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Original Research Article

Evaluation of Carbohydrate Content in Various Tissues of Fresh Water Carp (*Cyprinus carpio*) under the Effluent Stress

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ABSTRACT:
The present study was carried out to determine the effect of sub-lethal concentration of treated textile bleaching effluent on the carbohydrate content in gill, liver, muscle and intestine of *Cyprinus carpio* after 28 days of exposure. A Significant decrease in carbohydrate content was observed in muscle, gill, liver and intestine of effluent treated fish compared to control fish. Liver tissue showed maximum decline in carbohydrate content followed by muscle, intestine and gill. Reduction in carbohydrate content could have happened by increased utilization of it under chronic stress by rapid glycogenolysis or by the inhibition of glycogenesis. In conclusion, the treated textile bleaching effluent containing toxic contaminants induced stress and reduced the nutritive value of fish.

Keywords: Carbohydrate, Textile bleaching effluent, *Cyprinus carpio*, Toxicity

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INTRODUCTION

Fresh water bodies are being affected by anthropogenic activities. Pollution is the most unabating problem of the entire ecosystem posing a potential threat to living world. Unprecedented spurt in human population resulted in an increase in industrialization and urbanization. Direct discharge of industrial effluent without proper treatment are putting constant pressure on water resources and on aquatic ecosystem, in a broader way (Singh and Prakash, 2020). Contaminants in the effluent can reduce the quality of water which in turn leads to health hazards in aquatic organisms particularly fish. Fishes are extremely sensitive to any kind of pollutants present in water. Fish fry, larvae and finger lings are the most susceptible life stages which are harshly being affected by the contaminants in the aquatic bodies. Alterations in vital organs like gills, kidneys and liver might destress the physiology, rate of survival, osmoregulation, buoyancy, reproductive rate etc. (Khoshnood, 2017). Natural physiological functioning of organisms gets disturbed on exposure to toxicant stress. Toxicants affect the fish at cellular / molecular level, ultimately causes physiological, pathological and biochemical alterations (Monali and Roy, 2017). Pollutants enter into the body of fishes either directly through the digestive tract due to consumption of contaminated water and food or non-dietary routes across permeable membranes such as the gill or skin.Bio chemical alterations in organisms are considered as most sensitive events of any pollutant damage (Tasneem and Yasmeen, 2020). Carbohydrates play an imperative role in structure and functional components of cell, connective -tissue matrix, nucleic acids, galactolipids of brain and many proteins. The energy derived from the oxidation of carbohydrates is of prime importance for the survival of organisms (Yallappa and Nushat, 2018). Many authors authenticated the alteration in biochemical components in response to environmental stress (Javed and Usmani, 2015; Ogundiran *et al*, 2021). The present study aimed at investigating the sublethal effect of treated textile bleaching effluent on the carbohydrate content in various tissues of *Cyprinuscarpio.*

MATERIALS AND METHODS

For the present study the fish, *C. Carpio* (weight 1±0.5 g) were selected because of their wide availability and commercial importance. Fingerlings were procured from Tamil Nadu Fisheries Development Corporation Ltd., Aliyar Fish farm and acclimatized to laboratory condition (28±2°C) in glass aquaria. They were fed *ad libitum* with rice bran- oil cake mixture and commercial pellet feed. Treated textile bleaching effluent was collected from the factory outlet at Mettupalayam, Tamil Nadu. Unchlorinated tap water was used in the study for various purposes. Physico-chemical features like temperature, pH, dissolved oxygen, total alkalinity and hardness of the water was determined following standard procedures as described in APHA (2005).

Toxicity of treated effluent to *C. Carpio* was studied by employing static bioassay method as described by Trivedy *et al*, (1987). The fish were subjected to preliminary range finding tests to determine a mortality range of 0-100% in various concentrations of effluent. Based on the preliminary exploratory studies, concentrations of effluent ranging from 26.0% to 29.0% for treated effluent were selected for toxicity studies. LC 50 values for 24 hours were obtained by employing Probit analysis of Finney (1971).

