Bull. Environ. Contam. Toxicol. (1994) 53:149–152

Environmental Contamination and Toxicology

Evaluation of Liver Protein Due to Stress under 2,4-D Intoxication in *Channa punctatus* (Bloch.)

S. Singh, D. P. S. Bhati

Department of Zoology, Institute of Basic Sciences, Khandari Agra University, Agra-282002, India

Received: 1 February 1993/Accepted: 6 January 1994

Pesticides are being used globally on an increasing scale (Singh and Srivastava 1984). In India use of these chemicals is steadily increasing and is expected to register the projected estimate of 149-795 tones by 1983-84 (Gupta and Gupta 1976). The persistence and ubiquitous nature of organochlorines, organophosphates and carbamates, coupled with their tendency to concentrate the non-target organism through the food chain, ultimately produce toxicity to fish, birds, wildlife and in turn to man.

The present investigation evaluates the toxicity of the weedicide, 2,4-D on the biochemical alterations of the total protein in the liver of Channa punctatus (Bloch.).

MATERIALS AND METHODS

Full grown specimens of Channa punctatus (Bloch.) measuring 12-15 cm in length and 29-65 g in weight were selected for the present study. They were acclimatized at the room temperature in glass aquaria (75 cm x 37.5 cm x 37.5 cm) containing 10L non-chlorinated tap water.

2,4-Dichlorophenoxyacetic acid, a common weedicide containing 80% active ingredient was used. It is moderately toxic to human being, wildlife and aquatic animals, but highly toxic to the weeds.

The median tolerance limit was evaluated by using short term static bioassay method (Standard method, APHA, AWWA and SPCR 1971). The protein content was estimated by the method described by Lowry et al. (1951).

RESULTS AND DISCUSSION

C. punctatus were exposed to 1125, 1250, 1375, 1500, 1625 and 1750 ppm of 2,4-D for 24, 48, 72 and 96 hr, and the survival number and survival percentage were recorded.

Correspondence to: S. Singh

The statistical analysis showed that the change in the survival number is significant in relation to exposure time and concentration of 2,4-D. There is a corresponding decrease in the survival percentage with the increase in concentration and exposure time. The TLM values recorded are 1687.5, 1437.5, 1250.0 and 1212.5 ppm for 24, 48, 72 and 96 hr respectively. The sub-lethal concentrations of 2,4-D weedicide-600 ppm and 800 ppm, were selected for the present study.

On exposure to the sub-lethal concentrations of 2,4-D the fish exhibited erratic swimming ability and difficulty in respiration prior to death. The rapid opercular and irregular jerky movements of the body were observed. During exposure to the sub-lethal concentrations the fish secreted excessive mucous. The body colour gradually becomes lighter with the increase in the exposure time. In contrast, the control fish exhibited normal respiratory and opercular movements.

Table 1, Protein content in the liver of C. punctatus in control and experimental conditions.

Exposure time	Concentration of 2,4-D			
	600 ppm		800 ppm	
	protein content	Alteration %	Protein content	Alteration %
24	6.80±0.31[a]	15.73	4.69±0.15[a]	41.88
48	5.87±0.48[a]	27.26	4.14±0.28[a]	48.69
72	4.30±0.56[a]	46.71	3.70±0.36[a]	54.15
96	3.35±0.56[a]	58.48	3.15±0.43[a]	60.96
Control set	8.07±0.59	-	8.07±0.15	-

Values are mean ± of 5 individual observations
a = $p < 0.001$
b = $p < 0.05$
c = $p < 0.01$
Protein content in mg/g tissue weight
± = Standard Error.

The mean value of total protein content in liver of control set of C. punctatus is 8.07±0.59 mg/g (Table-I). In an experimental group at a concentration of 600 ppm there is a progressive decrease in the protein content with increase in exposure time. The values recorded are 6.80 mg/g, 5.87 mg/g, 3.40 mg/g and 3.35 mg/g at 24, 48, 72 and 96 hr respectively (Table-I). The statistical analysis showed that the changes recorded in the values of protein content for different exposure time are very highly significant ($P < 0.001$).

