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A.Paritha Bhanu

P.G. and Research Department of
Zoology, Chikkaiah Naicker
College, Erode - 638004,
Tamilnadu, India.

M.Deepak

P.G. and Research Department of
Zoology, Chikkaiah Naicker
College, Erode - 638004,
Tamilnadu, India.

Impact of cypermethrin on biochemical aspects of clinical importance in the blood of freshwater fish *Cyprinus carpio*

A.Paritha Bhanu, M.Deepak

Abstract

LC₅₀ 96 hr value of cypermethrin to the freshwater fish *Cyprinus carpio* (Linn) was determined through static bioassays. The fish were reared in sublethal concentration of the pesticide for 28 days. Blood was collected from the treated and control fish and used for clinically important biochemical analysis. The biochemical variables such as glucose, urea and creatinine increased in the blood of *C. carpio* whereas the proteins, albumin and globulin decreased significantly. The study evidenced that the fish might have experienced a higher energy demand as well as conditions like hyper glycemia, proteinemia, liver damage, kidney destruction and muscle destruction under cypermethrin exposure.

Keywords: Cypermethrin, *Cyprinus carpio*, Protein, Albumin, Globulin, Urea and Creatinine.

1. Introduction

Though the terrestrial agriculture is the major source of food materials to mankind, supplementary proteins are needed in order to meet the prevailing protein deficiency. In many countries, the marine and freshwater fish serve as preferred animal proteins. The fish are the cheapest source of animal proteins to humans^[1]. But most of the freshwater protein sources have become unhealthy due to pollutants which affect the aquatic organisms especially the fishes. Among the pollutants, pesticides are the major contaminants of the environment affecting the non-target organisms as more than 70% of chemical formulations are employed in agricultural sector^[2]. In recent times, cypermethrin, a synthetic pyrethroid pesticide has been extensively used to control the insect pests.

As the normal physiological processes are affected prior to the death of an organism, it is important to analyze physiological and biochemical parameters in evaluating toxicity^[3]. According to National Research Council (1989), the analyses of clinical chemistry are faster and cheaper than the analytical methods to detect the impact of pollutants on organisms. In animals, the nature of blood indicates all vital processes in the body and any alteration in blood chemistry could be useful to detect the toxicity in fish. Therefore, the present study has been made to determine the effect of cypermethrin on clinically important biochemical aspects in the blood of freshwater fish *Cyprinus carpio*.

2. Materials and methods

Healthy and active fresh water common carp, *Cyprinus carpio* were obtained from Tamil Nadu State Fisheries Department, Aliyar, Tamil Nadu, and India. Cypermethrin is a synthetic pyrethroid insecticide with analargrade 99.4% was procured from Gharda Chemicals, Mumbai, India. Bioassays were carried to find LC₅₀ 96 hr value of cypermethrin to *C. carpio* in the Zoology laboratory of our college. Then a group of 10 fish were exposed to sub lethal concentration of cypermethrin (0.2 ppm) for 28 days along with appropriate controls by using dechlorinated tap water in which the variables such as temperature (30 ± 1 °C), pH (7.1 – 7.9), salinity (0.4 – 0.7 ppm) and dissolved oxygen (5.5 – 6.2 mg/l) were maintained. The fish were fed with artificial fish meal daily and the test solutions were changed daily by using respective concentrations of the pesticide. The blood from the experimental and control fish was collected by cardiac puncture and syringe rinsed with EDTA and then drained into a sterile eppendorf tube for blood serum chemistry on day 4, 7, 14, 21 and 28. Each of these sample was transferred into a glass test tube and allowed to clot at room temperature for 1hr. Serum was obtained by centrifugation at 720 g for 15 minutes and stored at -80 °C for 2 or 3 days to estimate various biochemical parameters.

Correspondence:

A.Paritha Bhanu

P.G. and Research Department
of Zoology, Chikkaiah Naicker
College, Erode - 638004,
Tamilnadu, India.

The glucose level in the blood was estimated by the method of Dubowski ^[4], protein content by the method Lowry *et al.* ^[5], the concentration of albumin and globulin by the method Kingsley ^[6], the Urea by the method Varley ^[7] and creatinine level by the method Owen *et al.* ^[8].

