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RESEARCH ARTICLE

BIOCHEMICAL STUDY ON THE EFFECT OF CEMENT FACTORY EFFLUENT ON THE FRESH WATER FISH, *CIRRHINUS MRIGALA*

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ABSTRACT

Biochemical changes induced by industrial effluent lead to metabolic disturbances inhibition of important enzymes, retardation of growth and reduction in the fecundity and longevity of the organism. Chronic exposure to low levels of effluent may have a more significant effect on fish populations. The acute and sub-lethal toxicity of the cement factory effluent on the fingerlings of Cirrhinus mrigala was evaluated to determine its effect on the biochemical values. The fish was exposed to varying levels of the toxicant concentrations using static bioassay to determine the median lethal concentration. The LC50 value is 1.20 per cent the fish was exposed to different hours (24, 48, 72 and 96 hours) in sub lethal concentration is 0.120 per cent. Biochemical characteristics like Protein, Carbohydrate and Lipid were estimated in gill, liver, kidney and muscle. The decrease of biochemical constituents from the control was noted. The results are statistically analysed and most of the values found to be significant.

INTRODUCTION

The high rate of increase in human blood population and rapid pace of industrialization have created an acute problem of disposal of waste products. The domestic wastes and industrial effluents are indiscriminately discharged in physiological and biochemical parameters of toxicant treated fish has recently emerged as an important tool for the water quality assessment of fish culture environment. Biochemical parameters are suitable tools for assessing environmental influences and stress effects of anthropogenic origin on the condition and health of aquatic vertebrates since there is a close association between the circulatory system of fish and the external environment, the effect of external stressors and toxic substances on exposed fish could be manifested through clinical diagnosis of fish physiology. The body components like Protein, Carbohydrate and Lipid play a significant role in body construction and energy production. They are involved in major physiological events and the assessment can be considered as diagnostic tool to determine the physiological phases of organism (Martein and Arivoli, 2008). Therefore an attempt has been made to study the possible impact of paper mill effluent on some biochemical aspect of a fresh water fish, *Cirrhinus mrigala.*

MATERIALS AND METHODS

Cirrhinus mrigala is a fish of the carp family Cyprinidae, found commonly in rivers and fresh water lakes in around South Asia and South East-Asia. Bulk of sample of fishes *Cirrhinus mrigala* ranging in weight from 14-17 gms and measuring 7-10 cm in length were procured from Aliyar fish farm.

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Fishes were acclimatized to the laboratory conditions for one month in large plastic tank (200 L).The fishes were fed with adlibitium, rice bran, wheat bran and oil cakes. Appropriate narrow range of concentration 0.120 ml was used to find the median lethal concentration and the mortality was recorded for every 24 hrs upto 96 hrs. It was found as 1.20 ml for 96 hrs using probit analysis method (Finney, 1971). Three groups of fishes were exposed to 0.120 ml (1/10th of 96 hrs LC_{50} value) concentration of the insecticide cement factory for 24, 48 72 and 96 hrs respectively. Another group was maintained as control. At the end of the each exposure period, fishes were sacrificed and tissues such as liver, gill, muscle and kidney were dissected and removed. The tissues (10 mg) were homogenized in 80% methanol, Centrifuged at 3500 rpm for 15 minutes and the clear supernatant was used for the analysis of different parameters. Total protein concentration was estimated by the method of (Lowry *et al.,* 1951). Quantitative estimation of glycogen in the tissues was done following the method as described by (Kemp and Kits, 1945). Cholesterol was estimated based on enzymatic method using cholesterol esterase, cholesterol oxidase and peroxidase (Richmond, 1973).

RESULTS AND DISCUSSION

In the present investigation, the effect of Cement factory effluent on biochemical nature of protein, carbohydrates and cholesterol has been studied in the different tissues (liver, kidney, gills and muscles) of the fresh water fish, *Cirrhinus mrigala.* The results were tabulated (1-3) and statistically analyzed. Liver recorded 2.51, 1.40, 1.00, 0.81 mg/gm, Kidney recorded 1.93, 0.88, 0.61, 0.57 mg/gm, Gills recorded 0.79, 0.71, 0.62, 0.46 mg/gm, Muscle recorded 1.22, 1.17, 0.99, 0.47 mg/gm of protein in 0.120 ml concentration of cement factory effluent in 24, 48, 72 and 96 hours exposures. The control values were noted as 3.41, 2.40, 0.91 and 1.99 mg/gm in Liver,

Kidney, Gills and Muscles respectively. Decrease in protein content may be due to the rapid utilization of body protein or poor intake of dietary protein by fish under pollutant stress (Das *et al*., 2004).

