Recent Research in Science and Technology 2011, 3(12): 07-10
ISSN: 2076-5061
www.scholarjournals.org

www.recent-science.com

RRST-Zoology

Cypermethrin and Fenvalerate Induced Protein Alterations in Freshwater Crab *Barytelphusa cunicularis* (Westwood)

P.P. Joshi[1*] and G.K. Kulkarni[2]

[1]*Department of Zoology, Adarsh Education Society's Arts, Commerce and Science college, Hingoli-431 513 (M.S.)*
[2]*Department of Zoology, Dr. B. A. Marathwada University, Aurangabad-431 004. (M.S.)*

Article Info

Article History

Received : 17-02-2011
Revised : 26-05-2011
Accepted : 01-06-2011

*Corresponding Author

Tel : +91-9595648535
Fax : +91-2456221749

Email:
drprashantjo@gmail.com

Abstract

Cypermethrin and fenvalerate are two synthetic pyrethroid pesticides, commonly used in agriculture fields for the control of insects because of their high insecticidal activity and low mammalian toxicity. The mobilization of these pyrethroids from field to aquatic system induce lethal and sub lethal effects on non-target animals particularly crabs, which has high food value.

In the present study, an attempt has been made to study the effect of cypermethrin and fenvalerate on protein content of different tissues like ovary, hepatopancreas, intestine, gill and thoracic muscle of the freshwater crab *Barytelphusa cunicularis* (Westwood). The crabs were exposed to sub lethal concentration ($1/10^{th}$ of 24 h LC_{50}) of cypermethrin and fenvalerate for a period of ten days. The treatments of these pyrethroids brought about significant decrease in protein content in all tissues as compared to control. The maximum decrease was observed in hepatopancreas. The percent decrease of total protein content was in the order of: hepatopancreas > ovary > gill > intestine > muscle. The obtained results indicate that cypermethrin has more toxic effects than fenvalerate. The significance of these studies as bioindicator for assessing the toxicity and economic importance of the crab are discussed.

Key Words: Cypermethrin, Fenvalerate, Toxicity, Protein, Crab

Introduction

A class of agricultural insecticides, the synthetic pyrethroids, has emerged as a complement to the organochlorines, organophosphates and carbamates and is more popular for their high toxicity to wide range of insects [1]. Now days, continuous usage of these pesticides to control the crop disease causing vectors has caused havoc to aquatic ecosystem. Cypermethrin is one of the recent pyrethroid being used for cotton pest control and wide variety of other crop pests in India. Fenvalerate is also recently developed type II synthetic pyrethroid that has replaced other groups of insecticide due to its improved potency and rapid biodegradability. Higher concentrations of toxicants in aquatic environment cause adverse effect on aquatic organisms at cellular or molecular level and ultimately it leads to disorder in biochemical composition.

Numerous biochemical indices of stress have been proposed to assess the health of non-target organisms exposed to toxic chemicals in aquatic ecosystem [2]. Proteins are important organic substance required by organisms in tissue building. They are intimately related with almost all physiological processes, which maintain a simple biochemical system in 'living condition.' The freshwater fish *Garra mullya* is important food item in this area hence, an attempt is made to study the changes in total protein content as a function of the effect of pesticides cypermethrin and fenvalerate.

Material and Methods

The crabs, *Barytelphusa cunicularis* were also collected from Kham River at Tisgaon. They were acclimatized to laboratory conditions under normal day/night illumination at 27 ± 1°C for about one week in plastic troughs (18" diameter) containing sufficient tap water so that they submerged. Before experimentation intermoult (stage C_3) female crabs [3] of approximately equal carapace width (45 to 50 mm) and body weight (50 to 55 gm) were sorted. To study the effect of cypermethrin and fenvalerate on the biochemical constituents crabs were divided in groups of 10 in each. Sub lethal concentrations used to expose crabs for 10 days were 0.0000382 $mg1^{-1}$ of cypermethrin and 0.000141 $mg1^{-1}$ of fenvalerate both $^1/_{10^{th}}$ of 24 h LC_{50}. Along with experimental group a corresponding control group of 10 crabs was also run in normal tap water to compare the results. After their respective exposure period, tissues like ovary, hepatopancreas, intestine, gill and thoracic muscles were collected on ice and used for the analysis of protein by the method of Lowry [4]. Bovine serum albumin was used as standard. The amount of total protein content was expressed in terms of mg% of wet weight of tissue. Each observation was confirmed by taking at least three replicates. The significance of difference in protein values control and experimental animals was tested by student't' test [5].

