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Toxicity analysis of a synthetic pyrethroid insecticide on protein content of fresh water catfish

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ABSTRACT

Laboratory analysis was made to check the toxicological effect of cypermethrin on fresh water catfish (*Clarias batrachus*). Exposure of (LC 50) sub-lethal dose of cypermethrin resulted significant alterations in protein content in various tissues of fish. At sub-lethal concentration cypermethrin resulted alterations in total protein, as in muscles (-13.95%), in liver (-27.58%), in intestine (-16.88%) and in gills (-13.72%). Highest reduction of protein content level was recorded (-27.58%) in liver 0.029 µl/100mg dry weight. Cypermethrin has shown strong piscicidal capacity against selected catfish and adversely affected the protein content.

Keywords: *Clarias batrachus*, Cypermethrin, Toxicology, Catfish

1. INTRODUCTION

Walking catfish, scientifically named as Clarias batrachus, is a freshwater air-breathing catfish reported majorly in Southeast Asia. Clarias batrachus is named as walking cat fish, for its ability to crawl on dry land in search of food or suitable environments. Walking cat fish prefers slow-moving and stagnant waters in ponds, swamps, streams and rivers and temporary pools. Clarias batrachus is generally considered to be one of the most important catfish species for aquaculture as well as for its economic value as food in almost all over India. Now a day's attempts have been increased to elevate food production by use of pesticides and insecticides. Such chemicals enter into the aquatic ecosystem and cause pollution. Several investigations regarding the effects of insecticides and pesticides (Arunachalam et al., 1985) on physiology of fish have been reported so far. The changes in biochemical content in different tissues of fish, due to toxic effects of insecticides have been recorded by previous researchers (Saxena et al., 1989; Khan et al.,1992; Virk and Sharma, 1999; Rawat et al., 2002).

Cypermethrin is a synthetic pyrethroid insecticide used to control many pests, including moth pests of cotton, fruit and vegetable crops. Cypermethrin is a moderately toxic material by dermal absorption or ingestion. It may cause irritation to the skin and eyes. Symptoms of dermal exposure include numbness, tingling, and itching, burning sensation, loss of bladder control, in-coordination, seizures and rare possibility of death. Pyrethroids may adversely effect the central nervous system.

According to Neuhold & Sigler (1960) cypermethrin accumulation in aquatic environment caused decline of fishery production. As per previous studies, habitats of fishes have been found to have measurable accumulation of cypermethrin. Since the cypermethrin content in water bodies is increasing day by day due to increased uses at domestics and industrial level, it has become a serious threat to aquatic ecosystem.

In present investigation, researchers studied the toxicity responses induced by cypermethrin, on freshwater cat fish, *Clarias batrachus* and recorded adverse impact on the protein content in various tissues.

2. MATERIALS AND METHODS

Specimens of *Clarias batrachus* were collected with the help of local fishermen and kept in holding tanks for a seven days using aged water for acclimatization. During acclimatization they were fed every day. The acclimated fishes were exposed to sub-lethal dose of cypermethrin (0.176 µg/l) (Tiwari *et al.*, 2012) for 14 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 muscles, liver, intestine and gills were extracted and used to investigate biochemical contents under toxicant stress. Protein content was estimated by Follin phenol reagent method (Lowry *et al.*, 1951).

3. RESULTS

Catfish *Clarias batrachus* was selected for the examination. The analysis was done to measure the effect of toxicant cypermethrin. Selected fishes were exposed to toxicant at sub-lethal concentration at repeated dose for 14 days. Effect of toxicants was observed in liver, gill, muscles and intestine by their protein content estimation (table 1).

During the study of protein content analysis, variations in protein content were reported. At sub-lethal concentration cypermethrin resulted alterations in total protein, as in muscles (-13.95%), in liver (-27.58%), in intestine (-27.58%) and in gills (-13.72%). Highest reduction of protein levels was recorded in liver 0.029 µl/100mg dry weight (-27.58%). Selected toxicant, cypermethrin resulted toxicity in the form of protein depletion in the liver of catfish as 0.029 µl/100mg dry weight. Therefore investigation of toxicants has a diagnostic significance in evaluating negative effect of pesticides to fresh water fishes (Fig 1-2).

