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EFFECT OF DELTAMETHRIN ON SOME ASPECTS OF LIPID METABOLISM IN FRESH WATER FISH *LABEO ROHITA* (HAMILTON)

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Abstract: Effect of sub lethal concentration of deltamethrin (0.01µg/lt) was studied on total lipids, lipase activity and free fatty acids of the fish *Labeo rohita*. The levels of total lipids declined on 1st day exposure and gradually elevated on 7th day and 15th day. From 15th day onwards their levels gradually declined and came nearer to control at 30th day exposure period. In contrast to this the levels of lipase activity and free fatty acids followed an opposite tend.

Key Words: Deltamethrin, sublethal, *Labeo rohita*, total lipids, lipase activity and free fatty acids.

INTRODUCTION

In order to meet the global demand for increased food production a multitude fertilizers, chemicals and pesticides were put into use in ever increasing quantities. Pesticides are the biological toxicants which are required by man to kill insects, pests and also man's fight against the spread of diseases[1]. As the use of these pesticides to control the crop destroying insects and also to control the spread of disease increase, so did the insect resistance to the pesticides and this led to synthesis of more new, more powerful and more toxic chemicals.

Pesticides usage became an indispensible and integral part of world agriculture. In addition to agriculture practices together with pest control programmes, the surface runoff and aerial spraying forming the major source for trans locating pesticides into aquatic ecosystems[2,3,4]. Pesticides residues have been reported in fruits and vegetables [5,6] and even in breast milk[7]. The contamination of water by pesticides may effect on non - target organisms like fish [8,9,10]. So an attempt was made on sublethal effect of deltamethrin on some aspects of lipid metabolism in the fish *Labeo rohita*.

MATERIALS AND METHODS

Test Chemical

The pesticide selected for the present investigation was synthetic pyrethroid Deltamethrin. It is widely used on diverse agricultural crops to control pests of crops, flies and mosquitoes. It has been widely used because of its high photostability, degradability, non -persistent nature and low mammalian toxicity. Its commercial name was Decis. Commercial grade was used and its effective concentration was 2.8%.

Experimental design

Fresh water fish *Labeo rohita*, weighing 10±2gm were procured from local fisheries department and stored in spacious aquaria. The water in aquaria was aerated twice day, the fish were fed daily with groundnut cake and rice bran. The physic-chemical properties of water used for experiments had pH 7.4± 0.2, dissolved oxygen 6-7 ml /lt, hardness 160 ppm and temperature 28±1 °C. Before experimentation has been executed, the fish were acclimated to the laboratory conditions for a period of 10 days. Later groups of 10 fish were exposed to different concentration of Deltamethrin ranging from 0.02µl to 0.2µl. The mortality was observed during 96 hrs exposure period. The LC_{50} / 96 hrs was determined from the percent and probit mortality versus log concentration curves (Finney[11]) and were subsequently verified by Dragstedt and Behrens method as given by Carpenter[12]. After determination of LC_{50}/96 hrs (00.1µg/lt), the fish were exposed to sublethal concentration of Deltamethrin (1/10th of LC_{50}/96hrs i.e. 0.01 µg/lt) for five exposure periods i.e 1,7,15,20 and 30 day.

In the present investigation the levels of total lipids, lipase activity and free fatty acids were estimated in the brain, liver, gill, kidney and muscle of fish. Each experiment was carried out in the organs of six individuals and the mean of six values were taken into consideration. The total lipids were estimated by method of Folch *et al.*, [13], lipase activity by Colowick and Caplan[14] and free fatty acids by the method of Natelson[15].

RESULTS

In this investigation the levels of total lipids, lipase activity and free fatty acids were estimated in the brain, liver, gill, kidney and muscle of fish, on

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1,7,15,20 and 30 days of exposure to sub lethal concentration of Deltamethrin besides control levels were presented in tables 1,2 and 3. The levels of total lipids declined relative to controls in all organs of fish at first day exposure and gradually elevated on 7 and 15 day exposure periods. From 15 day onwards their levels gradually declined and came nearer to control at 30 day exposure period. The values were found to be significant (P<0.001).