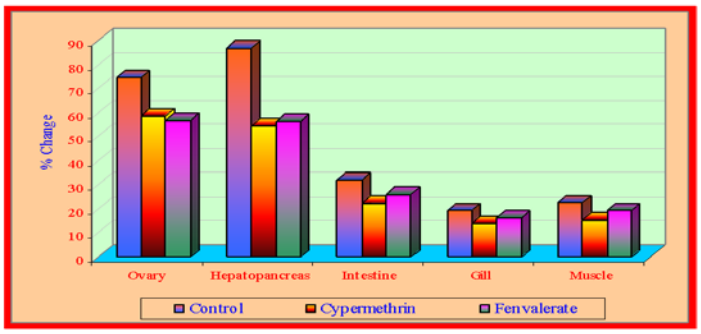
Results

In the crab, *Barytelphusa cunicularis* also depletion in protein content in all tissues were noted after exposure to sub lethal concentration of cypermethrin (0.0000382 $mg1^{-1}$) and fenvalerate (0.000141 $mg1^{-1}$) respectively. The calculated values of total protein and standard deviation with percent change over the control in different tissues viz. ovary, hepatopancreas, intestine, gill and muscle of the crab, *Barytelphusa cunicularis* (Westwood) after ten days exposure period are given in Table 1 and Graph. 1.

Table 1: The protein content of the crab, *Barytelphusa cunicularis* exposed to sub lethal concentration of cypermethrin (0.0000382 $^{mg1-1}$) and fenvalerate (0.000141 $mg1^{-1}$) for a period of 10 days

Sr. No.	Tissues	Control	Cypermethrin	Difference (%)	t-value	Fenvalerate	Difference (%)	t-value
		Mean ± SD	Mean ± SD			Mean ± SD		
1	Ovary	82.87 ± 1.72	48.22 ± 1.15	-41.81***	26.1600	56.44 ± 2.13	-31.90***	17.0507
2	Hepatopancreas	69.37 ± 0.65	28.12 ± 1.12	-59.46***	43.7094	33.00 ± 1.72	-52.43***	32.0727
3	Intestine	62.06 ± 0.86	51.75 ± 1.95	-16.62**	8.2962	57.94 ± 0.56	-6.65*	5.2341
4	Gill	63.75 ± 1.30	41.81 ± 0.86	-34.41***	20.5886	48.56 ± 1.17	-23.82**	13.1047
5	Muscle	54.07 ± 1.02	46.87 ± 1.3	-13.31**	6.5477	47.62 ± 1.72	-11.93*	5.2862

Mean ± SD of three individual observations expressed in mg %.
* Statistically significant at P < 0.05
** Statistically significant at P < 0.01
*** Statistically significant at P < 0.001



Graph 1: Percent change in the protein content of the crab, *Barytelphusa cunicularis* exposed to sub lethal concentration of cypermethrin and fenvalerate for a period of 10 days