4. Discussion

Liver is the major organ for detoxification (Hulterer *et al.*, 1969) and it is expected that toxicant may reach liver cells for detoxification and excretion. Current situation may result the structural changes in the liver, may also lead the alteration of liver metabolism and biochemical content. The toxicants may acts as a stress and fish may respond by developing necessary changes occurring in body, these changes may be used as bio-markers of stress. Reduction in the protein content was reported during the complete exposure period. The sub-lethal exposure of cypermethrin shows the protein content reduction, this reduction of protein content showed a direct correlation with the depletion of protein. Such depletion of protein content occurred, may be due to the impairment of protein synthesis or may be increase in the rate of its degradation to amino acids. According to Harper (1983) protein content alterations may occur due to the 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. Similar reduction in protein content due to the toxicity stress was 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. Rawat (2002) also observed decline in protein content in liver of *Etrophis maculates* under Ekalux stress. Borah & Yadav (1995) reported decrease in protein, glycogen and lipid contents in the liver of freshwater fish, *Catla catla* under Cadmium Chloride stress. In present study, similar results were recorded supporting the previously available data.

Table 1. Changes in protein content induced by Cypermethrin in *Clarias batrachus.*

Control (µl/100mg dry weight)	**Sub-lethal** (µl/100mg dry weight)	**Protein depletion (%)**
Muscles		
0.049±0.007	0.043±0.011	(-)13.95%
Liver		
0.037±0.021	0.029±0.016	(-)27.58%
Intestine		
0.090±0.015	0.077±0.007	(-)16.88%
Gills		
0.153±0.015	0.132±0.006	(-)13.72%