Table 1: Total lipids (mg/gm wet wt.) in the organs of *Labeo rohitha* on exposure to sub lethal concentration of Deltamethrin. Mean and standard deviation are a pool of six individual measurements. The percent change in the total lipids at different periods was calculated in relation to the total lipids in the control medium. The differences between control and exposure period days were found to be statistically significant (P < 0.01).

S. No	Organs	Control	Exposure period in days				
			1 day	7 day	15 day	20 day	30 day
1.	**Brain**	82.0	60.5	68.2	72.4	63.5	59.5
	SD	4.0	2.02	3.72	2.42	3.14	3.15
	PC		-26.21	-16.82	-11.70	-22.56	-27.43
2.	**Gill**	58.6	32.2	41.5	47.6	42.5	39.0
	SD	3.02	1.72	2.07	2.56	1.90	1.56
	PC		-45.05	-29.18	-18.77	-27.47	-33.44
3.	**Kidney**	84.59	94.83	98.10	105.38	92.85	78.36
	SD	3.66	4.89	3.53	2.13	6.17	2.21
	PC		-12.10	-15.97	-24.57	-9.76	-7.36
4.	**Liver**	71.0	64.0	72.4	78.5	74.80	68.2
	SD	2.31	3.14	2.42	1.92	2.72	3.72
	PC		-9.85	-1.97	-10.56	-5.32	-3.94
5.	**Muscle**	23.0	18.7	24.0	29.5	25.2	21.5
	SD	1.98	2.18	3.39	2.11	3.70	2.78
	PC		-18.69	-4.34	-28.26	-11.30	-6.52

SD – Standard Deviation; **PC** – Percent change

Table 2: Lipase activity (mg/gm wet wt.) in the organs of *Labeo rohitha* on exposure to sublethal concentration of Deltamethrin. Mean and standard deviation are a pool of six individual measurements. The percent change in the lipase activity at different periods was calculated in relation to the lipase activity in the control medium The difference between control and exposure period days were found to be statistically significant (P < 0.01).

S. No	Organs	Control	Exposure period in days				
			1 day	7 day	15 day	20 day	30 day
1.	**Brain**	164.5	181.2	166.0	147.6	151.3	156.8
	SD	7.38	8.12	7.42	6.01	6.78	7.01
	PC		10.15	0.91	-10.27	-8.0	-4.68
2.	**Gill**	156.0	168.5	163.5	138.2	143.8	150.6
	SD	6.87	7.8	7.18	5.75	5.97	6.18
	PC		8.01	4.80	-11.41	-7.8	-3.46
3.	**Kidney**	132.5	156.0	151.1	143.6	136.5	125.4
	SD	8.25	9.75	8.72	7.30	7.95	8.10
	PC		17.73	14.49	8.37	-3.01	-5.35
4.	**Liver**	340.5	361.2	348.0	326.5	318.6	306.0
	SD	9.01	6.32	5.09	4.28	4.12	4.72
	PC		6.07	2.20	-4.11	-6.43	-10.13
5.	**Muscle**	81.2	104.0	96.5	66.8	71.2	77.0
	SD	3.64	4.18	4.10	2.78	3.01	3.30
	PC		-28.07	17.39	-18.13	-13.38	-6.32

SD – Standard Deviation; **PC** – Percent change

Table 3: Free fatty acids (mg/gm wet wt.) in the organs of *Labeo rohitha* on exposure to sub lethal concentration of Deltamethrin. Mean and standard deviation are a pool of six individual measurements. The percent change in the free fatty acids at different periods was calculated in relation to the free fatty acids in the control medium. The differences between control and exposure period days were found to be statistically significant (P < 0.01).