In the ovary of control crab the protein concentration was 82.9 mg%, whereas in the ovary of experimental crab decreases of 41.8% and 31.9% were observed after exposure to cypermethrin and fenvalerate respectively. In the hepatopancreas of control crab the protein content was found to be 69.4 mg%. As compare with control, the protein content in hepatopancreas was found significantly (P<0.001) decreased by 59.5% and 52.4% in crabs cypermethrin and fenvalerate respectively. In the intestine of control crab the protein concentration was found to be 62.1 mg%. As compare with control the protein content in intestine of experimental crab was found significantly (P<0.01) decreased by 16.6% exposed to cypermethrin and (P<0.05) 6.6% in fenvalerate exposed crabs. In the gills of control crab the protein concentration was found to be 63.7 mg%. In the gills of treated crabs, a decrease of 34.4% and 23.8% was observed after exposure to cypermethrin and fenvalerate respectively. In the muscle of control crab 54.07 mg% of protein was found. In the muscle of experimental crab significant (P<0.01) decreases of 13.3% and (P<0.05) 5.3% were observed after exposure to sub lethal concentration of cypermethrin and fenvalerate respectively.

Maximum decrease in the protein content was observed in the hepatopancreas as compared to other tissues of crab, *Barytelphusa cunicularis*. The percent decrease of total protein content was in the order of:

Cypermethrin: Hepatopancreas > Ovary > Gill > Intestine > Muscle

Fenvalerate: Hepatopancreas > Ovary > Gill > Muscle > Intestine

Discussion

Biochemical changes are better indices of damage by pollution than the conventional pathophysiological changes.

Changes in biochemical parameters point to the development of sub lethal abnormalities, which limit potential of an animal population in effectively coping with the normal stress and strain for survival. Biochemical studies have been carried out at the level of whole animals, organs, tissues and sub cellular organelles [6]. A few workers studied the effects of pyrethroids and other pesticides on changes in the biochemical composition of aquatic animals. Rao [7] studied changes in the protein metabolism of a freshwater gastropod, *Indoplanorbis bisexustus* due to Decis toxicity. Bhawan [8] studied alterations in the protein content of prawn, *Macrobrachium malcolmsonii*. Jadhav [9] studied endosulfan and thimet induced changes in biochemical composition of a freshwater fish, *Barbus stigma*. Kale [10] correlated cadmium toxicity and biochemical changes in another freshwater crab, *Barytelphusa cunicularis*.

The nutritive and medicinal value of crab has been recognized from time immemorial. Crab is an excellent source of protein and vitamins besides being rich in calcium, iron, phosphorus and iodine for human diet. Traditionally the crab is considered as the, "protein for poor" [11].

Understanding of the protein components of cell becomes necessary in the light of the radical changes taking place in protein profiles during pesticide intoxication. Proteins occupy a unique position in the metabolism of cell because of the proteinaceous nature of all the enzymes which mediate at various metabolic pathways [12,13].

The maximum decrease of protein was observed in hepatopancreas after 10 days exposure to these pyrethroids. The percent decrease of total protein content was in the order of: hepatopancreas > ovary > gill > intestine > muscle. The obtained results indicate that cypermethrin has more toxic effects than fenvalerate (Table 1 and Fig. 1). Ehsan [14] observed decrease in total protein content of the hill stream teleost *Garra mullya* during egg maturation due to cadmium toxicity. It is possible that decrease in protein content may be because of more utilization of protein in stressful environment conditions. Decrease in protein content may also be attributed to the inhibition of protein synthesis. Variation in the protein metabolism of fish exposed to these pyrethroids indicates their toxic effect on the cellular metabolism thereby leading to impaired protein synthetic machinery [15]. It is possible that decrease in protein content in *Barytelphusa cunicularis* may be because of more utilization of protein in stressful environment conditions. Decrease in protein content may also be attributed to the inhibition of protein synthesis. Many workers have reported depletion in protein content in different tissues in crabs exposed to various toxicants. Rao [16] observed decline in protein content in gonad, muscle and hepatopancreas of *Scylla serrata* exposed to Dimecron. Machale [17] reported decrease in protein content in gonad, hepatopancreas and muscle of *Barytelphusa gureini*. Bhagyalaxmi [18] noticed depletion in protein content in the crab, *Oziotelphusa sensex senex* exposed to fenvalerate. Sreenivasan [19] also reported significant decrease in protein content in different tissues of freshwater crab, *Spiralothelphusa hydrodroma* exposed to cypermethrin.

