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Studies on changes in muscle and liver glycogen in xylachlor induced fresh water teleostean fish, *Channa marulius*

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ABSTRACT

Studies on Xylachlor (a weedicide) induced changes in plasma and muscle glycogen content have been made in an air breathing fresh water murrel fish, *Channa marulius*. It was observed that Xylachlor at all the concentrations (1.0 to 2.5ppm) caused marked effect on the levels of plasma as well as muscle glycogen of the fish under experiment causing a gradual decrease in the value as compared to control upto 96hrs of treatment in both sexes; thus indicating the deteriorated nutrient value of the fish exposed to xylachlor. The reason and mechanism of such changes have been discussed here.

Figure : 00 References : 26 Table : 01

KEY WORDS : Fish, Glycogen, Liver, Muscle, Xylachlor.

Introduction

Weedicides have proved successful in the control of weeds in aquaculture system for better fish production. However, the production of increasing number of pesticides and herbicides has caused unprecedented ecological damage mainly through their effect on non target organisms including fish. The toxicity of weedicides may also affect the fish inhabiting the same pond or lake in the course of eradication of aquatic weeds. Aquatic weeds are unwanted vegetations ,if left unchecked, the water is posing a serious menace to pisciculture Weedicides have been successful in control of weeds in aquaculture system on one hand and health hazards in fishes on the other hand, Scanty reports are available on the effect of Linuron and Phosalone (both weedicides) on fish physiology but no body has made any study till now on the effect of xylachlor on fish physiology as such this is a new venture.The best way of eradication of weed in chemical as compared to mechanical, manual and biological. It is apprehended that xylachlor is damaging the roots of weeds but details are not available. Workers[26] have reported decrease in nutrient value in *Sarotherodon* mossembicus after their exposure to Thiodon and the same phenomenon can't be ruled out. The present work is an endeaver to evaluate the effect of Xylachlor on changes in the muscle and liver glycogen in an air breathing murrel fish, *Channa marulius*.

Material and Methods

Live specimens of *Channa marulius* were procured from local fish dealers at Patna. Fishes were transported to the laboratory, treated with $KMNO_4$ solution (0.1%) for few minutes and then transferred to glass aquarium. Unhealthy and injured fishes were rejected. Experiments were performed after a minimum acclimatization period of seven days in the laboratory. Before starting any experiment, toxicity values of Xylachlor (a weedicides, 2 chloro N (2, 3 dimethyl phenyl) N (1 methyl ethyl) acetamide) were calculated[3] and the experiments were conducted at sublethal concentrations (as illustrated in Table-1). Based on the probit analysis, LC_{50} values of Xylachlor for this fish were found to be 3.236, 2.570, 2.359 and 1.675, and 2.014 mg. respectively for 24, 48, 72, 96 and 120 hrs exposure. At the end of the Xposure periods (as indicaed in Table-1), the fishes were anaesthetized with 1 : 2500 MS 2222 (Triocane methane sulfonate, Sandoz) for two minutes. They were weighed, muscles and liver were quickly dissected out in the fish saline. The tissues were weighed to the nearest milligram on an electric digital monopan balance. Small pieces of the above tissues/organ were fixed and processed for biochemical studies. The quantitative estimation of glycogen of the fish, *Channa* marulius was determined[6] . The differences of significance, if any, between control and experimental fishes were calculated by Student's t test at the level of 5%.

Results

The data showing the effect of Xylachlor at different concentrations and hours of exposure on changes in muscle and liver glycogen in both the sexes of *Channa marulius* have been presented (Table-1). It indicates a gradual decrease in the level of muscle and liver glycogen from the controlled condition upto 96 hrs of Xylachlor treatment in both the sexes of *C. marulius* at all the concentrations and at each time intervals, which may be attributed to the increased production of catecholamines. The continued fall upto 96 hrs exposure exhibits the failure of the fish to adapt itself against the toxic effect of Xylachlor. It was observed that hyperglycemia in blood (in another related study) and decline in liver glycogen occur simultaneously under the stress of the weedicides.

Discussion

In the present investigation the biochemical investigation of liver and muscle glycogen showed marked depletion upto 96 hrs of Xylachlor treatment. Liver glycogen is probably the source of hyperglycemia and its depletion corresponded with the increases in blood glucose levels[14]. Decrease in glycogen may be attributed to an initial regulatory step which increase intermediary metabolism resulting in protection of hepatocytes. The interconversion of glycogen and glucose during toxicant treatment has been confirmed by many investigators[2,17].

A number of earlier studies also denote similar results in fishes exposed to various groups of pesticides, some of which need to be mentioned here to make the discussion more meaningful, logical and convicing.

