensive work has been carried out on the toxic effects of pesticides on metabolic indices of fishes, very little work has been done on biochemical indices of carp fish, *Cyprinus carpio*. So the present work has been designed to assess the extent of alterations of protein content in fish treated with chemathoate toxicity.

II. RESEARCH AND ELABORATIONS

The freshwater fish *Cyprinus carpio* were collected from the freshwater fish breeding and culture centre, Kalyanidam, near Tirupati. Fishes were acclimatized in dechlorinated and well aerated ground well water supplied by the university, for two weeks. During acclimatization they were fed daily with pieces of live earthworms. The holding water was changed daily. The average temperature of water was 26±1ºC. The LC50 values are determined by following the guidelines given on committee of toxicity tests with aquatic organisms. Stock solutions of the test compounds and their dilutions were made according to the guidelines given in the standard methods (APHA, AWWA, WEF, 1998). The test species were also selected as recommended by these standard methods. The water was continuously aerated before putting in the fish to remove any residual chlorine. The fish were fed daily during conditioning period. Duration of the static acute bioassays was 96 h. Toxicity range finding was by pre experiments carried out in aquaria containing 10 fish. The LC50 values are calculated by Probit Analysis Method Finney (1971).

The acclimatized fishes were exposed to acute lethal concentration (4.369 ppm) for 96h and ½ and 1/4th sub lethal concentrations (2.185 and 1.092 ppm) for 30 days. Simultaneously a control group of healthy fishes were maintained constantly (Table-1). At the end of the each exposure period, fish were stunned to death and target organs such as different tissues viz. gill, liver, gonads, brain, kidney, intestine and muscles were dissected out and were processed for the biochemical estimations. Protein content was estimated by Folin phenol reagent method (Lowry et al., 1951).

III. RESULTS AND DISCUSSION

In the present study observed that chemathoate caused a significant decrease in total protein content in testis, ovary and brain and least decrease in intestine, liver, gills and muscles, whereas increased protein level was observed in kidney at acute exposure to lethal concentration (4.369 ppm) of chemathoate for 96 hours. The two sub lethal concentrations (1/4th and ½ sub lethal of LC_{50}) caused a decrease in the level of protein content in ovary, brain, intestine, muscles, gills and liver of fish, *Cyprinus carpio* (Table-2). Therefore in testis protein level increased at 1.092 ppm and decreased in 2.185 ppm exposure periods. Sub lethal exposures have accelerated to increase the protein level 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 (1/4th of LC50).

Decrease in protein content after exposure to chemathoate 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. Similar findings were reported by Kale et al (1999) proteins are the main source of energy there degradation is to cope with high energy demand augmented during malathion stress in *Cyprinus carpio.* Also the total protein level showed decreased trend in Nile Tilapia (*Oreochromis niloticus*) in response to the treatment of cypermethrin by Korkmaz et al.(2009). In *Clarius gariepinus* exposed to cyhalothrin decreased protein observed by Ogueji and Auta (2007). Atamanlap et al. (2002) reported decrease in protein content in rainbow trout (*Oncorhynchus mykiss*) due to contaminated environment condition.

Yogana et al. (1981) reported decrease in protein content of muscles after DDT treatment in the fish *Clarias batrachus*. Reddy et al. (1991) observed decreased level of protein in brain, liver and muscles of fenvalerate exposed fish *Cyprinus carpio.* Saxena et al. (1989) observed decreased level of protein in gonads of *Channa punctatus* after fenitrothion and carbofuran exposure. Shinde et al. (2002) has also been reported the decrease of protein content in ovary of *Notopterus notopteus* treated with heavy metals. 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 (24) 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 sub lethal concentrations of fenvalerate in the gills of *Catla catla.*

Proteins are the main energy sources and play an important role in the maintenance of blood glucose. Initially insignificant alternation of proteins at the end of 96 hours was observed in the tissues suggesting that the fish tend to resist the sudden stress for shorter duration, later with increases of time the decrease of protein content. Mastan and Rammayya, (27) are stated that the survival ability of animals exposed to stress mainly depends on their protein synthetic potential and the degradation of protein suggests the increase in proteolytic activity and possible utilization of their products for metabolic purposes and cause damage to tissues.

In the present study the decreased protein content during chemathoate 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.

The present study proved that the chemathoate is highly toxic and had a detrimental impact on the responses of *Cyprinus carpio* at sub lethal concentrations and any alterations caused by the pesticides may lead to variations of total proteins in fish. A decrease in the protein content during exposure to chemathoate is indicating the decrease of the nutritive value of fish that leads to decrease of market demand of fish, so the aquaculture scientists have to monitor the release of pesticides in to the aquaculture field.

REFERENCES

[1] Almeida, J., Novelli, M. E., Dal Pai, S. and Junior, R. 2001. Environmental cadmium exposure and metabolic responses of Nile Tilapia, Oreochromis niloticus. Environ. Pollut. 114: 169-175.

[2] APHA, AWWA, WEF, 1998. Standard Methods for the Examination of Water and Wastewater, Washington, DC.

