Toxicity of Endosulfan on Total Lipid and Protein of Liver, Kidney and Gonads of Fish *Channa punctatus* (Bloch.)

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Abstract

The current study includes the toxicity effect Endosulfan on fish. The alterations induced by chronic (30 days) exposure of the fish Channa punctatus to a sublethal concentrations (0.01 ppm conc.) of Endosulfan on the profile of total protein and lipid in the liver, kidney and gonads. The liver and kidney showed significant depletion of total protein content amounting. Estimation of total lipid was recorded significantly. The present study therefore points towards a severe metabolic dysfunction in response to Endosulfan toxicity in the fish Channa punctatus (Bloch.)

Keywords: Endosulfan, *Channa punctatus*, Toxicity, Protein contents, Lipid contents.

INTRODUCTION

Organochlorine insecticides have strong insecticidal properties and broad applications due to their low cost of large scale production. However, some organochlorine pesticides have been banned due to their persistent residual characteristics and unexpected toxicities to non-target organisms in the environment, (Jonsson, *et.al.*, 1993). While much less persistent than other organochlorines, endosulfan is known to be neurotoxic and highly toxic to fish (Sharma, *et. al.*2011). In addition, this compound at the concentration of 1 μg L^{-1} has been shown to be genotoxic to fish, affecting reproduction (Dutta *et.al.*, 2006). Endosulfan is one of 123 pesticides that have been listed as potential endocrine disruptors (Mckinlay *et.al.*, 1993). Even though endosulfan is highly toxic to aquatic life, it is still being used in many countries. Therefore, methods for the fast and low cost assessment of the adverse effects of endosulfan in aquatic ecosystems need to be developed. Accurate and precise techniques have elucidated the unknown toxic effects of compounds, including endosulfan (Park DS, *et.al.*, 2015). Its toxicity to fish has been reported at LC_{50} values lower than those of terrestrial animals (Chow *et.al.*, 2013).

The fish, *Channa punctatus* (Bloch), locally known as "Garai", having the presence of suprabranchial accessory respiratory organs, an air-breathing teleost and endosulfan were selected for present study.

MATERIALS & METHODS

The air-breathing teleost *Channa punctatus* procured live from the local fish market were washed with 0.1% $KMnO_4$ solution to remove dermal infection if any. Healthy fish of average length (9–12cm) and weight (21–25 g) were acclimated for 15 days to laboratory conditions. The fish were fed with chopped goat liver every day adlibitum. Running tap water was used in all the experiments and the fish were adjusted to natural photoperiod and ambient temperature. No aeration was done.

Static acute bioassays were performed to determine LC_{50} values of endosulfan for 24, 48, 72 and 96 hours following the methods of APHA, AWWA & WPCF (1985). The LC_{50} values for these periods were 8.25 ppm, 6.25 ppm, 4.25 ppm and 3.25 ppm respectively. The sub-lethal concentration was determined following the formula of Hart *et al.* (1945). Twenty acclimated fish were exposed to a sub-lethal concentration (0.01 ppm) of endosulfan for 30 days. Side by side same number of fish as that of experimental one was maintained as the control group. At the end of exposure period the fish were anaesthetized with 1:4000 MS 222 (tricane, methane, sulfonate, sandoz) for two minutes. The liver, kidney, testis and ovary were quickly dissected out, weighed to nearest mg and processed for the quantitative estimation of total protein by the methods of Varley *et al.* (1980). The total lipid extraction was done by done by the method Folch *et. al.* (1957).

RESULTS

The protein profiles of liver, muscle, testis and ovary in response to endosulfan exposure showed a significant decline. The liver and kidney showed statistically more significant decline. The liver and kidney showed statistically more significant ($P < 0.001$) decline i.e. 31% in , while 30% in liver. The testis showed significant ($P < 0.05$) while ovary showed significant at ($P < 0.01$). The testis showed decline 19% while ovary 17%. Total protein in the control liver, kidney, testis and ovary was estimated to be 102.19±1.81, 75.006±1.04, 80.48±1.41, and 121.01±1.89 respectively. As against there, the total protein profiles in the experimental lots were 50.08±1.96 , 45.08±0.01, 60.16 ± 0.98 and 70.08±0.01 respectively (Table-I).

