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IMPACT OF TEXTILE INDUSTRY EFFLUENT ON THE CATFISH *MYSTUS GULIO*

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ABSTRACT

Pollution may be defined as fouling of the environment. It is an undesirable change in the physical, chemical or biological characteristics of the land, air and water that may or will harmfully affect human life or that of desirable species. The physiological, biochemical and histological changes in *Mystus gulio* after exposure to sublethal concentrations of the dairy industry effluent have been investigated. The physiological and biochemical changes in *Mystus gulio* after exposure to sublethal concentrations of the textile industry effluent have been investigated for the period of 21 days. Two different concentrations of textile industry effluents were used to carry out the experiment viz 25 cm^3/dm^3 and 50 cm^3/dm^3. The results of physiological and biochemical changes in muscles and blood of *Mystus gulio* showed that, fish were under considerable stress during the exposure periods to the sublethal doses. The results obtained in the present study showed that, the industrial effluents from textile caused marked depletion in the biochemical composition of muscles and blood parameters of fish *Mystus gulio* after the exposure period. The biochemical changes, protein, lipid and carbohydrate were recorded.

KEYWORDS: Textile industry effluent, toxicity of fishes, *Mystus gulio*, Physiological response, Biochemical changes.

INTRODUCTION

Today most environmental problems are attributed to the production and release of toxic chemical capable of interacting with the environment and disrupting the ecosystem. Water pollution has many sources. The most polluting of them are the city sewage and industrial waste discharged into the rivers. Industrial waste is defined as waste generated by manufacturing or industrial processes. The types of industrial waste generated include cafeteria garbage, dirt and gravel, masonry and concrete, scrap metals, trash, oil, solvents, chemicals, weed grass and trees, wood and scrap lumber, and similar wastes. Industrial waste which may be solid, liquid or gases held in containers, is divided into hazardous and non-hazardous waste. Hazardous waste may result from manufacturing or other industrial processes.

Textile industries represent a very diverse sector in terms of raw materials, processes, products and equipments and have very complicated industrial chain (Savin and Butnaru, 2008). A number of dyes, chemicals and other materials are used to impart desired grade and quality to fabrics. These industries generate substantial quantity of effluents, which contaminates the natural water bodies altering their physical, chemical and biological nature. Textile effluents can seep into aquifer, thus, polluting the underground water. The impact of textile industry on environment, both in terms of the discharge of pollutants and of the consumption of water and energy has long been recognized (Lacasse and Baumann, 2006).

Textile processing employs a variety of chemicals, depending on the nature of the raw material and product (Aslam et al., 2004). Major pollutants in textile wastewaters are high suspended solids, chemical oxygen demand, heat, colour, acidity, and other soluble substances. Colour is imparted to textile effluents because of various dyes and pigments used. In addition to dyes, various salts and chemicals are the major sources of heavy metals in wastewater.

Sediments, suspended and dissolved solids are important repositories for toxic heavy metals and dyes causing rapid depletion of dissolved oxygen leading to oxygen sag in the receiving water (Alihameed and Ahmed, 2008). The metals and contaminants like dyes tend to persist indefinitely, circulating and eventually accumulating throughout the food chain. The dyes and metals have direct and indirect toxic effects in the form of cancers and allergies besides, inhibiting growth at different trophic levels (Kant Rita, 2012).

Alteration in the chemical composition of a natural aquatic environment by industrial effluents, usually induce changes in the behavioural, biochemical and pathological aspects of the inhabitants, particularly fish (Edwards, 1973). The effluents released from tanneries, pulp factories, paper mills, sugar factories etc., and are having large amounts of toxic chemicals, which cause death of organisms. The level of toxicity of these chemicals may be either increase or decrease, when the effluent is stored.

Although there are several papers available on the effects of the effluent of the Copper to aquatic organisms (Hamza *et al.*, 1985, Mourad, 1995, Aboul-Naga and Allam, 1996), yet no information has been published about physiological and histological changes following the exposure to this waste water. The measurement of these changes may provide a sensitive method for predicting the effect of chronic exposure on survival, reproduction and growth. Therefore, the main objective of this study is to assess the physiological and Biochemical changes in *Mystus gulio* after exposure to sublethal concentrations of the effluent of the textile industry.

MATERIALS AND METHODS

Effluent was collected from Textile industry effluent, Tirupur, Tamil Nadu, India for a period of one year (October 2016 to September 2017). Samples were collected in large sterilized container and brought to the laboratory. The effluent samples were filtered through cotton to remove suspended coarse particles before use. About 150 litre of raw effluents from the canal was collected in clean polyethylene containers and stored at room temperatures.

The fish is abundant, inhabiting mouths and tidal parts of rivers, and adjacent coastline in and around Adirampattinam. Live specimens were caught from natural habitats of local backwaters of Agniyaru estuary, situated in the Thanjavur District, Tamil Nadu, India and reared in large aquarium tanks with continuous circulation of the estuarine water. Later the collected fish were acclimatized to the laboratory conditions. For the experiments fishes with 9 – 10 cms length were selected because the minimum length of the mature fish is 8 cm (Raveendran, 2000).

