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Cypermethrin Induced Biochemical Changes in Kidney of *Clarias batrachus*

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Abstract: The objective of this study was to observe the effect of Synthetic Pyrethroid (Cypermethrin) on the biochemistry of kidney of *Clarias batrachus*. The biochemical parameters studies were DNA, RNA, Total protein, acid phosphatase and alkaline phosphatase. In kidney, the DNA content found increase up to 97.5 percent and RNA, ALP, ACP and protein content decreased up to 60.5, 69.5, 66.0 and 88.2 percent respectively. Thus on the basis of obtain result in the present investigation it can be concluded that 96 hrs exposure of 80 ppm of Cypermethrin aqueous solution has toxic effect and alter the biochemistry of kidney. Therefore, it is recommended to the user of this pesticide that should be careful about the dose they are using.

Key words: Biochemical Parameters · Cypermethrin · *Clarias batrachus* · Toxicity · Kidney

INTRODUCTION

Pesticides vary in their toxicity and in their potential ecological impact. In this modern age of technical and scientific farming use of pesticides increases a lot to increase field. This increases presence of pesticides in aquatic resources. Aquatic contamination by the pesticides causes acute and chronic poisoning in fish and other organism. The early life stages of fish, like eggs and larvae are particularly sensitive to contaminants [1]. The pesticides may damage the vital organs [2] cause skeletal deformities [3] and reduces reproductive ability [4, 5] in fishes. Several studies have shown that chronic exposure to low levels of pesticides can also cause mutations and/or carcinogenicity [6, 7].

The use of synthetic Pyrethroid for controlling various pests is regularly increasing in past few years. In fishes, the entry of pesticides into the body of fishes is largely through gills and the effect is on the rate of respiration [8]. Cypermethrin is a synthetic Pyrethroid broad-spectrum insecticide, used extensively in households and industrial and agriculture fields [9] for control of several insect pests [10]. The Cypermethrin are the new generation pesticides which are good substitutes for organochlorides and organophosphate [11]. It was discovered by Elliott and was developed by Shell International Chemical Company. It can be produced by the esterification of α-hydroxy-3 phenoxy phenybactonitrite with 3-(2, 2-dichlorivinyl)-2, 2-dimethyl cyclopropane carboxylic acid. The technical Cypermethrin is yellowish brown viscous mass.

It is stomach and contact insecticide. It is very effective against different types of pests on various crops. Therefore, the present experimental program was undertaken to study the Cypermethrin induced biochemical changes in kidney of *Clarias batrachus*.

MATERIALS AND METHODS

Experimental Animal: Healthy *Clarias batrachus* were used as an experimental animal and it is was collected from local fish market and acclimatized to the laboratory for one week during which they were regularly feed with prawn powder and soya meal.

Test Chemical: Cypermethrin was used as a test chemical. Tested fishes were exposed to sub-lethal doses (80µl/l) for maximum 96 hrs. This dose was selected on the basis of previous literature.

Experimental Design: In the present investigation experimental fishes were divided into two groups.

Control Group: In this group 10 fishes were kept and exposed to normal water.

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Experimental Group: In this group 40 fishes were exposed to 80 µl concentration of Cypermethrin solution.

Experimental Duration: In both control and experimental group fishes were exposed to maximum 96 hrs.

Autopsy: Fishes of control and experimental groups were sacrificed at 0 hrs, 24 hrs, 48hrs, 72 hrs and 96 hrs. The kidney was blotted weighted and then processed for various biochemical tests.

Biochemical Analysis: Following standard biochemical methods were used, which are described in manual of biochemical tests and experiments [12].

- Extraction and estimation of DNA by DPA method.
- Extraction and estimation of RNA by Orcinol method.
- Extraction and estimation of Total protein by Biuret method.
- Determination of alkaline phosphatase (ALP) by King and King Method.
- Determination of acid phosphatase (ACP) by King and King Method.

RESULTS AND DISCUSSION

DNA Content: DNA content in the Kidney of experimental fishes was observed in increasing manner as the duration of exposure of experimental solution increases (Table 1). The increases in DNA content after 96 hrs exposure of Cypermethrin (80µl/l) was 97.5%. The increase in DNA concentration after 48 and 72 hrs were 50.4 and 83.6 % respectively. However, after 24 hrs exposure of test chemical the DNA found decreased up to 3.84 %.

RNA Content: RNA content in the Kidney of experimental fishes was observed in decreasing manner as the duration of exposure of experimental solution increases (Table 2). The decreases in RNA content after 96 hrs exposure of Cypermethrin (80µl/l) was 60.9%.The decrease in RNA concentration after 24, 48 and 72 hrs were 9.38, 28.1 and 53.1% respectively.

Alkaline Phosphatase (ALP): The effect of Cypermethrin on alkaline phosphatase activity of Kidney of *Clarias batrachus* was similar to RNA. The alkaline phosphatase activity was found decreased as the duration of exposure of Cypermethrin increased except after 96 hrs (Table 3). The decrease in alkaline phosphatase after 24, 48, 72 and 96 hrs of exposure of Cypermethrin was 11.14, 34.5, 77.4 and 69.5% respectively. The important observation in this experiment was that the alkaline phosphatase decrease percent increase up to 72 hrs. However, decrease percentage in 96 hrs was less than 72 hrs. It shows that after 72 hrs. Alkaline phosphatase stared recovery.