S. No	Organs	Control	Exposure period in days				
			1 day	7 day	15 day	20 day	30 day
1.	**Brain**	6.62	6.98	6.46	5.86	6.26	6.48
	SD	0.68	0.72	0.79	0.52	0.62	.72
	PC		5.43	-2.41	-11.48	-5.43	-2.11
2.	**Gill**	2.13	2.14	1.92	1.68	1.85	2.12
	SD	2.12	2.42	1.92	1.40	2.01	2.59
	PC		13.14	-9.85	-21.12	-13.14	-0.46
3.	**Kidney**	8.46	8.59	8.42	8.22	8.82	8.12
	SD	1.23	1.87	1.50	1.24	170	1.62
	PC		3.58	-2.43	-2.54	-2.80	-6.01
4.	**Liver**	5.26	5.63	5.14	4.70	4.98	5.20
	SD	0.32	0.92	0.16	1.80	1.62	1.78
	PC		7.03	-2.28	-10.64	-5.32	-1.14
5.	**Muscle**	1.12	1.26	1.06	0.74	0.89	1.02
	SD	1.01	0.82	0.67	0.52	.071	0.92
	PC		12.50	-5.35	-33.92	-20.53	-8.92

SD – Standard Deviation; **PC** – Percent change

Whereas the levels of lipase activity and free fatty acids elevated in all organs of fish at first day exposure period, relative to controls. Their levels gradually declined on 7 and 15 day exposure periods. From 15 day onwards their levels gradually elevated and came nearer to control on 30 day exposure period. The values were found to be significant (P<0.001).

DISCUSSION

Lipids are heterogeneous group of complex macro molecules. They are the components of living system, insoluble in water but soluble in polar solvents. They form energy rich reserves whose calorific values are twice that of carbohydrates or proteins. The mobilization lipid reserve in an organism testifies the imposition of high energy demands[16]. Observations on the involvement of lipid metabolism exposed to pesticides are many[17-21]. All these studies shows that shifts in lipid metabolism when animals are exposed to toxicants.

The present study result also indicates the involvement of lipid metabolism in the fish *Labeo rohita* on exposure to sub lethal concentration of Deltamethrin. In this study relative to controls the levels of total lipids declined, whereas the levels of lipase activity and free fatty acids elevated on first day exposure. The decline in total lipid levels followed by elevation in the levels of lipase activity and free fatty acids on first day exposure indicates the high energy demand associated with imposed Deltamethrin stress. To overcome this animal tends to mobilize the lipids by stimulating the lipase activity. Some of the observations were also supports the present trend in

the decline of total lipid levels. Susan *et al.,*[22] reported decrease in total lipid content when *Catla catla* exposed to pyrethriod, fenvalerate. Senthilkumar *et al.,*[23] found the reduction of lipid content in the freshwater crab *Spiralathelphusa hydrodroma* when it was exposed to a pesticide, chlorpyrifos. Frontera *et al.,*[24] observed decline in lipid content in hepatopancreas of freshwater crayfish *Cherax quadricarinatus on* exposure to glyphosate. Arun kumar and Jawahar Ali[25] reported similar decrease in lipid content in the fresh water shrimp *Streptocephalus dichotomous* on exposure to organophosphorus pesticides. Suneel kumar[26] reported significant decrease in total lipids in Channa punctatus on exposure to lethal concentration of nuvan.

Lipase activity initially elevated on 1 day exposure followed by its inhibition on 7 & 15 day exposure periods. This is clearly evident by drastic decline in free fatty acids and elevation in total lipids up to 15 day exposure period. Thus maximum percent inhibition in lipase activity and free fatty acids were seen at 15 day exposure period[27-30]. Swami *et al.,*[18] observed metabolic shift from carbohydrate to lipid metabolism through acetyl-CoA barrier leading to an increment in lipids in the organs of fresh water mussel *Lamellidens marginalis* under pesticide toxicity. Similar significant decline in total lipids followed by elevation of lipase activity and free fatty acids has been reported in tissues of Labeo *rohita* exposed to sublethal concentration of Nuvan[31]. Furthermore Sirohi and Saxena[32] also reported decreased in total lipids during initial exposure periods and gradually recovered on 30th day exposure period in fresh water fish *Channa Punctatus* on exposure to synthetic pyrethriod λ-Cyhalothrin.

