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Alteration of lipid content in the fresh water carp, *Cyprinus carpio* under the toxic stress of industrial effluent

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ABSTRACT

Contamination of aquatic ecosystems by industrial effluents causes harmful effects on health, growth, survival of aquatic animals like fishes which serves as a useful model for assessing the effect of chemicals mixed in the aquatic environment. Present study investigated the effect of sub-lethal concentrations (1.5%, 2 and 2.5%) of the treated textile bleaching effluent on the total lipid content in muscle, gill, liver and intestine of *Cyprinus carpio* after exposure to 28 days. A significant decrement in total lipid content suggested that lipid might have utilized for the energy demand under the condition of stress.

Key words : *Textile bleaching effluent, Cyprinus carpio, Total Protein, Toxicity*

Introduction

Water bodies are constantly being contaminated by various pollutants like chemical compounds, industrial and agricultural wastes. Industrial wastes are undesired outcomes of economic development and in India, only 60% of 13500 million liters or more of industrial effluent discharged daily by industries is treated. When discharged into rivers, streams, other aquatic reservoirs cause a reduction in the quality of water which leads to health hazards in the aquatic organisms especially fish (Tasneem and Yasmeen, 2020). Fishes are extremely sensitive to any kind of pollutants present in water and theses pollutants can infuse physiological and biochemical changes in the fish which in turn lead to growth inhibition (Han *et al*., 2019) cell death, immunological impairement, ineffective tissue repair, premature aging, and carcinogenesis (Malik *et al*., 2009; Singh *et al*., 2018). Alteration in the general physiology and metabolism of fishes can be evaluated by their biochemical and heamatological indices (Ogundiran *et al*., 2021).

Many authors elucidated the impact of exposure of industrial effluents on the biochemical components in the tissues of fishes (Mamta and Singh, 2017; Borgia *et al*., 2019; Prakash and Upadhyay, 2022). Lipids play an important role in the architectural dynamics as well as transport mechanism across cell membrane (Gijare *et al*., 2011) biochemical adaptation of animal to stress condition (Swami *et al*., 1983). Hence the present investigation was undertaken to study the sublethal effects of textile bleaching industrial effluent on the total lipid content in the freshwater fish, *Cyprinus carpio*.

Materials and Methods

Healthy *Cyprinus carpio* fingerlings weighing 1±0.5 gm were collected from the fish farm in Aliyar and

brought to laboratory with suitable precautions. Fish were acclimatized to laboratory conditions for a period of 30 days at room temperature. 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. Toxicity of treated effluent to *C. carpio* was studied by static bio assay method (Trivedi *et al*., 1987). LC_{50} values for 24 hours was calculatedby employing probit analysis (Finney, 1971). It was calculated as 27.23%.

Three sublethal concentrations of 1.5%, 2% and 2.5% effluent were prepared with unchlorinated tap water. Healthy fishes 40 each were recruited from the stock and separately introduced into effluent medium and reared for 28 days. A control group was also maintained. They were fed *ad libitum.* Feces and food remnants were removed daily and medium was changed every 96 hours. Fish were starved for 24 hours prior to estimation. Both experimental and control fishes were sacrificed on 7th, 14th, 21st and 28th days of exposure. Muscle, gills, liver and intestine were dissected, weighed, homogenized in known volume of phosphate buffer (pH 7.0 0.01M) and centrifuged. Supernatant was taken for estimation of total lipid (Folch *et al*., 1957). The results (each value represents the mean (±SD) of 3 estimations) obtained were subjected to statistical analysis using SPSS software.