TABLE – I

Profiles of total protein (mg/g wet tissue) in tissue of *Channa punctatus* chronically exposed to endosulfan for 30 days. Values are mean ± SE 0f 5 observations.

Tissue	Control	Endosulfan treated
Liver	102.19±1.81	50.08±1.96
Kedney	75.006±1.04	45.08±0.01
Testis	80.48±1.41	60.08±0.01
Ovary	121.01±1.89	70.08±0.01

Value are mean ± SE of 5 observations, Significant level =P<0.05

The estimation of total lipid was recorded significantly decreases under the experimental concentration and duration of endosulfan exposure, and was to be 70.08±0.01 mg/g in liver, 18.49±0.83 mg/g in kidney, 12.54±0.77 mg/g in testis and 16.05±0.66 overy.

TABLE – II

Profiles of total lipid (mg/g wet tissue) in tissue of *Channa punctatus* chronically exposed to endosulfan for 30 days. Values are mean ± SE 0f 5 observations.

Tissue	Control	Endosulfan treated
Liver	28.10±1.56	15.40±.56
Kedney	20.68±1.17	18.49±0.83
Testis	16.74±0.72	12.54±0.77
Ovary	21.19±0.97	16.05±0.66

Value are mean ± SE of 5 observations, Significant level =P<0.05

DISCUSSION

The level of tissue protein and lipid in control fish recorded in the present study indicates that total proteins and lipids are the largest contributors to the wet weight of the tissues after water. Previous workers have also reported decline in tissue protein profiles in a number of fish species exposed to various pesticides and endosulfan. Ramalingam and Ramalingam (1982) noted a steady decline in the total protein of liver and muscle after 7 and 15 days exposure of the fish, *Sarotherodon mossambicus* to malathion and mercury and correlated it with an intensive proteolysis. Similarly, a significant decrease in the protein content was recorded by Kumar and Ansari (1984) in the Zebra fish, *Brachydanio rerio*, exposed to malathion and suggested inhibition of protein synthesis by the toxicant. Proteins being involved in the architecture and physiology of the cell seem to occupy a key role in the cell metabolism. The observed significant depletion of tissue protein in the present case denotes high catabolic potency of those organs and may be attributed to the intensive proteolysis and utilization of their degradation products for metabolism under the toxic influence of Herbiclon. They might have been fed into TCA cycle through aminotransferase system to cope with the excess demand of energy during stressful situations as suggested by Jha (1991). The loss of gonadal proteins may also be associated to the direct action of pyrethroids leading to arrest of vitellogenesis in ovary and loss of germ cells in testis (Jha and Jha, 1995). Moreover, the decreased protein contents might also be attributed to the tissue destruction, necrosis, or disturbance of cellular function and consequent impairment in protein synthetic machinery (Srivastava, *et al*., 1995). The liver of *Clarias gariepinus* exposed to the cypermethrin showed hyperplastic hepatic and necrosis of hepatic cells (Andem A. B. *et al.* 2016). The toxicity was found to increase with endosulfan concentration, various structural changes were already induced on the morphology of the vital organs, i.e. gill, liver and kidney even with exposure to low, sublethal endosulfan concentration (Nordin, *et. al*. 2018).

The estimation of total lipid was recorded significantly decreases under the experimental concentration and duration of endosulfan exposure. Previous workers have similar reported decline in total lipid of different tissue profiles in a number of fish species exposed to various pesticides and endosulfan. The decrease might have occurred mainly due to altered lipid metabolism and energy demand in fishes under stress of toxicants.

CONCLUSION

The test fish *Channa punctatus* when exposed to sub lethal concentration of endosulfan (0.01 ppm) for 30 days, significant decrease in total lipid and total protein content in the tissue of all four organs, liver, kidney, testis and ovary. The decrease might have occurred mainly due to altered lipid and protein metabolism and energy demand in fishes under stress of toxicants.

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