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Effect of sub lethal concentrations of textile bleaching effluent in the total protein content in the fish, *Cyprinus carpio*

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ABSTRACT

Proteins can be expected to be involved in the compensatory mechanism of stressed organisms. Toxic effect of treated textile bleaching effluent on the fish *Cyprinus carpio* was assessed. Alteration in the protein content in muscle, liver, gill and intestine was determined after exposure to sublethal concentrations of the effluent for a period of 28 days. Data showed that total protein content was decreased in all test tissues compared to control. Results indicated the toxic nature of the effluent.

Key words : *Total protein, C. carpio, Textile bleaching effluent, Sub-lethal concentrations*

Introduction

Rapid growth of industrialization and urbanization boost the economy of the country on one hand and on the other hand resulted in a substantial increase in the liquid waste traditionally discharged in to open land or into nearby natural water bodies, causing many environmental problems (Prakash and Upadhyay, 2022). Industries contribute to colossal quantities of wastes generally contains high quantities of dissolved and suspended solids, organic and inorganic chemicals, high BOD and COD, oils and grease which cause deleterious effects on the fish when discharged into water bodies. Fish is much sought-after food being highly nutritious and easily digestible. Nutritional value of fish depends on the biochemical composition which is affected by water pollution (Fahmy, 2012). As there is a close association between circulatory system of fish and external environment, biochemical parameters are often recognized as a suitable tool for assessing the stress effect of anthropogenic pollutants on the condition and health of aquatic vertebrates as well as the overall health of the ecosystem (Jiyavudeen and Puvaneswari, 2016). Many authors authenticated the alterations in biochemical components of fish as response to environmental stress (Maruthi and Rao, 2000; Banu and Noorjahan, 2017; Tasneem and Yasmeen, 2020).

Biochemical components like proteins plays an important role in body construction and energy production. Proteins are also involved in the major physiological events and therefore, assessment of protein content can be considered as a diagnostic tool to determine the physiological phases of organisms. Hence it is decided to investigate the influence of textile bleaching effluent on the protein content of the fresh water fish, *Cyprinus carpio*.

Materials and Methods

The fish, *Cyprinus carpio* (wt 1±0.5 g) were selected

because of their wide availability. The fingerlings procured were acclimatized to laboratory conditions in glass aquaria and were fed *ad libitum* with rice bran-oil cake mixture and commercial pellet feed. Treated textile bleaching effluent was collected from the outlet of bleaching factory at Mettupalayam, in Coimbatore District, Tamil Nadu State. Toxicity of treated effluent to *C. carpio* was studied by static bioassay method(Trivedy *et al*., 1987). Based on preliminary exploratory studies, concentration of effluent ranging from 26.0% to 29.0 % were selected for present toxicity studies.

LC_{50} values of textile bleaching effluent to *C. carpio* for 24 hours were obtained by employing probit analysis of Finney (1971) and it was 27.23%. Considering the range of "application factors" (Anderson and D' Apollonia, 1978) by chronic and sublethal tests, three sublethal concentrations (1.5%, 2 % and 2.5%) of treated effluent were evolved to perform the studies on the biological effect of effluent on the fish.

For biochemical studies, healthy fingerlings were recruited from the stock and divided into three groups as 40 each. They were separately introduced into the medium of 2.5%, 2% and 1.5% effluent medium prepared with unchlorinated tap water. The exposure medium was renewed every 96 hours. No aeration was done. The fish were fed with pellet food *ad libitum* but were starved for 24 hours prior to estimation. The fish were dissected and tissues viz., liver, muscle, gill and intestine were isolated from the control as well as experimental groups. Tissues weighed, homogenized in known volume of phosphate buffer (pH 7.0 0.01M) and centrifuged. Super-

Table 1. Sublethal effect of textile bleaching effluent on protein content (mg/g wet tissue) in different tissues of *Cyprinus carpio* at different exposure period.

Exposure period (day)		Muscle	Liver	Gill	Intestine
1.5%					
	0	40.93±0.37	38.19±0.97	32.36±0.66	30.54±1.23
	7	36.27±1.10 (11.39)	34.02±1.63 (10.92)	29.93±1.09 (7.51)	27.36±0.20 (10.41)
	14	33.13±1.33 (19.06)	30.25±0.88 (20.79)	25.74±1.39 (20.46)	23.11±0.16 (24.33)
	21	28.54±0.71 (30.27)	27.63±1.95 (27.65)	22.42±0.91 (30.72)	21.32±0.93 (30.19)
	28	25.38±0.57 (37.99)	24.59±0.82 (35.61)	20.16±1.91 (37.70)	19.86±1.44 (34.97)
2%	0	40.93±0.37	38.19± 0.97	32.36±0.66	30.54±1.23
	7	34.18±0.32 (16.49)	30.12±0.38 (21.13)	26.33±0.74 (18.63)	24.92±1.03 (18.40)
	14	31.70±0.40 (22.55)	29.20±0.35 (23.54)	24.22±0.65 (25.15)	21.36±1.19 (30.06)
	21	27.33±1.05 (33.23)	25.45±1.37 (33.36)	22.10±0.28 (31.71)	20.48±0.40 (32.94)
	28	24.14±0.28 (41.02)	23.02±0.48 (39.72)	19.84±0.74 (38.69)	18.13±0.82 (40.64)
2.5%					
	0	40.93±0.37	38.19±0.97	32.36±0.66	30.54±1.23
	7	30.11± 1.46 (26.44)	28.83±1.77 (24.51)	25.61±1.36 (20.86)	21.38±0.63 (29.99)
	14	27.05±0.89 (33.91)	25.18±0.88 (34.07)	23.24±1.63 (28.18)	20.65±0.40 (32.38)
	21	24.30±0.60 (40.63)	21.48±0.73 (43.75)	20.18±0.59 (37.64)	18.94±1.71 (37.98)
	28	22.14±1.08 (45.91)	19.05±0.77 (50.12)	18.38±1.30 (43.20)	16.15±0.30 (47.12)

Each value represents the mean (±SD) of 3 estimations. The percentage change is given in parentheses. The value on day 7,14,21 and 28 are significantly different (P^0.05) over that of day 0.

natant was taken for estimation of total protein (Lowry *et al*., 1951) and were done on day 0,7,14,21 and 28. The results obtained were subjected to statistical analysis using SPSS software version 21. All the results are presented as mean ± standard deviation at $p<0.05$ level of significance.

