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IMPACT OF DAIRY INDUSTRY EFFLUENT ON FRESH WATER FISH *CATLA CATLA*

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ABSTRACT

An investigation was carried out to assess the dairy industry effluent on fresh water fish *Catla catla*. The physiological and biochemical changes in *Catla catla* after exposure to sublethal concentrations of the dairy industry effluent have been investigated for the period of 21 days. Two different concentrations of dairy 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 *Catla catla* 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 dairy caused marked depletion in the biochemical composition of muscles and blood parameters of fish *Catla catla* after the exposure period. The biochemical changes, protein, lipid and carbohydrate were recorded.

KEYWORDS: Dairy industry effluent, toxicity of fishes, *Catla catla*, Physiological response, Biochemical changes.

INTRODUCTION

In India, the indiscriminate discharge of raw sewage and industrial effluents has been the major source of pollution of rivers. Uncontrolled discharge of industrial effluent in Alexandria has led to severe impact on ecological balance and appreciable environmental deterioration. Heavy metals are among the pollutants that can cause pollution to aquatic organisms. Their concentrations usually show a considerable rise in the waters receiving industrial wastes.

The milk house is a critical place on a dairy farm for maintaining sanitation to produce high quality milk. The milk house is where the milk is brought from the barn by pipeline, cooled and stored. A milk house may also have a utility room, storage room, or office space. Milk houses contain a bulk tank for storing the milk, a milk receiver jar where the pipeline empties, a filtration device, in-line cooling equipment, automatic cleaning controls, and a place to wash and store milking equipment. The walls and floor are cleaned daily to maintain proper sanitation for safely handling milk. Milking equipment and pipelines are cleaned after each milking. Bulk tanks are cleaned each time they are emptied, typically once a day or every other day. The typical milking equipment cleaning regime is usually has four cycles. In addition to this one needs to consider the chemical constituents of the water at discharge, the flow rate and the volume of effluent all of which can vary immensely from process to process.

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.

Common Carp (*Catla catla*) is an important commercial species around the world to feed populations and is as an economic rather than an ornamental fish. As a group, carp provide 4 million metric tonnes of fish annually - over a quarter of all fish culture worldwide. Due to its food value, *Catla catla* is in high demand in India. It is also a candidate species in carp poly-culture systems. Thus, it is necessary to study the magnitude of nutritive efficiency on the physiological as well as chemical parameters of this important fish species.

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 *Catla catla* after exposure to sublethal concentrations of the effluent of the dairy industry.

MATERIALS AND METHODS

Effluent was collected from Dairy industry effluent, Thanjavur, Tamil Nadu, India for a period of one year (October 2015 to September 2016). 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.

Juveniles of *Catla catla* a facultative air breathing fish, were collected from the local pond of Nagappattinam, Tamil Nadu, South India while they were swimming as group; obviously they belonged to the same brood. Fish were reared individually in glass aquaria (15 cm diameter) containing 20 cm depth of fresh water (3.0 Lit.) and accumulated laboratory conditions and feeding schedule. *Catla catla* were taken as a group (Six fish in each) in a cylindrical aquarium containing 3.0 Lit. water. Before the commencement of the experiments, the fish were starved for one day. The fishes were fed with boiled eggs and fish feed every day. Water in the tank was renewed 2 to 3 times a weak. Fishes ranging in size 10.5±2 cm and weight 15.5 ± 2 gm were brought to the laboratory and acclimated under appropriate experimental conditions for two weeks. The fish were fed on a diet containing 35% of protein. The water temperature ranged from 22 to 24°C. The dissolved oxygen concentration was maintained at, or close to 100% of air Saturation by vigorous aeration.

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

Table 1. Physiological and Biochemical response of *Catla catla* exposed to sublethal concentrations of dairy effluent for 21 days.

S. No	Parameter		Concentration (vol./vol.)	
		Control	2.5 cm^3/dm^3	5.0 cm^3/dm^3
1	Hematocrit (%)	26.88 ±1.08	32.23 ±1.19*	33.81 ±0.98*
2	Plasma protein (mg/100 cm^3)	4.83 ±0.1 3	4.95±0.13*	4.99 ±0.21*
3	Plasma glucose (mg/100 cm^3)	59.80 ±4.34	69.30 ±4. 13*	82. 00 ±6.38*
4	Plasma sodium (mmol/dm^3)	140.00 ±3.79	144.50 ±3.08*	146.50 ±4.8*
5	Plasma potassium(mmol/dm^3)	13.50 ±1.10	14.60 ±1.70	15.40±1.80*
6	Muscle protein (mg/1 00 mg)	25.60 ±1.20	24.20 ±1.08*	22.30 ±1.27*
7	Muscle lipid (mg/100 mg)	1.6810.62	1.72 ±0.48	1.69 ±0.52
8	Water content (%)	80. 20 ±1.84	78.10 ±1.78	76.70 ±1.86
9	Ash content (%)	7.10+0.85	7.30 ±0.94	7.60 ±0.59
10	Fish condition (Kf)	1.62 ±0.03	1.57 ±0.03*	1.58 ±0.02*

* Significant difference in comparison to control group.

Average of 10 fish ± standard deviation.

The results of acute toxicity test for *Catla catla* exposed to different concentrations of the dairy 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 cm3/dm3) for 21 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 (McKim *et al.*, 1970 amd 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.

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