Biological Forum — An International Journal, **3**(2): 65-68(2011)

ISSN No. (Print) : 0975-1130
ISSN No. (Online) : 2249-3239

Biochemical Changes Induced by Dimethoate in the Liver of Fresh Water Fish *Puntius Ticto* (HAM)

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(Received 23 November, 2011, Accepted 25 December, 2011)

ABSTRACT : Freshwater fish *Puntius ticto* was exposed to lethal (5.012 ppm) and sublethal (2.50 ppm and 1.253 ppm) concentration of Dimethoate for 96 hrs and 60 days durations. Biochemical changes in liver tissue were analyzed after exposure period. The protein level decreased in lethal and sublethal exposures. Significant decrease in glycogen, slight decrease in protein where as increased cholesterol and ascorbic acid content has been noted to both concentrations exposure.

Keywords : Protein, Glycogen, Cholesterol, Ascorbic acid, Dimethoate, Puntius ticto.

INTRODUCTION

Man has attempted to increase the world's food production to solve the problem of malnutrition. He achieved this by increased use of fertilizer to nourish the plant and by increased use of pesticides to protect them from pests. Recently a large quantity of pesticides and fertilizers are used to nourish the plants and food production. These chemical have entered into the aquatic system and create pollution, which pose a great threat to aquatic organisms. There are several reports regarding the effects of pesticides (Arunachalam et.al., 1985) on physiology of fish. The pesticides used in pest control programmes also produce many physiological and biochemical changes in freshwater organism particularly the fish (Girija 1984). Although some data available on the effects of different pesticides on the biochemical aspects of fish gill. The alteration in biochemical contents in different tissues of fish is due to toxic effects of different heavy metals and pesticides have been reported by many workers (Saxena et.al., 1989, Khan et.a., 1992, Virk and Sharma 1999, Rawat et.al., 2002). Results of controlled laboratory exposures of fish to pesticides and related chemical have revealed that liver is often the organ with highest pesticides concentrations (Duke and Wilson 1971). Although more than 900 commercial pesticides are in general use, fewer than 30 have been examined for their adverse effects on fish liver (Pimental et.al., 1971& Gupta 1986).

A very little work has been done on the biochemical changes in liver of Puntius ticto. Hence the present attempt has been made to study the effect of Dimethoate toxicity on the biochemical contents of liver of freshwater fish Puntius ticto (Ham).

MATERIAL AND METHODS

Puntius ticto, freshwater fish were collected from freshwater sources around Aurangabad city (M.S. India). Fishes were brought to laboratory and kept in aquaria for a week using aged water for acclimatization. During acclimatization they were fed on alternate days with pieces of live earthworms. The Lc 50 values are determined by following the guideline given by Finney (1971) and Anon (1975). The acclimated fishes were exposed to lethal concentration (5.012 ppm) for 96 hrs for 60 days. Simultaneously a control group of healthy fishes were maintained under identical conditions. The fishes were sacrificed immediately at the end of exposure period and liver was isolated and used to investigate biochemical contents under Dimethoate stress. Protein content was estimated by Follin phenol reagent method (Lowry et.al., 1951), Glycogen content was analyzed by using Anthrone reagent method (De zwaan *et.al.*, 1972), Cholesterol content was analyzed by the method described by Kolmer et.al, (1969) and ascorbic acid content was estimated by the method described by Roe J.H. (1967).

RESULTS AND DISCUSSION

The results obtained in the present investigation are summarized in Table 1 and Graph 1. Liver is the primary organ for detoxification (Hulterer *et.al.*, 1969) and hence it is expected that toxicant could reach there for detoxification and disposal. This results in structural changes in the liver, the arrangement of hepatic cords leading to the alteration of liver metabolism and its biochemical content. The pollutants acts as one kind of stress and organism respond by developing necessary potential occurring in body give first indication of stress. During stress as organism needs sufficient energy which is supplied from reserve food material *i.e.* protein, glycogen, cholesterol etc.