Results and Discussion

The protein levels in muscle, liver, gill and intestine of *C. carpio* exposed to three different sub-lethal concentrations of textile bleaching effluent showed significant decrease compared to control (Table 1 & 2). The protein content in muscle tissue was initially (on day 0) found to be 40.93±0.37 mg/g wet tissue. When exposed to 1.5% effluent, it decreased to a level of 25.38 ± 0.57 mg/g wet tissue at the end (day 28) of the experiment. The total amount of reduction in protein content was 15.55 mg/ g wet tissue and the percent change over initial was 37.99. When exposed to 2% effluent, the total reduction in protein content was 16.79 mg/g wet tissue (41.02% reduction over control). Still higher effect was observed under 2.5% exposure. The decline in protein content was 18.79 mg/g wet tissue and the percent decline over control was 45.91. The reduction in protein content of the muscle tissue in fish exposed to different concentrations at different periods of exposure was statistically significant (P<0.05).

Protein content in liver tissue of the control was 38.19 ±0.97 mg/g wet tissue. When exposed to 1.5% effluents, it reduced to 13.6 mg/g wet tissue. The percent decline was 35.61 over control. The protein content declined to 15.17 mg/g wet tissue and 19.14 mg/g wet tissue on exposure to 2 and 2.5% effluent respectively. The reduction was statistically significant (P > 0.05). The amount of protein content of gill tissue was reduced from 32.36 ± 0.66 mg/g wet tissue (day 0) to 12.20 mg/g wet tissue, 12.52 mg/g wet tissue and 13.98 mg/g wet tissue of fish exposed to 1.5,2 and 2.5% effluent respectively for 28 days. The protein content in intestine of control fish was 30.54 ± 1.23 mg/g wet tissue. A significant reduction (P^0.05) was observed in protein content of intestinal tissue in fish at various periods of exposure. The amount of decline was 10.68, 12.41 and 14.39 mg/g wet tissue in fish exposed to 1.5,2 and 2.5% effluent respectively on day 28. Maximum decline in protein content was observed in muscle tissue followed by liver, gill and intestine on day 28 of the experimental period.

Results of the present study clearly reflected that the principle biochemical constituent, protein of the test tissues (muscle, liver, gill and intestine) got mobilised under the toxic influence of the textile bleaching effluent. Depletion of tissue protein in fishes exposed to toxicants is a physiological strategy of the animal as an adaptation to the changed environment. A number of workers have reported decline in protein level of various organs/ tissues under toxic stress of pollutants. Total protein content in muscle, intestine and brain of *Catlacatla* decreases under the toxic stress of Ferrous sulphate (Ilavazhahan *et al*., 2012). Jiyavudeen and Puvaneswari (2016) observed a significant decline in protein content of liver and gill tissue of *Mugil cephalus* under the influence of industrial effluent. On exposing *C.carpio* to Malathion, a decrease in protein content and an increase in free amino acid and protease activity levels were observed (Reddy and Philip, 1991). The significant decline of protein observed in the test tissues in the present study could be attributed to the stress in the test fish triggered by various contaminants of the effluent. Stress

Table 2. Alteration of protein content in muscle, liver, gill and intestine of *Cyprinus carpio* exposed to different concentrations of textile bleaching effluent and the percentage of change over from the initial during the experimental period.

Tissue	Concentration of effluent (%)	Protein Content			
		On day 0 (Initial)	After exposure on day 28	Total amount of reduction over day 0	Percent change over day 0(%)
Muscle	1.52, 2.5	40.93	25.38, 24.14, 22.14	15.55, 16.79, 18.79	37.99, 41.02, 45.91
Liver	1.52, 2.5	38.19	24.59, 23.02, 19.05	13.60, 15.17, 19.14	35.61, 39.72, 50.12
Gill	1.52, 2.5	32.36	20.16, 19.84, 18.38	12.20, 12.52, 13.98	37.70, 38.69, 43.20
Intestine	1.52, 2.5	30.54	19.86, 18.13, 16.15	10.68, 12.41, 14.39	34.97,40,64,47.12

Values are expressed in mg/g wet tissue.

has been reported to accelerate the protein metabolism (Nichol and Rosen, 1963) as the protein is likely to undergo hydrolysis and oxidation through TCA cycle to meet the increased energy demand under the stress (Somnath, 1991). Under the toxic stress, diversification of energy occurs to accomplish the impending energy demands and hence total protein level depleted (Neff, 1985). Depletion in the total protein content in the present investigation in *C. carpio* suggests that during the stressful situation in the intoxicated fish, tissue protein might have undergone intense proteolysis.

In conclusion, changes in the protein content in effluent treated fish is due to the stress induced by the various contaminants in the effluent medium. Rate of protein decline depends on the period of exposure as well as concentration of the effluent. In view of the effect of treated effluent, it can be inferred that indiscriminate discharge of the effluent into nearby water bodies might threaten its living entities.

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Conflict of Interest

The author declares no conflict of interests regarding the publication this paper.

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