ISSN 2320-5407 International Journal of Advanced Research (2014), Volume 2, Issue 6, 361-366

ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

Impact of Deltamethrin on some aspects of Carbohydrate metabolism in fresh water fish *Labeo rohita* (Hamilton).

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Manuscript Info

Manuscript History:

Received: 15 April 2014
Final Accepted: 26 May 2014
Published Online: June 2014

Key words:
Deltamethrin, Sublethal, Labeo rohita, Blood glucose, Liver glycogen and Muscle glycogen

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Abstract

Impact of sublethal concentration of deltamethrin (0.01µg/lt) was studied on blood glucose, liver glycogen and muscle glycogen of the fish Labeo rohita. The blood glucose level elevated on 1st day exposure and gradually decreased on 7th day and 15th day. From 15th day onwards their levels gradually elevated and came nearer to control at 30th day exposure period. In contrast to this the levels of liver and muscle glycogen followed an opposite trend.

INTRODUCTION

Population and pollution are the most important problems faced by the globe. Population and pollution are linked with each other. The population goes on increasing year by year, in order to feed this population a tremendous pressure is put on the land. To boost agricultural productivity, the countries are producing and using more pesticides. Over the past forty years pesticides have become an integral and indispensable part of world agriculture. The pesticides usage is desirable for the control of pests on the one hand and on the other hand, these are causing environmental pollution (Zitko et al., 1975; Pandey et al., 2000).

In addition to agriculture practices together with pest control programmes the surface runoff and aerial spraying forming the major source for translocating pesticides into aquatic ecosystems (Glotfelly, 1990; Roche et al., 2007; Joseph and Raj, 2011). The contamination of water by pesticides may effect on non - target organisms like fish (Burkepile et al., 2000; Saxena and Gupta, 2005; Dutta et al., 2006). So an attempt was made on sublethal impact of deltamethrin on some aspects of carbohydrate 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±2 gm 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 0.02 µ l to 0.2 µl. The mortality was observed during 96 hrs exposure period. The LC50 / 96 hrs was determined from the percent and probit mortality versus log concentration curves (Finney, 1964) and were subsequently verified by Dragstedt and Behrens method as given by Carpenter (1975). After determination of LC 50/96 hrs (00.1µg/lt), the fish were exposed to sublethal concentration of Deltamethrin (1/10th of LC50/96hrs i.e. 0.01 µg/lt) for five exposure periods i.e 1,7,15,20 and 30 day.

Methods:

In the present investigation the levels of blood glucose, liver glycogen and muscle glycogen were estimated in fish on 1,7,15,20 and 30 days of exposure to sublethal concentration of deltamethrin besides controls. Each experiment was carried out in six individuals and the mean of six values were taken into consideration. The blood glucose levels were estimated by the Colorimetric Micro-method as described by Mendel et al (1954), liver glycogen and muscle glycogen were estimated by Colorimetric Anthrone method as described by Carrol et al (1956).

Results:

In the present investigation the levels of blood glucose, liver glycogen and muscle glycogen were estimated in the fish on 1, 7, 15, 20 and 30 days of exposure to sublethal concentration of Deltamethrin besides control levels were presented in tables 1, 2 and 3. The blood glucose level elevated relative to controls in fish at first day exposure and decreased gradually on 7 and 15 day exposure periods. From 15 day onwards their levels gradually elevated and came nearer to control at 30 day exposure period. The values were found to be significant (P<0.001).

Whereas the levels of liver and muscle glycogen declined in fish at first day exposure period relative to controls. Their levels gradually elevated on 7 and 15 day exposure periods. From 15 day onwards their levels gradually declined and came nearer to control on 30 day exposure period. The percent change in glycogen content was more in liver than in muscle. The values were found to be significant (P<0.001).

Table 1: **Blood glucose levels** (mg/ 100 ml of Blood) in the fish 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 blood glucose levels at different periods was calculated in relation to the blood glucose levels in the control medium. The differences between control and exposure period days were found to be statistically significant (P < 0.001).

	Control	**Exposure period in days**				
		1 day	**7 day**	**15 day**	**20 day**	**30 day**
Mean	51.8	62.3	45.4	24.6	30.2	36.8
SD	0.36	0.42	0.54	0.44	0.36	0.62
PC		+20.27	-12.35	-52.50	-46.69	-28.95

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

Table 2: **Liver glycogen levels** (mg/gm wet. wt) in the fish 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 liver glycogen levels at different periods was calculated in relation to the liver glycogen levels in the control medium. The differences between control and exposure period days were found to be statistically significant ($P < 0.001$).

	Control	**Exposure period in days**				
		1 day	**7 day**	**15 day**	**20 day**	**30 day**
Mean	24.2	15.4	28.06	40.8	32.6	20.5
SD	0.58	0.32	0.56	0.34	0.44	0.18
PC		-36.36	+18.18	+68.59	+34.71	-15.28

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

Table 3: **Muscle glycogen levels** (mg/gm wet. wt) in the fish 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 muscle glycogen levels at different periods was calculated in relation to the muscle glycogen levels in the control medium. The differences between control and exposure period days were found to be statistically significant ($P < 0.001$).