References

[1] Elliott M, Janes N. F. and Rettor C. (1978) The future of pyrethroids in insect control. Ann. Rev. Ent. 23: 443-469

[2] Nimmi A. J. (1990) Review of biochemical methods and other indicators to assess fish health in aquatic ecosystems containing toxic chemicals. J. Great Lakes Res. 16: 529-541

[3] Diwan A. D. (1973) Studies on sexual maturity and growth rate studies of the freshwater crab *Barytelphusa cunicularis*. Marath. Univ. J. Sci. 12:125.

[4] Lowry O. H., Rosenburough N. J., Farr A. L. and Randall R. J. (1951) Protein measurement with Folin Phenol reagent. J. Biol. Chem. 193: 265-275

[5] Mungikar A. M. (2003) Biostatistical Analysis. Saraswati Publ. Printing Press, Aurangabad. pp. 28-39.

[6] Sastry K. V. and Siddiquie A. (1984) Some haematological, biochemical and enzymological parameters of freshwater teleost fish, *Channa punctatus* exposed to sublethal concentrations of quinolphos. J. Pestic. Biochem. And Physiol. 22: 8-13

[7] Rao K. R., Patil P. N., Chaudhari T. R. and Vedpathak A. N. (1993) Changes in the protein metabolism of freshwater gastropod, *Indoplanorbis exustus* due to decis (pyrethroid) toxicity. Abst. Nat. Symp. on Impact of Environ. Factors on Physiol. of Aquat. Anim. Marathwada University, Aurangabd.

[8] Bhawan P. S. and Geraldine P. (1997) Alterations in concentrations of protein, carbohydrate, glycogen, free sugar and lipid in the prawn, *Macrobrachium malcolmsonii* on exposure to sublethal concentrations of endosulfan. Pestic. Biochem. Physiol. 58: 89-101

[9] Jadhav T. J. (2002) Effect of organic pesticides (endosulfan and thimet) on reproductive activities of edible fish and crab: A comparative study. Ph.D. Thesis. Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S.) India.

[10] Kale Monika K., Joshi P. P. and Kulkarni G. K. (2006) Effect of cadmium toxicity on biochemical composition of a freshwater fish *Rasbora daniconius*. In: Ecology and Environment (B.N. Pandey and M.K. Joyti Eds.) APH Publication Corporation, New Delhi. pp 271-278

[11] Mishra A. and Sharma A. P. (2004) Fish in human welfare. Everyman's Science, Vol. XXXIX No. 2. pp. 111-114.

[12] Lehninger A. L. (1983) In: Biochemistry. Kalyani Publ. Ludhiana, New Delhi.

[13] Harper H. A. (1985) In: Harper's review of Biochemistry (eds.) D.W. martin, P. a. Mayes and V. W. Rodwell, Lange Medical Publications, Maruzen, Asai (Singapore).

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

[15] David M., Mushigeri S. B. Shivakumar R. and Philip G. H. (2004) Response of *Cyprinus carpio* (Linn) to sublethal concentration of cypermethrin: Alterationa in protein metabolic profiles. Chemosphere. 56 (4): 347-352

[16] Rao K. S., Nagabhushnam R. and Sarojini R. 1987: Changes in the biochemical constituents of the marine edible crab*Scylla serrata* after exposure to dimcron. Utter Pradesh J. Zool., 7(1):20-25.

[17] Machale P. R., Khan A. K., Sarojini R. 1993: Biochemical changes induced cupros oxide in the various tissues of the freshwater crab *Barytelphusa guerini.* J. Adv. Zool. 12(12):115-120.
[18] Bhagyalaxmi A., Reddy P. S. and Ramamoorthi 1984: Subacute stress induced by sumithion on certain biochemical parameters in *Oziotelphusa senax senax,* the freshwater rice field crab. Toxic. Lett. 21:127-134.
[19] Sreenivasan R. S. 2005: A study on the effects of cypermethrin a pyrethroid compound in *Spiralothelphusa hydrodroma*. Ph.D. Thesis. Univ. of Madras, Chennai.