Results and Discussion

Figure 1 represents the changes in the lipid content in various tissues of fish exposed to textile bleaching effluent in comparison to control for 7, 14, 21 and 28 days respectively. In muscle, initial lipid content was 6.42±0.43 mg/g wet tissue. It decreased to a level of 0.927±0.08 mg/g wet tissue on exposure to 1.5% effluent. Thew amount of decline was 5.49 mg/g wet tissue (Table 1). On the 28th day of experimental period, lipid content in fishes exposed to 2 and 2.5% effluent were 0.853± 0.08 mg/g wet tissue and 0.796±0.21mg/g wet tissue respectively. In liver, control fish showed an initial lipid content of 9.92 ±1.91 mg/g wet tissue. On exposure to 1.5% effluent, it decreased to an amount of 7.72 mg/g wet tissue on the 28th day of experiment. On exposure to 2 and 2.5% effluent, the total reduction in lipid content was 8.83 and 8.89 mg/g wet tissue respectively. A similar trend was observed in the lipid content of gill tissue. The amount of reduction was from 5.83± 1.24 mg/g wet tissue to 4.16, 4.87 and 4.92 mg/g wet tissue at 1.5%, 2% and 2.5% effluent respectively. In the intestine, lipid content reduced to the levels of 0.362±0.21 mg/ g wet tissue, 0.862±0.21 mg/g wet tissue and 0.403±0.18 mg/g wet tissue respectively at 1.5%, 2% and 2.5% effluent from the initial amount of 3.89±0.93 mg/g wet tissue. Maximum decline in lipid content was observed in liver tissue followed by muscle, gill and intestine. Statistical analysis showed a significant reduction ($P<0.05$) in lipid content of various tissues on exposure to different sublethal effluent concentrations.

Lipid content is an essential organic constituent in animal tissues that plays the key role in energy metabolism. They form rich energy reserves whose calorific value was reported to be twice than that of an equivalent weight of carbohydrates or proteins (Gurr *et al*., 2016) also vital to embryogenesis (Chezhian *et al*., 2010). Any stress is found to change the course of events associated with lipid synthesis (Prakash and Verma, 2019).

Under sublethal exposure of *C. carpio* to textile bleaching effluent, an overall decrement in the total

Table 1. Alteration of lipid 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	1.522.5	6.42	0.92, 70.85, 30.796	5.49, 5.57, 5.62	85.51, 86.76, 87.54
Liver	1.522.5	9.92	2.2, 0, 1.09, 1.03	7.72, 8.83, 8.89	77.82, 89.01, 89.62
Gill	1.522.5	5.83	1.6, 70.95, 60.906	4.16, 4.87, 4.92	71.36, 83.53, 84.39
Intestine	1.522.5	3.89	0.36, 20.86, 20.403	3.53, 3.03, 3.49	90.75, 77.89, 89.72

Values are expressed in mg/g wet tissue.