	Control	**Exposure period in days**				
		1 day	**7 day**	**15 day**	**20 day**	**30 day**
Mean	2.62	1.86	2.76	3.10	2.68	2.24
SD	0.20	1.18	0.26	0.10	0.14	0.08
PC		-29.00	+5.34	+18.32	-2.29	-14.50

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

Discussion:

Carbohydrates are the immediate source of energy in the cells. They play a major role in the cellular metabolism by serving as fuel and providing energy to the cells. Fluctuations in oxygen consumption reflect fluctuations in energy demands of the animal, changes in carbohydrate metabolism that would meet the changing energy demands may be expected to stress (Lacerda and Sawaya, 1986; Santos and Nay, 1987). In vertebrates in general from fishes to mammals blood glucose level corresponds to the standard metabolic rate (Umminger, 1977).

In this study relative to controls the level of blood glucose elevated, where as the levels of liver glycogen and muscle glycogen declined on first day exposure. The elevation in blood glucose level followed by decrease in the levels of liver and muscle glycogen on first day exposure indicates the high energy demand associated with imposed deltamethrin stress. To overcome this animal tends to mobilize the blood glucose by stimulating the glycogenolysis. Some of the observations were also supports the present trend in the elevation in blood glucose level (Pant et al., 1987; Radaiah and Jayantha Rao, 1990; Nagendra reddy et al., 1991; Jayaprada et al., 1991; Somnath, 1991; Govindan et al., 1994; Anitha Susan et al., 1999; Luther Das et al., 1999; Kamble and Muley, 2000; Shoba rani et al., 2000; Sujay et al., 2001; Bhavan and Geraldine, 2002; Rawat et al., 2002; Tilak et al ., 2002; Jee et al., 2005; Thenmozhi, 2008; Muthukumarvel and Murthy, 2009; Visvanathan et al., 2009). All these studies shows that shifts in carbohydrates metabolism when animals are exposed to toxicants.

Similarly Tilak et al (2009) observed decrease in glycogen content in tissues of fish Channa punctatus on exposure to alachlor. Renuka and Andrews (2009) reported decline in liver glycogen and elevation in blood glucose level in the frog Euphlyctis hexadactylus on exposure to nuvacron. Sreenivasa and Indirani (2010) reported decrease in glycogen content in tissues of fish Oreochromis mossambicus on exposure to dimethoate. Lesley Sounderraj et al (2011) reported significant elevation in blood glucose level in the frog Rana trigrina on exposure to lethal and sublethal concentration of phosphomidon. Fahmy (2012) observed decreased carbohydrate content in the teleost fish Oreochromis niloticus exposed to malathion. Suneetha (2012) observed decrease in glycogen content in various tissues of Labeo rohita on exposure to sublethal concentration of endosulfan and fenvalerate. Pratap and Singh (2013) observed significant decrease in glycogen level in Channa punctatus on exposure to sublethal concentration of λ – cyhalothrin. Ram Yadav and Ajay Singh (2013) reported decrease in glycogen content in tissues of snail Lymnea acuminata exposed to plant pesticide. Arun Kumar and Jawahar Ali (2013) reported decrease in carbohydrate content in shrimp Streptocephalus dichotomus on exposure to sublethal concentration of malathion and glyphosate. Suneel kumar (2014) reported significant decrease in liver glycogen content in the fish Channa punctatus on exposure to nuvan.

Further more Nakano and Tomlinson (1967), Larsson (1973), Dalela et al (1981) and Asztalos et al (1990) have suggested that adrenal hormones like glucocorticoids and catecholamines may be induced by pesticides, elevate the blood glucose level by conversion of stored glycogen into blood glucose. Koundinya and Ramamurthy (1979) reported hyperglycemia accomplished by decrease in the levels of glycogen in the liver and muscle of fish Sarotherodon mossambicus exposed to sumithion. David et al (2005) suggested that carbohydrate metabolism disturbed when fish Labeo rohita exposed to pesticide fenvalerate. Israel Stalin and Sam Manohar Das (2012) reported initial decrease in liver glycogen content in various tissues and followed by its elevation in later exposure periods in the fish Cirrhinus mrigala on exposure to an organochloride fenthion. All these studies correlates initial elevation in blood glucose level followed by decrease in liver and muscle glycogen content.

Blood glucose level initially elevated on 1 day exposure followed by its inhibition on 7 & 15 day exposure periods. This is clearly evident by gradual elevation in liver glycogen and muscle glycogen up to 15day. In later half of exposure the blood glucose level gradually elevated and came nearer to control on 30 day exposure period, where as the levels of liver and muscle glycogen gradually decreased and came nearer to control at 30 day exposure period. Metabolic compensation involves break down and synthesis of products necessary to cope up with altered situations. In the present study the shifts in carbohydrate metabolism might have to compensate with situation shown by the fish for its survival.

Acknowledgement:

I express my sincere thanks and deep sense of gratitude to my teacher and research guide **Retired Prof. Md. Basha Mohideen**. I also express my sincere thanks to **Department of Zoology**, **SSBN Degree College**, Anantapuramu. I also express my sincere gratitude to **Dr. P. Ravi Sekhar** for his cooperation.

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