Considering the range of "application factors"(Anderson and D' Apollonia, 1978) by chronic and sublethal tests, three sublethal concentrations of treated effluent (1.5%, 2% and 2.5%) were evolved in order to perform studies on biological effect of effluent on the fish. Healthy fishes were recruited from the stock and divided into three groups as 40 each and they were separatedly introduced into medium of 1.5%, 2% and 2.5% effluent prepared with unchlorinated tap water. Exposure medium was renewed every 96 hours and no aeration was done. Remnants of food and faeces were removed regularly.

The fish were fed with pellet food *ad libitum* but were starved 24 hours prior to estimation. Tissues like liver, muscle, gill and intestine were isolated and washed in physiological saline solution. Tissues then weighed, homogenised in known volume of phosphate buffer (pH7.0 0.01M) and centrifuged. Supernatant was taken for the estimation of carbohydrate. Anthrone method (Roe, 1955) was adopted for the estimation of carbohydrate in the tissues. The results (each value represents the mean (±SD) of 3 estimations) obtained were subjected to statistical analysis using SPSS software.

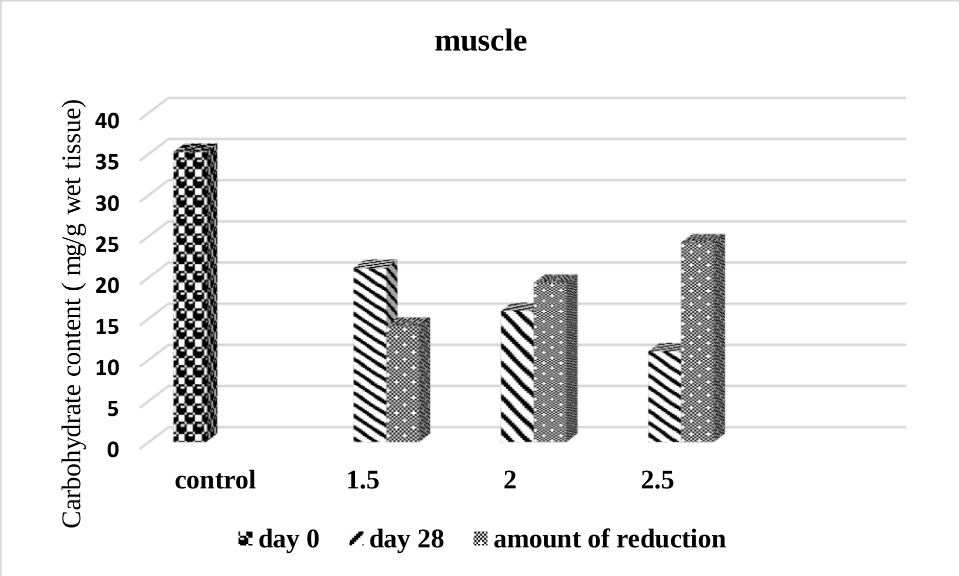
RESULTS AND DISCUSSION

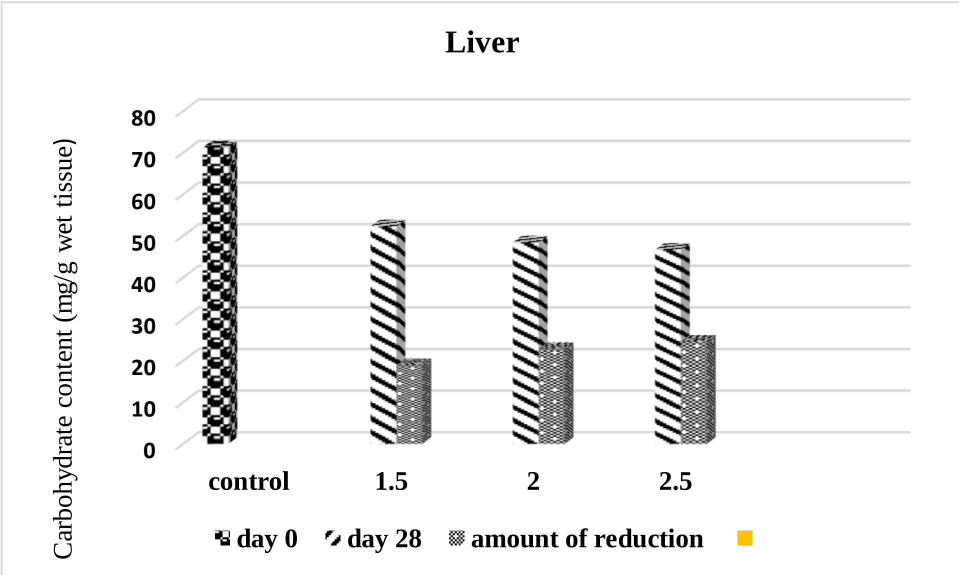
Total carbohydrate content in different tissues of control as well as effluent treated fish after 7th, 14th,21st and 28th day exposure are presented in Table 1 . Muscle - rich in protein forms mechanical tissue intended for mobility. Carbohydrate content showed significant decrease in muscles on exposure to toxic effluent. It declined to 21.13±0.29mg/g wet tissue compared to the initial value of 35.34± 0.36mg/g wet tissue during the experimental period of 28 days at 1.5% exposure. Amount of decline during the period was 14.11 mg/g wet tissue. When exposed to 2 and 2.5% effluent, the amount of carbohydrate was declined to a level of 15.90 ±0.81 mg/g wet tissue and 11.01±1.35 mg/g wet tissue respectively on the day 28 of the experimental period. The amount of decline was 19.34 mg/g wet tissue and 24.24 mg/g wet tissue respectively (Figure 1).

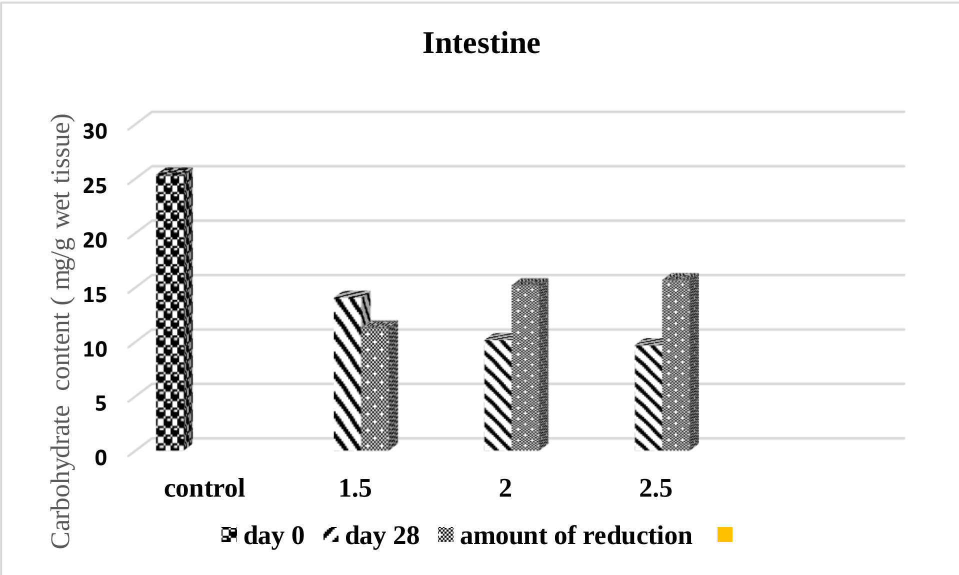
Table 1: carbohydrate content in various tissues of *Cyprinus carpio* exposed to sub-lethal concentrations of textile bleaching effluent at different periods