[3] Atamanlp, M, Keles, M.S., Haliloglu, H.I and Aras, M.S. 2002. The effect of cypermethrin (a synthetic pyrethroids) on some biochemical parameters(Ca,P,N and TP) of rainbow trout (Oncorhynchus mykiss) Turk J.Vet Anim Sci. 26:1157-1160

[4] Beaumont, M. W., Butler, P. J. and Taylor, E. W. 2000. Exposure of Brown trout, Salmo trutta,to a sublethal concentration of copper in soft acidic water :Effects upon muscle metabolism and membrane potential. Aquat. Toxicol. 51: 259-272.

[5] 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.

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

[7] 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.

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

[9] 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.

[10] Hatai, L. D. and Subhasis, 2005. Effect of environmental pollution in agriculture and its control . Agrobios news letter 5(8):81-83

[11] Ikem, A., Egiebor, N. and Nyavor, K. 2003. Trace elements in water, fish and sediment FromTuskegee Lake, Southeastern USA. Water, Air and Soil Pollut. 149: 51-75.

[12] 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.

[13] Mance, G. 1987. Pollution threat of heavy metals in the aquatic environments. Elsevier, London.

[14] Kale MN, John Rathore S and Batnagar D. 1999. Lipid peroxidative damage on pyrethroids exposure and alteration in antioxidant status in rat

erythrocytes, a possible involvement of reactive oxygen species.Toxicol.Lelt. 105:197-205

[15] 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.

[16] 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.

[17] Korkmaz N , Cengiz EI, Unlu E , Uysal E and Yanar M. 2009. Cypermethrin- induced histopathological and biochemical changes in Nile Tilapia (Oreochromis niloticus) and the protective and recuperative effect of ascorbic acid. Environ Toxicol Pharmacol. 28 (2):198-205.

[18] 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.

[19] Ogueji, E.O and Auta. 2007. Investigation of biochemical effects of acute concentration of lamba Cyhalothrin on African catfish clarius batrachus Teugels. Journal of fisheries international 2 (1): 86-90.

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

[21] 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.

[22] 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.

[23] 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.

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

[25] 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.

[26] 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.

[27] 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.

[28] 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.

[29] 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.

AUTHORS

First Author – Dr. S. Janardana Reddy, M.Sc., Ph.D., Asst. Professor, Department of Fishery Science And Aquaculture, Sri Venkateswara University, Tirupati-517 502, E-Mail: Sjreddy_7@Yahoo.Co.In

REVIEWERS

1. Dr. PURNACHANDRA NAGARAJU GANJI, Faculty, School of Medicine, Emory University, Atlanta, GA, USA E-mail ID: pganji@emory.edu ; ganjinagraju30@gmail.com;
2. Dr. P.V.KRISHNA , Associate Professor, Department of Zoology and Aquaculture,, ACHARYA NAGARJUNA UNIVERSITY, NAGARJUNA NAGAR, GUNTUR – 522510, E-mail ID: drpvkrishna@yahoo.co.in

Table 1: Physico-chemical parameters of water used in experiments

S. No	Parameter	values
1	Turbidity	8 Silica units
2	Electrical conductivity	28ºC 814 microohms/cm
3	pH value at 28ºC	7.8
4	Total Hardness (as CaCO3)	256mg/L
5	Calcium Hardness (as N)	74mg/L
6	Sulphate (as SO4)	Trace
7	Chloride (as Cl)	36mg/L
8	Fluoride (as F)	1.6mg/L
9	Iron (as Fe)	Nil
11	Dissolved Oxygen	8.5-10ppm
12	Temperature	26ºC

Table 1: Variations in protein content in Cyprinus carpio treated with lethal and sub lethal concentrations of chemathoate.

Tissues	Control	Lethal Exposure Period (4.369ppm)	Sub lethal Exposure Periods	
			½ LC50=2.185	1/4th LC50=1.092
Intestine	31.797 ± 0.834	21.346 ± 0.924	20.274 ± 1.057	15.123 ± 0.960
%change	----	(-32.867)	(-36.239)	(-52.438)
Ovary	30.233 ± 0.841	12.819 ± 0.595	18.263 ± 0.710	15.447 ± 0.483
%change	-----	(-57.599)	(-39.592)	(-48.907)
Testis	28.934 ± 0.588	21.236 ± 1.105	16.519 ± 0.536	29.896 ± 0.734 ns
%change	-----	(-26.605)	(--42.907)	(+3.329)
Gill	26.837±0.325	18.365 ± 0.554	17.192 ± 1.364	15.362 ± 0.530
%change	-----	(-31.568)	(-35.939)	(-42.758)
Liver	27.079±0.689	18.892 ± 0.498	16.545 ± 0.935	13.804 ± 0.982
%change	------	(-30.233)	(-38.901)	(-49.023)
Kidney	17.682 ± 0.209	23.732 ± 1.213	15.437 ± 0.739	13.937 ± 0.388
%change	------	(34.215)	(-12.696)	(-21.179)
Muscle	11.96 ± 0.241	9.721 ± 0.199	8.243 ± 0.176	6.758 ± 0.184
%change	------	(-18.741)	(-31.095)	(-43.509)
Brain	23.732 ± 1.213	12.682 ± 0.209	19.075 ± 0.123	21.125 ± 0.173
%change	-------	(-46.562)	(-19.623)	(-10.985)

Values are mean ± SD of six individual observations.
Each Tissue sample was pooled from six individual animals.
All values are significant at $p<0.05$; ns =not significant.