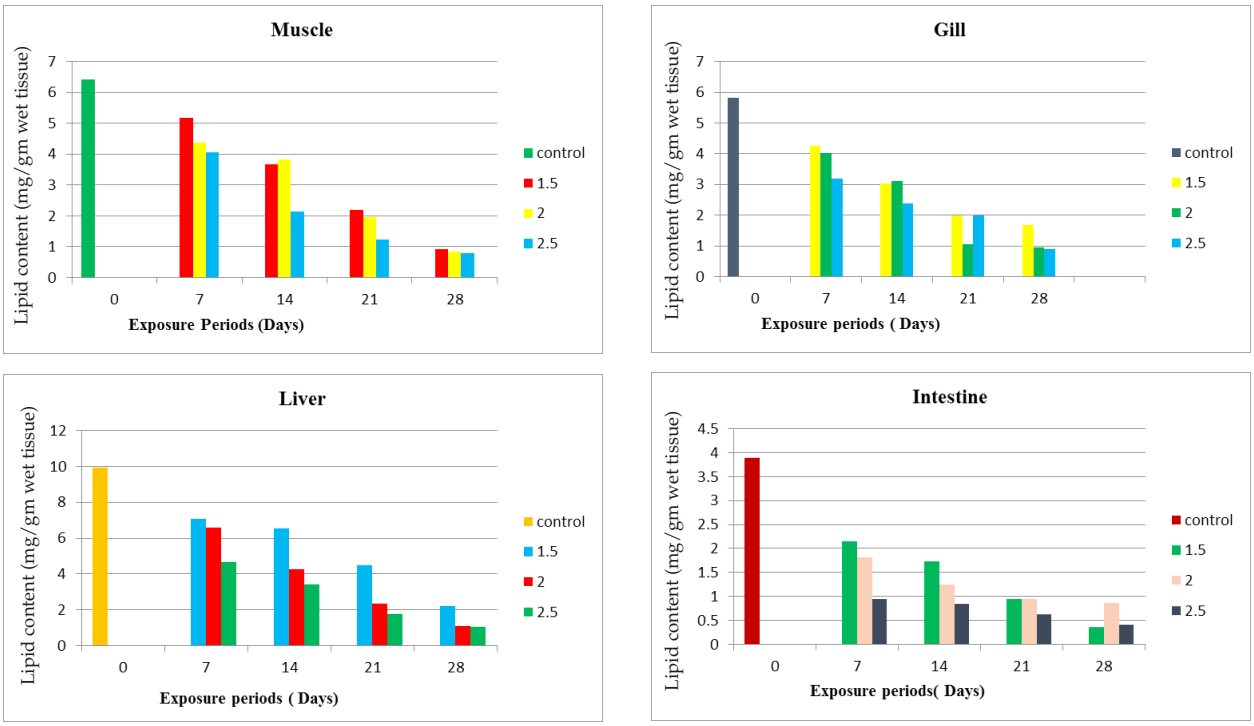

Fig. 1. Sublethal effect of treated textile bleaching effluent on lipid content (mg/g wet tissue) in various tissue of *Cyprinus carpio* at different exposure period

lipid levels in all the tissues was observed. Such decline in lipid content in tissues under stress conditions were reported earlier. Drastic decrease in lipid content in liver tissues of *Cirrhinus mrigala* exposed to cement factory effluent (Juginu *et al*., 2015), in muscle, gill, liver and kidney tissues in *Catla catla* exposed to electroplating effluent (Ambikadevi *et al*., 2016) were reported.Lipid content in the tissues under toxic stress declined due to sudden decrease in glycogen content in the same tissue, an intermediate energy resource during stress condition (Kamaraj andThamilmani, 2016) mitochondrial injury which impaired the function of TCA cycle (Sander *et al*., 2016) liver dysfunction or mobilization of glycerol or inhibition of oxidative phosphorylation (Tao *et al*., 2018). Low level of lipids recorded in the effluent treated fish suggests that pollutants might inhibit lipid synthesis and started mobilizing the stored lipids either through β-oxidation or through a gradual unsaturation of lipid molecules to meet the energy requirement of fish under stress conditions.

Investigations into the effects of textile bleaching effluent revealed that it is toxic to aquatic organisms and causes reduction in the lipidcontent of *C. carpio.* It is therefore suggested that adequate care should be taken to neutralise and detoxify the toxicants present in the effluent prior to its discharge.

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Conflict of interest

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

References

Ambikadevi, A.P., Kumari, B.S., Kumar, M.M., Drishya, M.K. and Aswin, B. 2016. Changes in the biochemical components in the tissues of fresh water fish, *Catlacatla* exposed to electroplating effluent. *International Journal of Recent Advances in Multidisciplinary Research.* 3(5): 1433-1436.

Borgia, V.J.F., Thatheyus, A.J. and Murugesan, A.G. 2019. Impact of electroplating industry effluent on the electrophoretic protein pattern of serum in the fresh water fish *Cyprinus carpio*. *Indian Journal of Biochemistry and Biophysics*. 56: 460-465.

Chezhian, A., Kabilan, N., Kumar, S.T., Senthamilselvan, D. and Sivakumari, K. 2010. Impact of common mixed effluent of sipcot industrial estate on histopathological and biochemical changes in estuarine fish *Lates calcarifer*. *Curr. Res. J. Biol. Sci*. 2: 201-209.

Finney, D.J. 1971. *Probit Analysis*. 3rd Edition. Cambridge University Press, London. 333.

Folch, J., Less, N. and Stanely, G.H.S. 1957. A simple method for the isolation and purification of total lipids from animal tissues. *J. Biol. Chem*. 220 : 497-507.

Gijare, S.S., Raja, I. A., Tantarpale, V.T. and Kulkarni, K.M. 2011. Lipid changes in the freshwater fish *Ophiocephalus punctatus* exposed to synthetic pyrethroid cypermethrin. *Biosci. Biotech. Res. Comm*. 4(1): 52-54.

