Research Article

Effect of Organophosphorus Nuvan on Some Aspects of Carbohydrate Metabolism in Fresh Water Fish *Labeo rohita* (Hamilton)

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ABSTRACT

Effect of sublethal concentration of Nuvan (0.011mg/ml) 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.

Keywords: Blood glucose, *Labeo rohita*, Liver glycogen and Muscle glycogen, Nuvan, Sublethal.

INTRODUCTION

Organisms and its environment are two integral and inseparable, entities of an ecosystem. In an ecosystem organisms are subjected to environmental changes some of which are manmade. To boost the agricultural productivity for the massive growth of population, pesticides and chemical fertilizers are put into use. 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] Now pesticides usage became an indispensible and integral part of world agriculture. Modern agriculture practices even though contributed to enhance crop production, but also widely polluted aquatic environment.[2] Agriculture practices along with pest control programmes, the surface runoff and aerial spraying forming the major source for translocating pesticides into aquatic ecosystems.[3-5]

The contamination of water by pesticides may effect on non - target organisms like fish.[6-8] The fish is a good indicator and highly sensitive in such ecosystem where the water gets contaminated with toxic chemicals. So an attempt was made on sublethal effect of nuvan on some aspects of carbohydrate metabolism in the fish *Labeo rohita*.

MATERIALS AND METHODS

Test Chemical

The pesticide selected for the present investigation was an Organophosphorus Nuvan. The active ingredient in Nuvan is Dichlorvos. It is widely used on diverse agricultural crops to control pests of crops, flies and mosquitoes. It has been widely used because of its degradability, non–persistent nature and low mammalian toxicity. Its commercial name was DDVP. Commercial grade was used and its effective concentration was 76%.

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 Nuvan ranging from 0.7 mg/ml to 1.4 mg/ml. 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[9] and were subsequently verified by Dragstedt and Behrens method as given by Carpenter.[10] After determination of LC 50/96 hrs (0.11mg/ml), the fish were exposed to sublethal concentration of Nuvan (1/10th of LC50/96hrs i.e. 0.011 mg/ml) for five exposure periods i.e 1, 7, 15 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 and 30 days of exposure to sublethal concentration of Nuvan 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*[11], liver glycogen and muscle glycogen were estimated by Colorimetric Anthrone method as described by Carrol *et al.*[12]

RESULTS

In the present investigation the levels of blood glucose, liver glycogen and muscle glycogen were estimated in the fish on 1, 7, 15 and 30 days of exposure to sublethal concentration of Nuvan 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 near 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 near 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 rohita* on exposure to sublethal concentration of Nuvan. 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	30 day
Mean	26.7	37.14	20.2	13.22	18.26
SD	0.82	0.65	0.72	0.54	0.68
PC		+41.91	-23.11	-49.48	-30.22

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

Table 2: **Liver glycogen levels** (mg/gm wet. wt) in the fish *Labeo rohita* on exposure to sublethal concentration of Nuvan. 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	30 day
Mean	18.06	13.36	22.51	24.47	13.16
SD	0.86	0.55	0.91	0.85	0.82
PC		-26.02	+24.64	+35.49	-27.13

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

DISCUSSION

Carbohydrates are essential component of living cells and are chief and immediate sources of energy for animals. 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.[13,14] In vertebrates in general from fishes to mammal's blood glucose level corresponds to the standard metabolic rate.[15]

Table 3: Muscle glycogen levels (mg/gm wet. wt) in the fish *Labeo rohita* on exposure to sublethal concentration of Nuvan. 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	30 day
Mean	1.22	1.02	1.29	1.42	0.81
SD	0.04	0.05	0.06	0.04	0.04
PC		-16.39	+5.73	+16.39	-33.60

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

In this study relative to controls the blood glucose level elevated, where as the levels of liver glycogen and muscle glycogen decreased 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 nuvan 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.[16-35] These entire studies shows shift in carbohydrates metabolism were observed when animals are exposed to toxicants.

Similarly Sreenivasa and Indiran[36] reported decrease in glycogen content in tissues of fish *Oreochromis mossambicus* on exposure to dimethoate. Lesley Sounderraj *et al* [37] reported significant elevation in blood glucose level in the frog *Rana trigrina* on exposure to lethal and sublethal concentration of phosphomidon. Fahmy[38] observed decreased carbohydrate content in the teleost fish *Oreochromis niloticus* exposed to malathion. Suneetha[39] observed decrease in glycogen content in various tissues of *Labeo rohita* on exposure to sublethal concentration of endosulfan and fenvalerate. Praveen *et al* [40] reported decrease in glycogen content in various tissues of fish *Labeo rohita* on exposure to sodium cyanide. Pratap and Singh[41] observed significant decrease in glycogen level in *Channa punctatus* on exposure to sublethal concentration of λ – cyhalothrin. Ram Yadav and Ajay Singh[42] reported decrease in glycogen content in tissues of snail *Lymnea acuminata* on exposure to plant pesticide. Arun Kumar and Jawahar Ali[43] reported decrease in carbohydrate content in shrimp *Streptocephalus dichotomus* on exposure to sublethal concentration of malathion and glyphosate. Roopavathy *et al* [44] reported decline in glycogen content in different tissues of fish *Oreochromis mossambicus* on exposure to malathion. Veeraiah *et al*[45] reported depletion in

glycogen content in tissues of fresh water fish *Cirrhinus mrigala* on exposure to lethal and sub lethal concentration of cypermethrin. Magar and Dub[46] reported that decrease in glycogen content in tissues of fish *Channa punctatus* on exposure to sublethal concentration of malathion. Suneel kumar[47] reported significant decrease in liver glycogen content in the fish *Channa punctatus* on exposure to nuvan. Manoj Deshpande *et al* [48] reported depletion in glycogen content in tissue of fresh water crab *Barytelphusa guerini* on exposure to sumidon.

In addition Nakano and Tomlinson[49], Larsson[50], Dalela *et al* [51] and Asztalos *et al* [52] 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[53] 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* [54] suggested that carbohydrate metabolism disturbed when fish *Labeo rohita* exposed to pesticide fenvalerate. Neeraja and Giridhar[55] reported decline glycogen content followed by elevation in blood glucose level in the fresh water fish *Labeo rohita* on exposure to deltamethrin. Bhattacharjee and Das[56] reported decline in glycogen content followed by elevation in blood glucose level in fish *Cyprinus carpio* on exposure to lindane. Lakshmanan *et al* [57] reported that depletion in glycogen content in different tissues followed by elevation in blood glucose level of fish Oreochromis mossambicus on exposure to Dichlorvos. Israel Stalin and Sam Manohar Das[58] 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 correlate 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 and 15 day exposure periods. This is clearly evident by gradual elevation in liver and muscle glycogen up to 15day. In later half of exposure period the blood glucose level gradually elevated and came near to control on 30 day exposure period, where as the levels of liver and muscle glycogen gradually decreased and came near to control at 30 day exposure period. Metabolic compensation involves break down and synthesis of products necessary to cope up with altered situations

CONCLUSION

In the present study the shifts in carbohydrate metabolism might be to compensate with situation shown by the fish for its survival to the imposed toxic stress.

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