Exposure period (day)		Muscle	Liver	Gill	Intestine
1.5%	0	35.24±0.36	71.21±1.46	28.40±0.20	25.56±0.15
	7	31.03±0.82 (11.95)	63.52±0.66 (10.80)	26.16±0.42 (7.89)	21.30±0.97 (16.67)
	14	28.26±0.30 (19.81)	61.27±0.28 (13.96)	22.14±1.41 (22.04)	19.03±0.38 (25.55)
	21	25.52±0.18 (27.58)	57.08±0.23 (19.84)	18.01±0.58 (36.58)	16.90±0.36 (33.88)
	28	21.13±0.29 (40.04)	52.30±0.21 (26.56)	15.25±0.94 (46.30)	14.05±0.64 (45.03)
2%	0	35.24±0.36	71.21±1.46	28.40±0.20	25.56±0.15
	7	25.45±0.21 (27.78)	60.50±0.36 (15.04)	26.58±0.73 (6.41)	16.13±1.24 (36.89)
	14	20.85±0.96 (40.83)	55.33±1.09 (22.30)	23.24±0.64 (18.17)	14.10±0.36 (44.84)
	21	18.73±0.53 (46.85)	51.62±0.54 (27.51)	21.88±1.67 (22.96)	12.50±0.32 (51.10)
	28	15.90±0.81 (54.88)	48.40±0.26 (32.03)	19.69±1.08 (30.67)	10.16±0.84 (60.25)
2.5%	0	35.24±0.36	71.21±1.46	28.40±0.20	25.56±0.15
	7	20.08±1.74 (43.02)	58.73±0.85 (17.53)	21.07±0.66 (25.81)	15.86±0.76 (37.95)
	14	16.23±0.83 (53.94)	54.16±0.89 (23.94)	18.82±0.59 (33.73)	13.75±0.65 (46.21)
	21	14.81±1.09 (57.97)	51.37±0.32 (27.86)	16.53±0.25 (41.80)	11.24±0.39 (56.03)
	28	11.01±1.35 (68.76)	46.66±0.08 (34.48)	13.40±0.31 (52.82)	9.69±0.47 (62.09)

Values are expressed in mg/g wet tissue. 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.


muscle
Carbohydrate content (mg/g wet tissue)
40
35
30
25
20
15
10
5
0
control
1.5
2
2.5
day 0
day 28
amount of reduction


Liver
Carbohydrate content (mg/g wet tissue)
80
70
60
50
40
30
20
10
0
control
1.5
2
2.5
day 0
day 28
amount of reduction


Intestine
Carbohydrate content (mg/g wet tissue)
30
25
20
15
10
5
0
control
1.5
2
2.5
day 0
day 28
amount of reduction

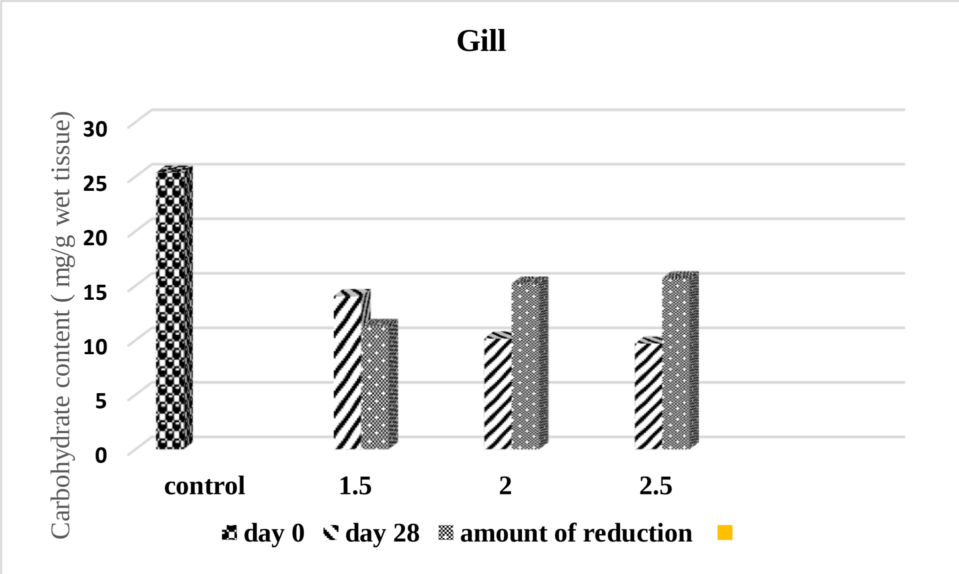


Figure 1: Alteration of carbohydrate content in muscle, liver, gill and intestine of *Cyprinus carpio* exposed to different concentrations of textile bleaching effluent

Being the prime organ to encounter environmental pollutants, drugs and ingested nutrients, liver is the regulatory center of metabolism involved in the synthesis of various proteins. Acute and chronic exposure to toxicants might alter the liver functions (Al-Attar, 2011). Carbohydrate content in liver in control fish was 71.21±1.46mg/g wet tissue, which declined to a level of 52.30±0.21 mg/g wet tissue, 48.40± 0.26 mg/g wet tissue and 46.66±0.08mg/g wet tissue on day 28 in fish exposed to 1.5, 2 and 2.5 % effluent respectively.