In later half of exposure period the lipase activity and free fatty acid levels goes on elevation and came nearer to control on 30 day exposure period, whereas the levels of total lipids followed an opposite trend. Metabolic compensation involves break down and synthesis of products necessary to cope up with altered situations. In conclusion the shifts in lipid metabolism may be to compensate with altered situation shown by the fish for its survival.

REFERENCES

1. Gold B, Leuschen T, Brunk G, Gingell R, 1981. Metabolism of a DDT metabolite via a chlorohepoxide, *Chem. Bio. Interact*, 35, 159.

2. Glotfelly DE, majewski MS and Seiber JN, 1990. Distribution of several organophosphorus insecticides in a foggy atmosphrer. *Environ. Sci. Technol.* 24:353-357.

3. Roche HA Tidov and A Persic, 2007. Organochlorine pesticides and biomarker responses in two fishes *Oreochromis niloticus* (Linnaeus, 1758) and *Chrysichthys nigrodigtatus* (Lacepede, 1803) and an invertebrate, *Macrobrachium vollenhoveniil* (Herkot, 1857), from the lake Taabo (Cote'd Ivoire). *J. Applied.Sci.*, 7:3860-3869.

4. Joseph B and SJ Raj, 2011, Impact of pesticide toxicity on selected biomarkers in fishes. *Int. J. Zool. Res.*, 7: 212-222

5. Tahir S, Anwar Intiaz Ahmad T, Aziz S, Mohammad A and Ahad K, 2001, Determination pesticide residues in fruits and vegetables in Islamabad market. *J. Environ. Biol.* 21(10):71-74.

6. Neela Bakore P, J John and Pradeep Bhatnagar, 2002, Evaluation of organochlorine insecticide residue levels in locally marketed vegetables of Jaipur city, Rajasthan, *India. J. Env. Biol.* 23(3): 247-252.

7. Somogyi A and Beck H, 1993, Nutrition and breast feeding exposure to chemicals in breast milk. Environ. Hlth. Perspect. Suppl.101:45-52.

8. Burkpile DE, Moore MT and Holland MT, 2000, Susceptibility of five non target organisms to aqueous diazinon exposure. *Bull. Environ. Contam. Toxicol.* 64:114.

9. Saxena KK and P Gupta, 2005. Impact of carbamates on glycogen contents in the muscles of fresh water fish *Channa punctatus. Poll. Res.*, 24: 669-670.

10. Dutta HM, Misquitta Doyglas and Khan Sanaaullah, 2006, The effect of endosulfan on the testes of bluegill fish *Lepomis macrochirus*. A Histopathological study. Archives. *Environ. Contam. Toxicol.*51 (1):149-156.

11. Finney DJ, 1964. Probit analysis. 2 Edn. Cambridge University Press. London.

12. Carpentor PL, 1975 *In: Immunology and Serology*. 3rd eds. W.B. Saunders Company. Philadelphia. London. Toronto. P. 254.

13. Folch J, Lees M and Solane Stanley GH, 1957 A simple method for isolation and purification of total lipids from animal tissues. *J. Biol. Chem.* 226:497-509.

14. Colowick SP and Kaplan NO, 1965 Lipase titremetric methods using water soluble substrates *In: Methods in enzymology* Vol630-31(Eds) Colowick, S.P. and Kaplan N.O. Academic Press, New York.

15. Natelson S, 1971 Total cholesterol procedure (Liberman-Burchard Reagent) *In: Techniques of Chemical Chemistry III editon,* Charles, C. Thomas Publishers. Spring Field, Illinois. U.S.A. pp263-268.

16. Srinivasa reddy M and Ramana Rao KV, 1989. In vivo modification of lipid metabolism in response to phosphomidon, methyl parathion, and lindane exposure in the prawn *Metapaeneus monoceros. Bull .Env. Contam. Toxicol.* 43:603-610

17. Kaphlino BS, Seth TD and Hussaigh MM, 1981. Organochlorine pesticides residues in some wild Indian birds. *Indian. J. Biochem. Biophys*. 18:157.