Hyperglycemia in the fish *Heteropneustes fossilis* exposed to formothion was reported[24]. Similarly, increased blood glucose level accompanied by reduced tissue glycogen profiles in *Channa panctuatus* under chronic stress of sevin and endosulfan have also been observed[4] and there was reduction in hepatic glycogen[22] indicating impairment of carbohydrate metabolism in the freshwater climbing perch. *Anabas testudineus* treated sublethally and lethally with Furadan. Significant decrease muscle and hepatic glycogen in Lindane exposed fish *Heteropneustes fossilis* was noted[25] associated the same to stress induced increase in catecholamines. Similar opinion has been advocated earlier also[18]. Exposure to sub lethal and lethal doses of thiodon elicited a severe hypoxia in the fish *Sarotherodon mossambicus* resulting from utilization of stored glycogen by way of anaerobic glycolysis to meet energy demand during pesticide stress as evidenced by a fall in glycogen content of liver, muscle and heart[26]. There was decrease in muscle glycogen and an increase in blood glucose in the European eel[10], *Anguilla Anguilla* exposed to sublethal concentration of endosulfan. Activation of glycogen phosphorylase and depression of glycogen transferase as also the tissue acidosis might be possible reasons for glycogen decrease in fish tissues under toxicants stress[13].

There was decrease in carbohydrate content of *Labeo rohita* exposed to sublethal Monocrotophos[19]. An increase in blood glucose level in the cat fish *Carassius auratus* has been reported[5] and under Carbofuran exposure in *Labeo rohita* intoxicated with Cypermethrin[7]. Similarly, significant hyperglycemia was reported in *Labeo rohita*[21] under Chronic endosulfan exposure[20] and *Channa punctatus* under sublethal stress of Nuvan[23]. Similar results like the present one in tissue glycogen profiles were obtained earlier in *Labeo rohita* exposed to endosulfan[12] and in the freshwater fish *Puntius ticoto* exposed acutely and sub lethally to Dimethoate which has been attributed to hypoxia[9].

The observed hyperglycemic response in the present case may be due to cholinergic inhibition induced by the pesticides since cholinergic inhibitors also affect secondary adrenergic reactions. They might have blocked glucose receptors of pancreatic B cells making them non reactive and thereby raising the blood glucose level[24]. Further, reduction in calcium permeability at the level of cell membrane causing inhibition of insulin release might have induced hyperglycemia, since calcium is required for insulin secretion[16].

The mobilisation of tissue glycogen may be a consequence of energy demand under pesticidal stress for limiting the degree of hypoxia. Investigators[11] explained altered insulin, CAMP and bivalent cations responsible for elevated blood glucose and suggested that decreased level of cyclic AMP leads to reduced insulin release which may account for hyperglyermic effects. Contrary to the present findings, a few reports[1,22] showing hypoglycaemia are also available under pesticidal stress which may be attributed to relative toxicity of the substances used and the species specific response of the fish to the toxicants as also to hyperplasia of islets of Langerhans leading to excessive secretion of insulin[8]. The observed depletion of tissue glycogen level in the present case is attributed to hypoxia since it increased glucose consumption to meet higher energy demand during stress conditions by increased anaerobic glycogenolysis[20] possibly by increasing the activity of glycogen phosphorylase[9].

Thus, the present observations on tissue glycogen have been discussed at length and it is obvious that under exposure of Xylachlor there exists a high catabolic potency which ought to have serious consequences for general body metabolism and energy economy of the fish.

TABLE-1 : Showing muscle and liver glycogen (in g/100g wet weight) of *Channa marulius* at different concentrations and hours of treatment of Xylachlor. N=6; water Temp. 28.5±1.0^{0}C; ±=sem; * significant (P=<0.05); C=Control; X = Xylachlor; MG=Muscle glycogen; LG = Liverglycogen.

Concentration	Hrs of	Males		Females	
(Xylachlor)	Treatment	MG	LG	MG	LG
1.0 ppm	C	0.388	19.614	0.346	19.248
	24	0.368	19.114	0.332	18.967
	48	0.345	19.010	0.305	18.917
	72	0.342	18.799	0.302	18.674
	96	0.320	18.515	0.278	18.336
1.5 ppm	C	0.384	19.367	0.344	19.286
	24	0.364	19.026	0.325	18.791
	48	0.346	18.999	0.306	18.759
	72	0.306	18.652	0.305	18.177
	96	0.283	18.349	0.266	18.140
2.0 ppm	C	0.402	19.601	0.362	18.228
	24	0.370	19.076	0.330	18.949
	48	0.336	18.897	0.295	18.661
	72	0.317	18.593	0.277	18.393
	96	0.269	18.121	0.229	17.900
2.5 ppm	C	0.391±0.01	19.660±0.21	0.351±0.012	19.276±0.32
	24	0.347	19.201	0.307	18.897
	48	0.327	18.624	0.287	18.519
	72	0.300	18.165	0.260	17.965
	96	0.242±0.02*	17.400±0.31*	0.202±0.01*	17.190±0.01NS

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