3. Results and Discussion

Since the blood is the most important fluid in animals reflecting the physiological condition, the blood study is now a days widely used to identify the toxic impact of pollutants ^[9]. In the present study, cypermethrin causes significant biochemical alterations in the blood of fishes as also noticed ^[10]. That is the clinically important biochemical variables like glucose, urea and creatinine concentrations increase in the blood of *C. carpio* whereas the levels of protein, albumin and globulin were decreased significantly (Table 1).

The increase in glucose level (hyperglycemia) in the blood of experimental fish can be assigned to intensive glycogenolysis and synthesis of glucose from extra hepatic tissue proteins and amino acids ^[11]. It is also shown that the toxic stress could induce glycolysis resulting in higher glucose level in the blood of fish ^[12]. Present investigation clearly evidences that a higher energy demand would have stimulated increased catabolism of

proteins in the blood of present experimental fish for the production of required energy, thereby reducing the serum proteins. It is also found that a high proteolytic activity or increased production of protease enzyme or impaired protein synthesis could cause decrement in protein content in tissues of fish under stress ^[13, 14]. Under cypermethrin toxicity, the albumin and globulin content reduced in the blood of *C. carpio* resulting in condition known as proteinaemia. The reduction in the level of albumin and globulin is shown to be indicative of reduced protein synthesis in the liver ^[15] or of liver dysfunction ^[16]. The blood urea and creatinine were significantly elevated in the blood of fish under the impact of cypermethrin ^[17]. It is shown that the increased blood urea could occur at times of impaired kidney function, liver diseases and cardiac arrest ^[18]. The accumulative creatinine could be result of extensive muscle destruction and renal diseases ^[19].

4. Conclusion

From this experiment it was observed due to cypermethrin toxicity, increased level of glucose level, decreased level of albumin and globulin and elevated level of urea and creatinine were found due to liver and kidney dysfunction.

Table 1: Effect of cypermethrin on various biochemical parameters in the blood of *C. carpio*

Days of exposure	Biochemical parameters					
	Glucose(mg/l)	Total proteins(mg/l)	Albumin(mg/l)	Globulin(mg/l)	Urea(mg/l)	Creatinine(mg/l)
Control	71.29 ± 1.68	8.23 ± 0.79	4.14 ± 0.25	3.19 ± 0.15	24.29 ± 0.69	0.33 ± 0.02
4	76.57 ± 1.93NS (+7.41) r=0.998	7.84 ± 0.70NS (-4.74) r=0.956	3.98 ± 0.22NS (-3.86) r=0.988	2.95 ± 0.12NS (-7.52) r=0.990	28.53 ± 0.89 (+17.46) r=0.999	0.39 ± 0.03 (+18.18) r=0.992
7	81.25 ± 2.14 NS (+13.97) r=0.992	6.76 ± 0.60 (-17.86) r=0.986	3.80 ± 0.20 NS (-8.21) r=0.992	2.67 ± 0.10 (-16.30)r=0.947	33.40 ± 1.13 (+37.51) r=0.990	0.44 ± 0.05 (+33.33) r=0.994
14	86.12 ± 2.30 NS (+20.80) r=0.995	6.22 ± 0.45 (-24.42) r = 0.895	3.25 ± 0.18 (-9.42) r=0.975	2.36 ± 0.09 (-26.02) r = 0.965	38.14 ± 1.34 (+57.02) r = 0.941	0.51 ± 0.06 (+54.55) r = 0.996
21	92.52 ± 2.58 (+29.78) r=0.998	6.08 ± 0.34 (26.12) r=0.926	3.84 ± 0.14 (-15.94) r=0.951	2.12 ± 0.08 (-33.54) r = 0.994	41.22 ± 1.74 (+69.70) r = 0.904	0.57 ± 0.08 (+ 72.73) r = 0.999
28	104.33 ± 2.90 (+46.35)r=0.982	5.61 ± 0.24 (-31.83) r=0.984	3.21 ± 0.12 (-22.46) r=0.966	1.80 ± 0.06 (-43.57) r = 0.997	45.33 ± 1.33 (+86.62) r = 0.903	0.61 ± 0.09 (+84.85) r = 0.910

Values are represented as Mean ± SD of five replicates

All values are significant at P<0.05 except NS (NS – Not Significant; r = Correlation Coefficient; - indicates percent decrease from control; + indicated percent increase over control)

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