Acid Phosphatase (ACP): The Acid phosphatase activity was found decreases as the duration of exposure of Cypermethrin increases (Table 4). The total inhibition in acid phosphatase activity after

Table 1: DNA in the Kidney of *C. batrachus* exposed to Cypermethrin (80 µl/l) for different duration

		DNA in mg/g wt. of tissue			
S. No.	Exposure Duration in Hrs.	Control	Experimental	Difference	% Alter
1	0	2.08	2.08 ±0.023	0	0
2	24	2.08	2.00 ±0.015	0.08	-3.84
3	48	2.08	3.13 ±0.028	1.05	+50.4
4	72	2.08	3.82 ±0.030	1.74	+83.6
5	96	2.08	4.11 ±0.025	2.03	+97.5

Table 2: RNA in the Kidney of *C. batrachus* exposed to Cypermethrin (80 µl/l) for different duration

		RNA in mg/g wt. of tissue			
S.No.	Exposure Duration in Hrs.	Control	Experimental	Difference	% Alter
1	0	45.71	45.71 ±0.040	0	0
2	24	45.71	41.42 ±0.039	4.29	-9.38
3	48	45.71	32.85 ±0.038	12.86	-28.1
4	72	45.71	21.42 ±0.035	24.29	-53.1
5	96	45.71	17.85 ±0.030	27.86	-60.9

Table 3: Alkaline Phosphatase in the Kidney of *C. batrachus* exposed to Cypermethrin (80 µl/l) for different duration

		Alkaline phosphatase activity in KA units/100 ml.			
S.No.	Exposure Duration in Hrs.	Control	Experimental	Difference	% Alter
1	0	26.03	26.03 ±0.011	0	0
2	24	26.03	23.08 ±0.013	2.9	-11.14
3	48	26.03	17.03 ±0.021	9	-34.5
4	72	26.03	5.87 ±0.027	20.1	-77.4
5	96	26.03	7.30 ±0.025	18.7	-69.5

Table 4: Acid Phosphatase in the Kidney of *C. batrachus* exposed to Cypermethrin (80 µl/l) for different duration

		Acid phosphatase activity in KA units/100 ml.			
S.No.	Exposure Duration in Hrs.	Control	Experimental	Difference	% Alter
1	0	22.04	22.04 ±0.036	0	0
2	24	22.04	19.67 ±0.033	2.37	-10.7
3	48	22.04	16.77 ±0.030	5.27	-23.9
4	72	22.04	10.7 ±0.025	11.34	-51.4
5	96	22.04	7.49 ±0.027	14.55	-66.0

Table 5: Total Protein in the kidney of *C. batrachus* exposed to Cypermethrin (80 µl/l) for different duration

		Protein in mg/g wt. of tissue			
S.No.	Exposure Duration in Hrs.	Control	Experimental	Difference	% Alter
1	0	3.40	3.40 ±0.015	0	0
2	24	3.40	2.0 ±0.021	1.4	-41.1
3	48	3.40	1.63 ±0.030	1.77	-52.0
4	72	3.40	0.30 ±0.033	3.1	-91.1
5	96	3.40	0.40 ±0.024	3	-88.2

96 hrs exposure of Cypermethrin was 66.0%. The decrease in acid phosphatase after 24, 48 and 72 hrs of exposure of Cypermethrin were 10.7, 23.9 and 51.4 % respectively. The interesting observation in this experiment showed that inhibition of acid phosphatase increases gradually on this exposure duration increases.

Total Protein (TP): The quantity of total protein in kidney of experimental fishes was found decreased in Cypermethrin treated group (Table 5). The decrease in total protein concentration in Kidney of experimental fishes after 96 hrs was 88.2 %. The decrease pattern of protein in experimental fishes was not constant. The decreases in protein values of Kidney after 24, 48 and 72 hrs were 41.1, 52.0 and 91.1 % respectively. The protein value gradually decreases up to 72 hrs. However, after 96 hrs the decrease in protein was less than 72 hrs. (88.2 %). This showed that after 72 hrs, recovery in protein value may start.

Kumar [13] and Holbrook [14] reported in increase in DNA content is might be to increased Thymidin uptake in the hepatic DNA. Bulow [15] and Brachet [16] also reported reduction in RNA content of brain, liver and muscles. One of the specific reasons for these alterations in RNA contents of different organs might also be due to variation in RNA polymerase activity, as observed by Kumar [13] and Holbrook [14] ALP is a microsomal enzyme, which is involved in membrane transport because of its high concentration in vertebrate kidney and its action on a number of phosphomonoesters of organic materials such as glucose. Decline in ALP activity may result from fall in the rate of synthesis of glycogen caused by lowered metabolic demands and electrolytic imbalance due to tissue over hydration [17]. The decrease in protein was significant in kidney may be because these organs are more active and require large amount of energy. It also appears that vigorous struggling may enhance kidney activity which may probably contribute to protein degradation that is

proteolysis. Decreased in protein level may be attributed to impaired synthetic machinery due to cypermethrin effect [18].