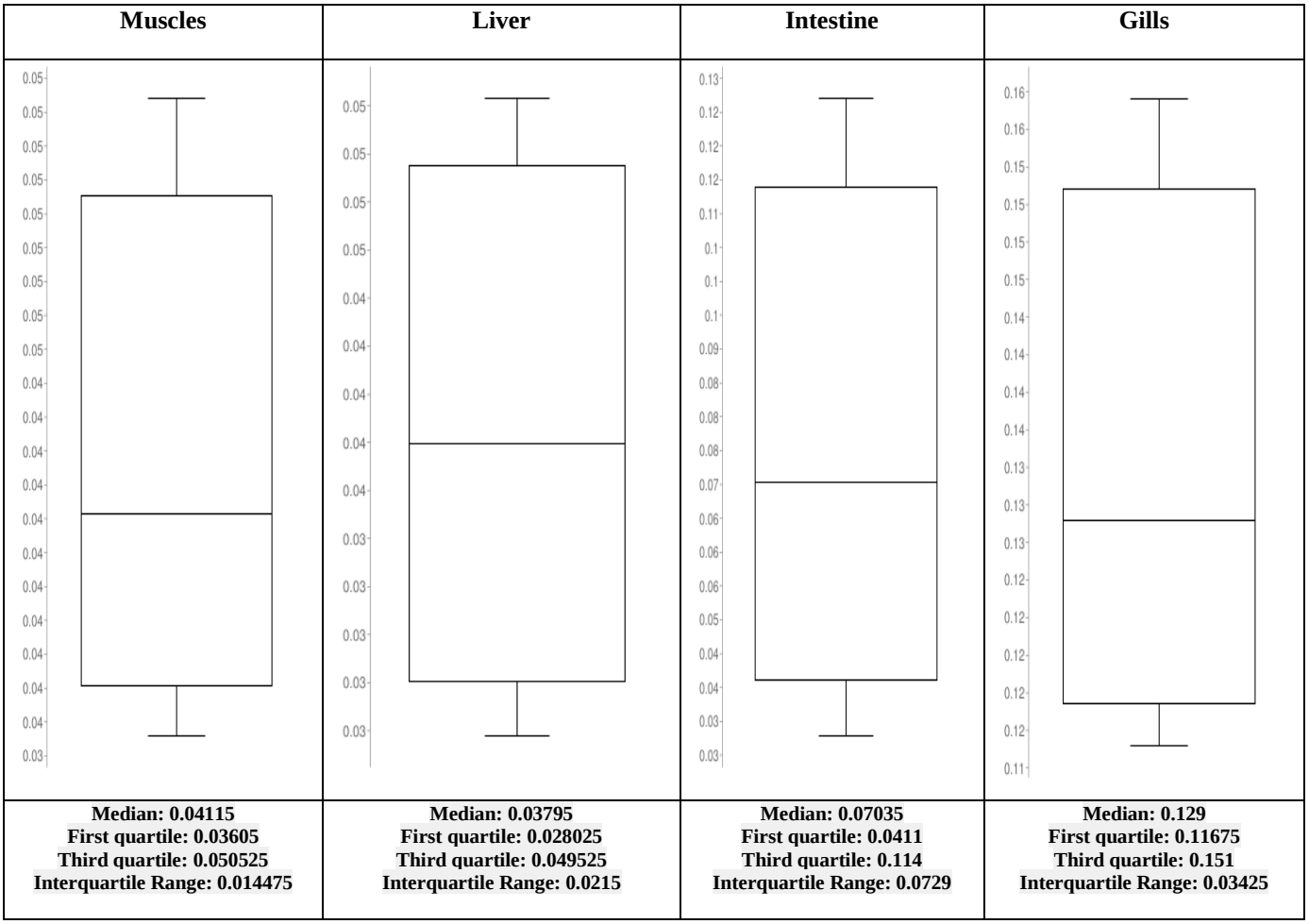

Figure 1. Box-plot analysis of protein content at sub-lethal dose in *Clarias batrachus*

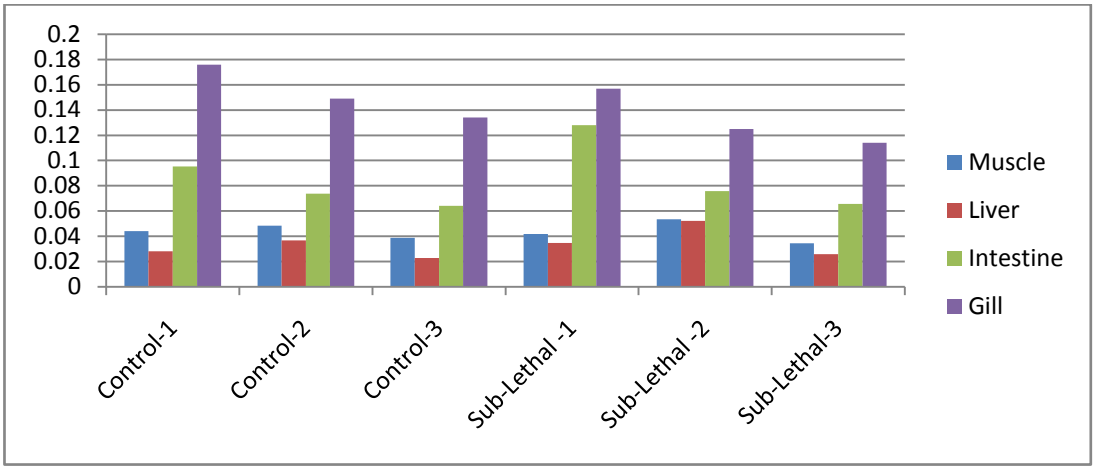

Fig 2. Changes in protein content induced by Cypermethrin in *Clarias batrachus*

4. CONCLUSIONS

Sub-lethal concentration of Zinc pyrithione (ZnPT), released in aquatic environment by human use (antidandruff shampoos) is an additional source of stress for aquatic organisms. Sub-lethal concentrations of ZnPT in the fresh water will not necessarily result in mortality but in-fact may result in several physiological dysfunctions in fish which could induce changes in blood parameters. This investigation suggests that use of any antidandruff shampoos containing ZnPT should be avoided near natural water bodies.

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6. ACKNOWLEDGEMENTS

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