Similarly at 800 ppm a significant decrease in protein has been noted. The values recorded are 4.96 mg/g, 4.14 mg/g, 3.70 mg/g and 3.15 mg/g at 24, 48, 72 and 96 hr respectively (Table-I). The statistical analysis showed that the change in the protein content is very highly significant ($P<0.001$) for each exposure time.

The toxicity of 2,4-D showed a direct correlation with the concentration and time exposure. Similar observations have been made by Leung et al. (1981) in paraquat and diquat exposed copepods and by Ramalingam and Ramalingam (1982) in DDT and malathion exposed Sarotherodon mossambicus.

The average value of the protein content in liver of C. punctatus is 8.07 mg/g which is lower than that reported by Murthy and Devi (1982) in Channa punctatus and Murthy et al. (1986) in Tilapia mossambicus. A decrease in the protein content has been recorded by Schaffer (1967) in Leuciscus cephalus after exposure to certain pesticides; Mehrle et al. (1971) in Salmo quirdneri with DDT and dieldrin; and Sakaguchi and Hamaguchi (1975) in yellow tail injected with carbon tetrachloride.

Thus the sub-lethal concentrations of 2,4-D change the behaviour of Channa punctatus and a decrease in liver protein content. The change in protein content may be due to damage caused to hepatic tissue (Hilmy et al., 1985) and increased proteolysis (Kabeer et al., 1978).

REFERENCES

APHA AWWA SPCR (1971) Standard method for the examination of water and waste water. 15th ed Am Publ Hlth Assoc Washington.

Gupta PK Gupta RC (1976) Pollution and Health, hazards in pesticides use: a review of the problem. UP Vet J 4: 128-144.

Hilmy AM Shabana MB Daabees a y (1985) Effect of cadmium upon in vivo and in vitro activity of protein and five enzymes in blood serum and tissue homogenate of Mugil cephalus. Comp Biochem Physio Co Comp Pharmacol Toxicol 81(1): 145-154.

Kabeer ASI Begum R Sivaish S Rao KVR (1978) Effect of malathion on free amino acids, total glycogen and some enzymes of Lamellidens masqunalis. Proc Ind Acad Sci 37(B): 377-380.

Lowry OH Rosebrough NJ Farr AL Randall RJ (1951) Protein measurement with the folin-phenol reagent. J Biol Chem 220: 265-275.

Leung TS Naqvi M Haqvi NZ (1980) Toxicity of paraquat and diaquat herbicide to fresh water copepods (Diatomous sp. and Encylops sp.). Bull Environ contamn Toxicol 25: 918-920.

Mehrle PM Stalling DL Bloomfield (1971) Serum amino in rainbow trout Salmo quairdneri as affected by DDT and dieldrin. Comp Biochem Physiol 38: 373-377.

Murthy AS Devi AP (1982) The effect of endosulfan and its isomers in tissue protein, glycogen and lipid in the Channa punctatus. Pest Biochem Physiol 17: 208-286.

Murthy BN Prasad KS Madhu Rao KVR (1986) Toxicity of lindane to fresh water fish Tilapia mossambicus. Env Ecol 4(1): 20-25.

Ramalingam K Ramalingam K (1982) Effect of sub-lethal levels of DDT, malathion and mercury on tissue protein of Sarotherodon mossambicus. Proc Ind Acad Sci 91(6): 501-505.

Sakaguchi H Hamaguchi A (1975) Physiological changes in the serum and hepatopancreas of yellow tail injected with carbon tetrachloride. Bull Jpn Soc Scient Fish 41: 283-290.

Schaffer R (1967) The effect of pollutants on the free amino acid content of the fish Leuciscus cephalus. Rev Biol 59: 385-407.

Singh NN Srivastava AK (1984) Toxicity of a mixture of aldrin and formathion and other Organophosphorous, Organochlorine and carbamate pesticides to the Indian catfish, Heteropneustes fossilis. Comp Physiol Ecol 9(1): 63-66.