Cypermethrin accumulates preferentially in the kidney tissues when the body burden of cypermethrin increases, new proteins such as metallothionein are synthesized in the liver and kidney [19]. In the present investigation, cypermethrin (80ul/l) exposure for 96 hrs to *Clarias batrachus* was found toxic as it altered rather increased the DNA content and decreased the studied biochemical parameter RNA, ALP, ACP and TP of kidney and thus support the observation of previous authors.Therefore it is recommended to the user of this pyrethroid pesticide that they should be careful about the dose they are using.

REFERERENCES

1. Fiumann, L.A., 1993. Water quality and early life stages of fishes. American Fisheries Society Symposium, 14: 172.
2. Joshi, N., Dharmlata and A.P. Sahu, 2007. Histopathological changes in the liver of Heteropneustes fossilis exposed to Cypermethrin. J. Environ. Biol., 28: 35-37.
3. Kumar, K. and B.A. Ansari, 1984. Malathion Toxicity: Skeletal Deformities in Zebrafish (*Brachydanio rerio* Cyprinidae). Pestic. Sci., 15: 107-111.
4. Singh, P.K. and B.A. Ansari, 2010. Effect of Neem-based formulations (Nimbecidine and Ultineem) on the spawning success of Zebrafish, *Danio rerio* (Cyprinidae). The Bioscan, 5: 669-672.
5. Ahmad, M.K. and B.A. Ansari, 2011. Toxicity of Neem based pesticide Azacel to the embryo and fingerlings of Zebrafish, *Danio rerio* (Cyprinidae). World J. Zool., 6: 47-51.
6. Bull, S., K. Fletcher, A. Boobis and J. Batterrshill, 2006. Evidence for genotoxicity of pesticides in pesticide applicators. Mutagenesis, 2: 93-103.
7. Karabay, N.U. and O.M. Gunnehir, 2005. Cytogenetic and genotoxic effects of the insecticides, imidacloprid and methamidophos. Genet. Mol. Res., 4: 653-662.
8. Ganapthy, R.S. and P. Karapagagganapathy, 1987. Effect of organophosphorous, pesticides monocrotophous on biomodal respiration in an air breathing teleost fish, Channa punctatus, Proc. Nat., Seminar on conservation of Env-Impact on biosystem, pp: 269-277.
9. Kakko, I., T. Toimela and H. Tahti, 2003. The synaptosomal membrane bound ATPase as a target for the neurotoxic effects of pyrethroids, permethrin and Cypermethrin. Chemosphere, 51: 475-480.
10. Yilmaz, M., A. G¨ul and K. Erbas li, 2004. Acute toxicity of alpha cypermethrin to guppy (Poecilia reticulata, Pallas 1859). Chemosphere, 56: 381-385.
11. Elliot, M.T., 1980. Established pyrethroid insecticides. Pestic. Sci., 11: 119-128.
12. Prakash, M.M., 2007. Manual of Biochemistry Test and Experiments. Published by Govt. Holkar Sciecnce College, Indore (M.P.), India.
13. Kumar, A., B. Sharma and R.S. Pandey, 2009. Assessment of Acute Toxicity of lambda cyhalothrin to a freshwater catfish, Clarias batrachus. Environ. Chem. Lett. doi 10.1007/s10311-009-0244-8.
14. Holbrook, J.R.., 1980. Effects of toxicants on nucleic on nucleic acid and protein metabolism. In Introduction to Biochemical Toxicology; Hodgson, E., Guthrie, F.E., Eds.; Blackwell Science Publications; Oxford, pp: 261-284.
15. Bulow, F.J., 1970. RNA/DNA ratios as indicators of recent growth rates of a fish. J. Fish Res. Bd. Can., 27: 2343-2349.
16. Brachet, J., 1955. The biological role of the pentose nucleic acids. In The Nucleic Acid, Chemistry and Biology, Chargaff. E., Davidson, J. N. Eds. Academic Press: New York., 2: 475-519.
17. Shaffi, S.A., 1979. Effects of starvation on tissue and serum gluconeogenic enzymes, alkaline phosphatase and tissue glycogen in the fresh water catfish, *Heteropneustes fossilis* (Bloch). Acta Physiol. Acad. Sci. Hung., 4: 50501-50505.
18. David, M., S.B. Mushigeri, R. Shivakumar and G.H. Philip, 2004. Response of *Cyprinus carpio* (Linn) to sub-lethal concentration of cypermethrin: alterations in protein metabolism profiles. Chemosphere, 56: 347-352.
19. Ooi, V.K. and F.K. Law, 1989.Changes induced by cadium in kindny of black Sea Bream, *Mylio macrocephalus* (Teleostei). Bull. Environ. Contam. Toxicol., 43: 769-775.