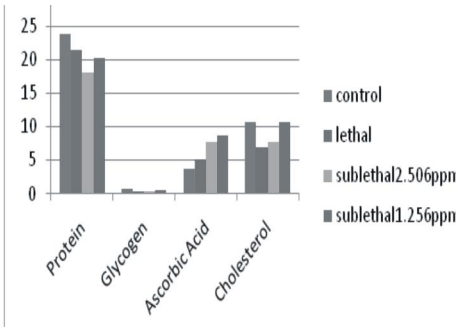
Decrease in the protein content was observed throughout the exposure period. The two sublethal exposure results shows the protein content decreases are depend upon the concentration. There is progressive decrease in the protein content with increase in concentration. The toxicity of dimethoate showed a direct correlation with the concentration and time exposure. Similar observation has been observed by Singh and Bhati (1994).

Table 1: Biochemical changes induced by dimethoate in the liver of *Puntius ticto* (HAM).

S. No.	*Parameters*	*Control*	*Lethal (5.012 pm)*	*% change*	*Sub-lethal (2.506 ppm)*	*% change*	*Sub-lethal (1.253 ppm)*	*% change*
1.	Protein	23.9298	21.5368*	–10.00	18.2368***	–23.790	20.3017**	–15.126
		± 1.0942	±0.4632		±0.2895		±0.3537	
2.	Glycogen	0.7220	0.3374***	–53.27	0.3771***	–47.77	0.5756***	–20.28
		±0.0155	±0.0595		±0.0227		±0.0149	
3.	Cholesterol	10.8952	7.0190**	–35.57	7.7523	–28.84	10.8952	00
		±1.0476	±0.5238		±1.0476		±1.0476	
4.	Ascorbic Acid	3.8847	5.1728	33.16	7.7695	100.00	8.7918	126.32
		±0.5111	±0.0511		±1.0223		±1.0223	

The values are expressed in mg/100 mg dry weight (mean ± S.D.)

* = P < 0.05; ** = P < 0.01; *** = P < 0.001.



Decrease in protein may be due to the impairment of protein synthesis or increase in the rate of its degradation to amino acids. This may be fed to TCA cycle through aminotransferase probably to cope with high energy demands in order to meet the stress condition. The decrease in proteins might be due to their utilization in cell repair and tissue organization with the formation of lipoproteins, which are important cellular constituents of cell membranes and cell organelles present in cytoplasm (Harper 1983). The decrease in protein content as a result of toxicity stress has already being reported by Borah and Yadav (1995) and Muley *et. al.*, (2007). Singh (1988) reported reduction in protein content of liver of Clarias batrachus in response to Malathion and Y-BHC. Saxena et.al., (1989) attributed the decrease in protein content due to decreased protein synthesizing capacity of liver of Channa punctatus exposed to carbaryl and malathion. Jones and Kumar (1996) also observed decline in protein content in liver of Etrophis maculates under Ekalux stress. Choudhary and Gaur (2001) observed decline in liver protein of Cyprinus carpio under sodium fluoride stress. Shobha *et. al.*, (2007) reported decrease in protein, glycogen and lipid contents in the liver of freshwater fish, Catla catla under Cadmium Chloride stress.

The decrease in protein liver during dimethoate exposure may be due to increased catabolism (Ghousia Begum and Vijaya Raghawan 1995) and decreased anabolism of proteins (Khare and Singh 2002). The loss of protein under pesticidal stress condition noticed in the present study may be due to the utilization of amino acids in the various catabolic reactions (Jones and Kumar 1996). Decrease in protein content may be due to increased proteolysis (Muley *et. al.*, 2007) or it may be due to metabolic utilization of the ketoacids to glucogenesis pathway for synthesis of glucose (Schmidt Nielson, 1975).

The alteration in protein value may also be related to some structural changes in the liver, the arrangement of hepatic words leading to the alteration of liver metabolism. The decrease in liver protein is also attributed to the inhibition of protein synthesis.