Gills are the primary organ of aquatic respiration for fishes. The branchial epithelium in fishes is a multipurpose organ that plays a central role in a suite of physiological responses to environmental and internal changes. Despite the fact that fishes do have kidneys, the gill actually performs most of the functions that are controlled by pulmonary and renal processes in mammals (Evans *et al*, 2005). As the gills are in constant contact with the external environment, they are the first targets of waterborne pollutants (Perry and Lauvent, 1993). The initial carbohydrate content in gill tissue was 28.40±0.20 mg/g wet tissue. It decreased to an amount of 13.15, 8.71 and 15.00 mg/g wet tissue on day 28 of experimental period at 1.5, 2 and 2.5% effluent respectively.

The intestine of fish is a multifunctional organ: lined by only a single layer of specialized epithelial cells, it has various physiological roles including nutrient absorption and ion regulation. It moreover comprises an important barrier for environmental toxicants, including metals (Minghetti *et al*, 2017). The intestinal carbohydrate content was reduced from the initial amount of 25.56 ±0.15 mg/g wet tissue to 11.31mg/g wet tissue, 15.20 mg/g wet tissue and 15.67mg/g wet tissue respectively in 1.5, 2 and 2.5% effluent. Liver tissue showed maximum decline in carbohydrate content followed by muscle, intestine and gill. Statistical analysis showed that the decline in the amount of carbohydrate in fish exposed to different concentrations of effluent was significant at $p<0.05$ level. In the present study, total carbohydrate content was highest in muscle, gill, liver and intestine of control fish and least in the fish of 28 days effluent exposure. In the control fish, liver tissue showed maximum carbohydrate content followed by muscle, gill and intestine. Results showed that carbohydrate content in the four organs- muscle, gill, liver and intestine decreased significantly after 7th, 14th, 21st and

28th day of effluent exposure. Similar results were reported earlier. On exposure to polycyclic aromatic hydrocarbon effluent, carbohydrate content in gill, liver and muscle of *Cirrhinusmrigala* decreased (Kamaraj and Thamilmani, 2016). Tasneem and Yasmeen (2020) reported decreased carbohydrate content in gill and liver tissues of *C. carpio* subsequent to chronic exposure to biopesticide. Stress is an energy demanding process for animal and to cope with it metabolically, animal mobilizes energy substrates (Vijayan *et al*, 1997). Carbohydrates act as a fuel to be oxidized to provide energy foe other metabolic process. Deficiency of carbohydrate metabolism has been observed in a variety of physiological disorders and pathological conditions (Harper *et al*, 1979). Significant decrease in carbohydrate content in various tissues in the present study could be attributed to the pollutant stress on the organism which results in extensive utilization of stored energy through glycogenolysis possibly by increasing the activity of glycogen phosphorylase (Olaganathan and Patterson, 2013) or the toxicant may have an effect on glycogenesis by inhibiting carbohydrate metabolism.

CONCLUSION

Waste water from textile industries contains a variety of organic and inorganic components. Some of them are hazardous to living organisms particularly dyes and surfactants. Toxicity studies of these waste is gaining importance as this can cause biochemical changes which in turn alter the growth, reproduction and survival of fish. Carbohydrates are the first and immediate source of energy to be utilized to a greater extent in the stress condition. Exposure to any kind of pollutant or toxicants results in stress which ultimately results in a reduction of total carbohydrates content in various tissues. Significant decreases in carbohydrate level may be due to high energy demand required for the hepatic synthesis of detoxifying enzymes. Since fishes are important in the diet of humans, biomonitoring of water and fish has to be undertaken for the safety of food. Present study results indicated that even after treatment, the effluent possesses toxicants to the level of causing severe effects on biochemical parameters of fish and thus, suggested that the treatment process is still to be improved.

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CONFLICT OF INTERES

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

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