18. Swami KS, Jagannatha Rao KS, Satyavely Reddy K, Srinivasamoorthy K, Lingamurthy G, Chetty CS and Indira K, 1983 The possible metabolic diversions adapted by the fresh water mussel to counter the toxic metabolic effects of selected pesticides. *Indian. J. Comp. Animal. Physiol.* 190:99-103.

19. Tewari H, Gill TS and Pant J. 1987 Impact of chronic lead poisoning on the haematological and biochemical profiles of fish *Barbus conchonius* (H). *Bull. Environ. Contam. Toxicol.*38: 748-752.

20. Singh SP and Singh S, 2011, Metabolic effects of an organophosphorus dipterex in *Trichogaster fasciatus. Ind. J. Biol. Res.* Vol: 1(1): P 61-66.

21. Stalin IS and Sam Manohar Das S, 2012, Biochemical changes in certain tissues of *Cirrhina fasciatus* (Hamilton) exposed to fenthion. *Int. J. Environ. Sci.*Vol:2, No: 3, 2012.

22. Susan T, K Anita Veeriah and KS Tilak, 1999. Biochemical and enzymatic changes in the tissues of *Catla catla* exposed to the pyrethroid fenvalerate. *J. Ecobiol.,* 11(2):109-116.

23. Senthilkumar P, K Samyappan, S Jayakumar and M Deecaraman, 2007. Effect of chloripyrifos on the nutritive value in a freshwater field Crab. *Spiralotherlphusa hydrodroma. Res. J. Agi and Bio. Sci.,* 3(6): 760-766.

24. Frontera JL, Vatnick I, A Chavlet and EM, Rodriquez, 2011. Effects of Glyphosate and Polyethylenamine on Growth and Energitic Reserves in the Freshwater Crayfish *Cherax quadicarinatus. Arch. Environ. Contam. Toxicol* 61: 590-598.

25. Arun Kumar MS and Jawahar Ali A, 2013. Toxic impact of two organophosphorus pesticides on Acetylcholinesterase activity and biochemical composition of fresh water fairy shrimp *Streptocephalus dichotomous. Int. J. pharma. Biosci,* (4)2: (B/P): 966-972.

26. Suneel Kumar, 2014, Acute toxicity evaluation of nuvan in liver of Channa puncatus (bloch). Adv. Res. Agri. Vet. Sci.Vol:1, No: 3, 35-38.

27. Ganesan RM, Jebakumar SRD and Jyaraman J, 1989, Sublethal effect of organochlorine insecticide endosulfon on protein, carbohydrate and lipid contents in their tissues of Oreochromis *mossabicus, Proc Indian Sci (Anim Sci),* 98: 51-55.

28. Sivaprasad Rao K and Ramana Rao KV, 1979. Effect of sublethal concentration of methyl parathion on selected oxidative enzymes and organic constituents in the tissues of fresh water fish *T. mossambica. Curr. Sci.* 48:526-528.

29. Kamble GB and Muley DV, 2000, Effect of acute exposure of endosulfon and chloropyrifos on the biochemical composition of the fish *Sarotherondon mossambicus. Indian. J. Environ. science.*4 (1):97-102.

30. Bhavan SP and Geraldine P, 2002, Carbaryl induced alterations in biochemical metabolism of the prawn *M. molcolmsonii. Journ. Env. Biol.* 23(2):157-162.

31. Giridhar P and Indira P, 1997, Effect of organophosphorus nuvan on total lipids and lipase activity of the fresh water fish *Labeo rohita* (Hamilton). *Indian. Journal of Comparative Animal Physiology.* Volume 4(1) P: 37-40.

32. Srohi V and Saxena KK, 2006. Toxic effect of λ Cyhalothrin on biochemical contents of fresh water fish *Channa punctatus. Journal of Fisheries and Aquatic Sciences*. 1:112-116.

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