Liver glycogen content decreased progressively during exposure period, this may be due to toxic stress. During stress an organism needs sufficient energy which is supplied from reserved glycogen. Glycogen is stored in the organism mainly in the liver and muscles in the form of carbohydrate. It may provide a reserve food for acute demands recurring as a result of transient stress (Love 1980). A fall in the glycogen level clearly indicates its rapid utilization to meet the enhanced energy demands in fish exposed to toxicants through glycolysis or hexose monophosphate pathway. It is assumed that decrease in glycogen content may be due to the inhibition of hormones which contribute to glycogen synthesis. Radhaiah et.al., (1987) observed decreased carbohydrate content in heptachlor intoxicated fish Tilapia mossambica and stated this may be due to the rapid utilization of carbohydrates by the tissue possibly to overcome the pesticides induced stress. James and Sampath (1995) observed decreased liver glycogen in the Heteropneustes fossilis (Bloch) under mixtures of copper and ammonia and reported glycogenolysis releasing glucose in to the circulatory system to meet increased energy demand during stress conditions Susan *et. al.*, (1999) observed drastic decreased glycogen content in liver of Catla catla under fenvalerate toxicity stress. Rawat et.al. (2002) have reported continuous decrease in quantity of glycogen in the liver of Heteropneustes fossilis exposed to endosulfan. Tiwari and

Singh (2009) observed decrease in total protein and glycogen in the liver of Colisa fasciatus, exposed to ethanolic extract of Nerium indicum mill latex.

Decrease in the glycogen level in liver suggests the possibility of glycogenolysis. A study indicating such depletion in fish models (Mishra and Srivastava 1984) during organophosphorus toxicity offers an excellent support to the decreasing levels of glycogen in the present study.

Cholesterol content was decreased in liver during exposure period. It might be possible that dimethoate causes general damage and structural changes in liver and it leads to effect on capacity of liver to store cholesterol. Khan *et. al.*, (1992) observed significant decrease of cholesterol in liver of Cd treated fish Garra mullya and stated in may be due to general damage in liver. Shakoori *et. al.*, (1996) studied effect of sublethal dose of fenvalevate on the liver of fish Ctenopharyngodon idella and observed decreased level of cholesterol. Virk and Sharma (1999) studied biochemical changes induced by nickel and chromium in the liver of Cyprinus carpio and observed significant decline in the cholesterol level of liver and stated this may be due to toxicity stress which suppresses the activity of a number of enzymes responsible for lipid transformation ultimately causing disturbance in lipid metabolism and leads decrease in values of cholesterol.

Ascorbic acid content plays an important role in detoxification of the foreign bodies or toxicants in metabolic process. The main process of detoxification takes place in liver and is also the main site where ascorbic acids are synthesized. Due to pesticidal stress significant increase in ascorbic content was observed in liver of Puntius ticto during present study.

Bhusari (1985) observed increased amount of ascorbic acid in liver of Barbus ticto during endosulfan, ekalux and sevmol exposure. Davane (1991) observed increased level of liver ascorbic acid in T. Sandkhol to dimethoate, thiodon and carbaryl. The liver is the main site of detoxification and having large amount of ascorbic acid. This type of observation is also made by Somasundaram *et. al.*, (1978). The ascorbic acid plays a role directly related to homeostatic mechanism and is essential for wound healing and regeneration. Gould (1963) Shah *et. al.*, (1971) several investigations have reported protective affects of ascorbic acid against the toxicity of various environmental chemicals Padhi and Pathaik (1978). Due to this factor ascorbic acid content must have been increased in liver of Puntius ticto under dimethoate toxicity stress.

ACKNOWLEDGEMENT

I am very much thankful to the Prof. and Head, Department of Zoology Dr. Babasaheb Ambedkar Marathwada University, Aurangabad for providing laboratory facilities.

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