Acute toxicity lest was carried out according to Standard Methods for the Examination of Water and Wastewater (1975). To study the effects of sublethal concentrations of this wastewater, ten fish were introduced to each aquarium containing 50 litres of different dilutions (2.5; 5.0 cm3/dm3). The time of experiment was 4 weeks. To determine the effects of sublethal concentrations on some haematological parameters of fish, the blood was collected directly from the caudal artery into heparinized capillary tubes. Plasma protein and glucose were measured using Standard kits (Modern Laboratory Chemicals). Plasma ion concentrations of sodium and potassimn were measured using Gallenkamp flame analyser. Hematocrit was determined using microhematocrit tubes. Muscle protein concentration was measured using the method of Biuret (Gornall *et al* 1949). Muscle lipid concentration was measured using the method of Knight *et al* (1972). Moisture was determined by drying at 125°C for 3 hours and ash was measured by heating at 55^0 C for 3 hours.

RESULTS AND DISCUSSION

The results of acute toxicity test for *Mystus gulio* exposed to different concentrations of the textile industry effluent showed that the LC_{50} was 25 cm^3, which means that this wastewater is highly toxic. The toxicity of this waste water is attributed mainly to combination of several synergistic factors e,g. high concentration of heavy metals and solids besides low pH and dissolved oxygen (Mourad, 1995). Table 1 represents the physiological response of *C. catla* after exposure to sublethal concentrations of the effluent of the dairy (2.5; 5.0 cm^3/dm^3) for 30 days. A significant increase in hematocrit from 25.9% to 30.2 and 31.8% was observed after exposure to this wastewater that may be attributed to gill damage or increased demand for oxygen by certain tissues (Andersson *et al.*, 1988). Several authors also observed hematocrit value increase after exposure to heavy metals of effluents (Mc Kim *et al.*, 1970 and Hilmy *et al.*, 1987).

A significant hyperglycaemia was also recorded after exposure to this wastewater e.g. control fish had a mean plasma glucose of 56.8 mg/100 cm^3 while the-treated fish exhibited an increase in the levels of plasma glucose to 65.3 and 81.0 mg/100 cm^3, respectively. This means that the fish were subjected to some sort of hypertoxic stress. It is well known that stressful stimuli elicit rapid secretion of both glucocorticoids (Wedemeyer, 1969) and catecholamines (Nakano and Tomlinson, 1967) from the adrenal tissues of fish and both of these hormones produced hyperglycaemia (Oguri & Nace 1966). The obtained results are in agreement with Dange, (1986) and Benson *et al.*, (1987) who recorded an increase in plasma glucose levels after exposure to heavy metals of effluents.

In this study, tissue and plasma total protein were generally influenced by this wastewater which may be attributed to the relative changes in the mobilization of protein, Changes in the plasma protein concentrations may be a result of increased production of metallothionein which is a sequestering agent (Cousins, 1982). On the other hand, the elevation of plasma glucose that runs parallel to a decrease in muscle protein content may be on indication of a gluconeogenetic response. This additional source of glucose may support the fish with the required energy highly demanded to cope with the presence of a potentially harmful substances such as effluents.

An increase in the levels of plasma sodium and potassium concentrations was also observed after exposure to this wastewater. This may be attributed to the changes in the permeability to sodium and potassium at the branchial site. The obtained results are in accordance with Stagg and Shuttleworth, (1982) who found disturbances in plasma electrolyte concentrations after exposure of the fish to effluents.

The condition of fish exhibited a significant depression after exposure to this wastewater, which might be a result of elevation of the fish metabolic rate and cessation of feeding. Buckley *et al.*, (1982) showed also a decrease in the condition of fish after exposure to effluents. Changes in the muscle lipid, ash, and water content were statistically insignificant. It has caused great problems to agriculturists around the city. Many studies have been undertaken to treat the effluent water in different method. The most common method used in the industry has been taken for the study to see the efficacy of the treatment.

Table 1: Physiological and Biochemical response of *Mystus gulio* exposed to sublethal concentrations of textile industry effluent for 30 days.

S. No	Parameter		Concentration (vol./vol.)	
		Control	2.5 cm^3/dm^3	5.0 cm^3/dm^3
1	Hematocrit (%)	24.84 ± 0.09	30.2 ± 0.21*	32.1 ± 0.18*
2	Plasma protein (mg/100 cm^3)	4.98 ± 0.15	5.15 ± 0.18*	5.42 ± 0.12*
3	Plasma glucose (mg/100 cm^3)	69.5 ± 1.13	79.8 ± 1.38*	92.5 ± 1.17*
4	Plasma sodium (mmol/dm^3)	135.2 ± 1.9	141.6 ± 13.2*	145.7 ± 1.5*
5	Plasma potassium(mmol/dm^3)	14.9 ± 0.8	15.4 ± 0.6	15.9 ± 0.3*
6	Muscle protein (mg/1 00 mg)	22.5 ± 1.7	27.5 ± 1.5*	29.3 ± 1.6*
7	Muscle lipid (mg/100 mg)	1.65 ± 0.62	1.72 ± 0.42	1.86 ± 0.76
8	Water content (%)	72.20 ± 1.18	76.12 ± 1.17	78.53 ±1.11
9	Ash content (%)	5.12 ± 0.85	6.23 ± 0.19	6.86 ± 0.15
10	Fish condition (Kf)	1.12 ± 0.23	1.35 ± 0.28	1.45 ± 0.19

* Significant difference in comparison to control group.

Average of 10 fish ± standard deviation.

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