Gurr, M.I., Harwood, J.L., Frayn, K.N. and Murphy, D.J.and Michell, R.H. 2016. *Lipids: Biochemistry, Biotechnology and Health.* 6th edition. Wiley-Blackwell, pp. 391.

Han, J.M., Park, H.J., Kim, J.H., Jeong, D.S. and Kang, J.U. 2019. Toxic effects of arsenic on growth, hematological parameters, and plasma components of starry flounder, *Platichthys stellatus*, at two water temperature conditions. *Fisheries and Aquatic Sciences*. 22(3): 1-8.

Juginu, M.S., Kumari, B.S. and Kumar, M.M. 2015. Biochemical study on the effect of cement factory effluent on the fresh water fish, *Cirrhinusmrigala*. *International Journal of Recent Advances in Multidisciplinary Research.* 2(11): 958-960.

Kamaraj, C. and Thamilmani, K. 2016. Impact of biochemical parameters of freshwater fish *Cirrhinus mrigala* exposed to polycyclic aromatic hydrocarbon effluent. *Int. J. Adv. Res. Biol. Sci.* 3(12): 152-159.

Malik, M.K., Kumar, P., Seth, R. and Rishi, S. 2009. Genotoxic effect of paper mill effluent on chromosomes of fish *Channa punctatus*. *Curr. World Env.4:* 353-357.

Mamta, K. and Singh, A. 2017. Hematological and biochemical changes induced by water pollutants in fishes collected from Ramgarh lake of Gorakhpur (UP) India. *International Journal of Life-Sciences Scientific Research*. 3(1): 792-799.

Ogundiran, M. A., Ayandiran, T.A., Olasunmibo, A.O., Olanipeku, A.S. and Okaseun, O.T. 2021. Changes in some behavioural, hematological and biochemical indices of air breathing *Clariasgariepinus* (Buchell, 1822) exposed to pharmaceutical effluent. *African Journal of Biotechnology*. 20(7): 287-292.

Prakash, S. and Upadhyay, K.S. 2022. Effect of paper mill effluent on the lipid profile of fresh water snake headed fish, *Channa punctatus* (Bloch, 1793). *Letters in Applied Nano Bioscience*. 11(2): 3430-3440.

Prakash, S. and Verma, A.K. 2019. Effect of arsenic on lipid metabolism of a fresh water cat fish, *Mystusvittatus*. *Journal of Fisheries and Life Sciences*. 4(1): 33-35.

Sander, M., Violante, H.S., Ventura, F.V. and Wanders, R.J.A. 2016. The biochemistry and physiology of mitochondrial fatty acid β-oxidation and its genetic disorders. *Ann. Rev. Physiol*. 78 : 23-44.

Singh, D.P., Upadhyay, S.K., Sharma, V. and Kumar, N. 2018. Effect of endosulfan on ATPase activity in liver, kidney and muscles of *Channa punctatus* and their recovery response. *Bull. Pure Appl. Sci. Zool.* 37A (1): 21-26.

Swami, K.S., Jagannadhan Rao, K.S., Sathyavelu Reddy, K., Srinivasmurthy, K., Lingamurthy, G., Chetty, C.S. and Indira, K. 1983. The possible metabolic diversion adapted by the fresh water muscle to counter the toxic metabolic effect of selected pesticide. *Ind. J. Anim. Physiol*. 1 : 95-106.

Tao, Y.F., Qiang, J., Bao, J.W., Chen, D.J., Yin, G.J., Xu, P. and Zhu, H.J. 2018. Changes in physiological parameters, lipid metabolism, and expression of microRNAs in genetically improved farmed tilapia (*Oreochromis niloticus*) with fatty liver induced by a high-fat diet. *Front. Physiol.* 9(1521): 1-14.

Tasneem, S. and Yasmeen, R. 2020. Biochemical changes in carbohydrate metabolism of the fish *Cyprinus carpio* during sublethal exposure to biopesticide-Derisom. *Iranian Journal of Fisheries Sciences*. 19(2): 961-973.

Trivedy, P.K., Goel, P.K. and Trisal, C.L. 1987. *Practical Methods in Ecology and Environmental Sciences*. Environmental Publications, Karad.