Table 1. Changes in the Protein content (mg/g) in the tissues of Cirrhinus mrigala exposed to Cement factory effluent

Tissues mg/g	Control	Exposure Periods			
		24 hours	48 hours	72 hours	96 hours
Gill	0.91±0.24	0.79±0.24	0.71±0.02	0.62±0.02	0.46±0.02
't' value		1.331**	1.112**	0.354**	0.021**
%		-17.58	-21.97	-31.86	-49.49
Liver	3.41±0.41	2.51±0.01	1.40±0.02	1.0±0.02	0.81±0.02
't' value		4.391**	9.852**	11.82**	12.75**
%		-26.47	-58.94	-70.67	-76.25
Kidney	2.40±0.16	1.93±0.02	0.88±0.02	0.61±002	0.57±0.02
't' value		5.876**	19.13**	22.53**	23.03**
%		-19.58	-63.3	-74.58	-76.2
Muscle	1.99±0.05	1.22±0.02	1.17±0.02	0.99±0.05	0.47±0.02
't' value		10.26**	28.46**	26.87**	55.39**
%		-41.20	-39.19	-50.25	-76.38

Results are mean (± SD) of observations: % = Percentage decrease over control, * = Significant at 0.05 level ** = Significant at 0.01 level *** = Significant at 0.001 level, NS = Non Significant

Table 2. Changes in the Carbohydrate content (mg/g) in the tissues of Cirrhinus mrigala exposed to Cement factory effluent

Tissues mg/g	Control	Exposure Periods			
		24 hours	48 hours	72 hours	96 hours
Gill	14.70±0.16	10.60±0.16	8.00±0.16	7.40±0.16	6.80±0.16
't' value		36.67**	59.93**	65.29**	70.66**
%		-27.89	-45.57	-49.65	-53.74
Liver	24.60±0.16	20.60±0.16	16.70±0.16	16.40±0.16	11.70±0.16
't' value		35.78**	73.34**	70.66**	115.00**
%		-16.26	-33.30	-32.11	-76.25
Kidney	22.0±0.16	17.40±0.16	10.70±0.16	8.70±0.16	8.00±0.16
't' value		41.14**	101.1**	119.0**	125.0**
%		-20.90	-51.36	-60.45	-63.63
Muscle	28.70±0.16	19.30±0.16	17.40±0.16	13.70±0.16	12.60±0.16
't' value		84.08**	101.1**	134.2**	144.0**
%		-32.75	-39.37	-52.26	-56.09

Results are mean (± SD) of observations: % = Percentage decrease over control * = Significant at 0.05 level ** = Significant at 0.01 level *** = Significant at 0.001 level, NS = Non Significant

Table 3. Changes in the Lipid content (mg/g) in the tissues of Cirrhinus mrigala exposed to Cement factory effluent

Tissues mg/g	Control	Exposure Periods			
		24 hours	48 hours	72 hours	96 hours
Gill	20.50±0.16	13.40±0.16	9.40±0.02	8.40±0.16	7.62±0.02
't' value		63.5**	139.7**	108.2**	162.1**
%		-36.63	-54.14	-59.02	-62.83
Liver	22.00±0.16	18.10±0.16	14.60±0.16	11.50±0.16	9.64±0.16
't' value		34.88**	66.19**	93.91**	155.6**
%		-17.72	-33.63	-47.27	-56.1
Kidney	24.0±0.16	20.50±0.16	11.50±0.16	10.50±0.16	8.91±0.16
't' value		16.99**	97.49**	106.4**	169.8**
%		-8.48	-49.32	-53.12	-60.22
Muscle	31.27±0.16	24.50±0.1	19.40±0.1	12.60±0.1	10.4±0.16
't' value		35.16**	61.14**	96.95**	108.4**
%		-21.65	-38.0	-59.70	-66.74

Results are mean (± SD) of observations: % = Percentage decrease over control * = Significant at 0.05 level ** = Significant at 0.01 level *** = Significant at 0.001 level, NS = Non Significant

In the present study, lethal and sub lethal concentration of cement factory effluent seems to have brought a maximum decline of protein in all the tissues which suggests an intensive proteolysis and decreased protein synthesis. The depletion in tissue proteins may be due to impaired or low rate of protein synthesis, their utilization in cell repair and organization and the decrease in uptake of amino acids into the polypeptide chain (Muley *et al*., 2007).

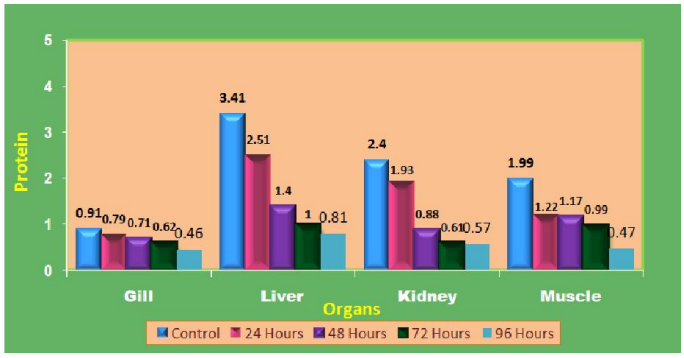

Figure 1. Changes in the Protein content (mg/g) in the tissues of Cirrhinus mrigala exposed to Cement factory effluent in different periods

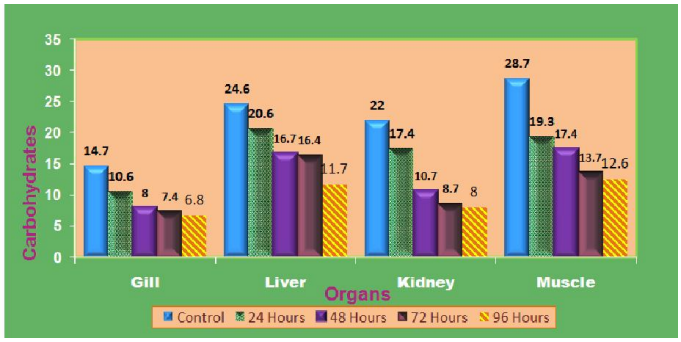

Figure 2. Changes in the Carbohydrate content (mg/g) in the tissues of Cirrhinus mrigala exposed to Cement factory effluent in different periods

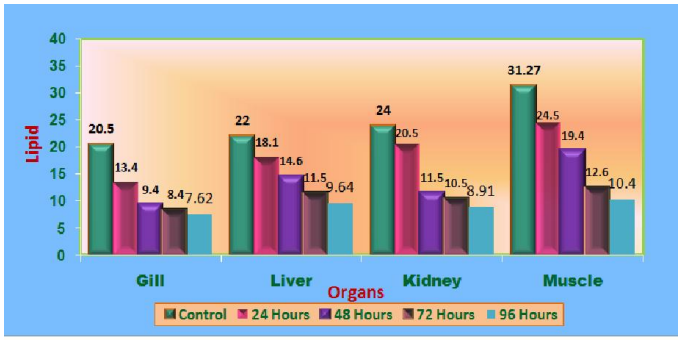

Figure 3. Changes in the Lipid content (mg/g) in the tissues of Cirrhinus mrigala exposed to Cement factory effluent in different periods

In Short term duration, Carbohydrate content was found to decrease from control in all tissues in all exposures. Liver tissue was found to contain 20.60, 16.70, 16.40, 11.70 mg/gm, kidney tissue was found to contain 17.40, 10.70, 8.70, 8.00 mg/gm, gill tissue was found to contain 10.60, 8.00, 7.40, 6.80 mg/gm, muscle tissue was found to contain 9.30, 17.40, 13.70, 12.60 mg/gm of carbohydrate in 0.120 ml concentration of cement

factory effluent in 24, 48 72 and 96 hours respectively. The control values were noted as 24.60, 22.0, 14.70 and 28.70 mg/gm in Liver, Kidney, Gills and Muscles respectively. The decline in carbohydrate level may be due to utilization of stored glycogen possibly through anaerobic glycosis to meet the energy demand under heavy metal stress. (Rani *et al.,* 2008). In the present study, significant decrease in the carbohydrate content has been noticed in the gill, liver, kidney and muscle as the duration pronounced in fish groups exposed to cement factory effluent for short and long term exposure periods. This may be due to high energy demand required for the hepatic synthesis of deteoxifying enzymes (Hori *et al*., 2006).

Liver recorded 18.10, 14.60, 11.50, 9.64, mg/gm, Kidney recorded 20.50, 11.50, 10.50, 8.91mg/gm, Gills recorded 13.40, 9.40, 8.40, 7.62 mg/gm, Muscle recorded 24.50, 19.40, 12.60, 10.40 mg/gm of Cholesterol in 0.120 ml concentration of cement factory effluent in 24, 48, 72 and 96 hours exposures. The control values were noted as 22.00, 24.00, 20.50 and 31.27 mg/gm in Liver, Kidney, Gills and Muscles respectively. Decrease in lipid content may be due to decline in the lipid synthesizing capacity and due to an incrase in the hydrolysis of hepatic lipids to combat stress condition (Virk and Sharma, 1999). The low level of lipid recorded in the exposed fish, which might have been used for energy production for other metabolic functions in which these products play a vital role during stress conditions (Pathan *et al.,* 2009).

Conclusion

In conclusion, various studies on the toxic effects on survival and biochemical parameters of fish revealed that decrease in oxygen content in water, affected survival of fish. Biochemical alteration in the body of a fish gives an indication of pollution and help to understand the mode of action and type of pollutant. The changes at biochemical levels might result in important of energy requiring vital processes and hence can deteriorate the health status of the fish population.

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