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Chronic Toxicity of Dairy Effluent on Biochemical Constituents of Fish, Blue Gourami (Trichogaster Trichopterus)

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ABSTRACT

Water is one of the most important requirements of all living beings for performing essential life functions and is considered as a precious natural resources.Industrial waste has been increased tremendously. The dairy industry is an important food industry which presents materially to fluid wastes. Hence an investigation had been carried out to estimate biochemical constituents present in different organs of fish, blue gourami (Trichogastertrichopterus). The result of impact of industry treated dairy effluent on biochemical constituents present in different organs such as gills, liver and muscle of fish, blue gourami revealed that gills was the most affected organ which showed decreased amount of biochemical constituents than that of liver and muscle of fish and among the biochemical constituents, carbohydrates was decreased drastically than lipid and proteins.

Keywords: Industry treated dairy effluent, biochemical constituents, fresh water fish, blue gourami (Trichogaster trichopterus), gills, liver and muscle.

I. INTRODUCTION

Pollution can be defined as any undesirable change in the physicochemical and biochemical properties of the environment. It is difficult to put a price tag on the cost of pollution (Arora, 2001). But due to the rapid growth of industries in the country, it has become a matter of the deteriorating environment.The situation has reached the stage where environment unable to support the industrial activity. Water pollution has become a threat to the ecosystem and act as an important cause of environment degradation.

Water pollution is the contamination of water bodies like lakes, rivers, oceans, aquifers, ground water by the disposal of pesticides and effluent discharged from various industries, sewage and so on. Industrial waste consists of both organic waste which include pesticide, residues, solvents and clearing fluids, dissolved residue from fruits and vegetables and lignin from pulp and paper etc. and inorganic wastes such as brink salts and metals. Excessive chemicals used for the above process, when discharged harden the texture of the solid act as flocculating agents that deprive the soil from wastes holding capacity.

Water resources aremost often affected by industrial waste such as dairy effluent is a serious concern throughout the world (Dhanam, 2009). There are 250 large dairy industries in the country handling some 16 million liters of waste water per day (Joseph, 1995). The untreated industrial effluent discharged on surface cause severe ground water pollution in the industrial belt of the country. Industrial effluent contaminating water bodies adversely affect organisms particularly fish.

Variation in biochemical components in response to environmental stress are authenticated by many authors which showed that effluent treatment can cause alterations in level of biochemical components depending on the toxic ingredients, individual ingredient, quantity and exposure period. Based upon these views, an investigat can has been carried out to study the impact of dairy effluent on biochemical constituents present in different organs of fish, blue gourami (*Trichogastertrichopterus*) which is used as an environmental biological indicator of pollution.

II. MATERIALS AND METHODS

Acquisition of test fish

The fresh water fish, blue gourami (*Trichogastertrichopterus)* having an average length 15 ± 1 cm and weight of about 40 ± 5 gms were collected in the clean canister of 10 liters capacity from the pond, located in Chennai. They were brought to the laboratory carefully and transferred to aerated aquarium for acclimatization. The fishes were fed daily with commercial fish feed.

Collection of dairy effluent

For the present investigation, the industry treated dairy effluent was collected from dairy industry located in Chennai, Tamil Nadu, India. Dairy effluent were collected in 40 liters capacity plastic containers and stored in the refrigerator at 20ºc until further analysis.

Experimental – fish

Blue gourami (*Trichogastertrichopterus*) small in size and indicating dots to represent with the same they are shorter finger lings. Each fish consist of 1L of water (1L = 1000 ml) around five fishes have on as same tub with an quantity of water (5L = 5000ml).The fishes were starved prior to the experiment for the period of 5 days. Arange finding bioassay was conducted by exposing the test animals to 5%, 10%, 20%, 40% and 80% concentrations of industry treated dairy effluent diluted with an dilution in ml with probation (duration) of 15 days and mortalities were recorded in that order of 5% to 80% dilutions respectively. LC_{50} value was also calculated. After 5, 10 and 15 days, the animals of both control and experimental were sacrificed by decapitation without anaesthetization. The tissues such as gills, liver and muscle of both control and experimental fishes were selected, excised and used for the estimation of biochemical constituents.

BIOCHEMICAL METHODS

Anthrone Method - Used to determine total glycogen content in tissues following the procedure of Seifter *et al.* (1950).

Lowry's Method - Total protein content was determined with FolinCiocalteau reagent following the procedure of Lowry *et al.* (1951).

Sulphophosphovanillin Method - Lipid were estimated by sulphosphovanillin reagent following the procedure of Barnes and Blackstock (1973).

III. RESULTS AND DISCUSSION

The results obtained in the present study are summarized in tables 1, 2 and 3. The Tables 1, 2 and 3 shows the results of estimation of glycogen, protein and lipid content in different organs of gills, liver and muscle on exposure to dairy effluent for the period of 15 days.Period dependent decrease in the biochemical estimations was observed throughout the exposure period. The toxicity of blue gourami (*Trichogaster trichopterus*) revealed correlation with the concentration of industry treated dairy effluent and period of exposure.

Total Glycogen Content

The carbohydrates is an important organic constituent of animal tissues and not only act as building blocks of cells, but also serve as a reservoir of chemical energy. Carbohydrates may be converted to glycogen or

shunted in the metabolic pathway to supply the carbon chain for amino acids or converted into fat.

The glycogen content (Table -1) were found to be 1.3 ± 0.09, 0.16 ± 0.05 and 0.15 ± 0.03 mg/g wt of tissue in gills of fishexposed for 5, 10 and 15 days respectively which were linearly decreased in comparison with control(2.39 ± 0.56, 2.34 ± 0.59 and 2.33 ± 0.56 mg/g wt of tissue). The value of glycogen content in the muscle of experimental groups were 1.72 ± 0.06, 0.19 ± 0.04 and 0.18 ± 0.04 mg/g wt of tissue for 5, 10 and 15 days exposure of tissue and that of control groups was (0.31 ± 0.06, 0.30 ± 0.05 and 0.29 ± 0.04 mg/g wt of tissue) . The value of liver glycogen content in the experimental groups were 0.83 ± 0.11, 0.29 ± 0.06 and 0.18 ± 0.02 mg/g wt. of tissue for 5, 10 and 15 days exposure of tissue and the control group was (2.39 ± 0.56, 2.38 ± 0.56 and 2.38 ± 0.58 mg/g wt. of tissue).

Carbohydrates are stored as glycogen in fish tissue and organ like liver in order to supply the energy needs when there are hypoxic condition and lack of food. Depletion of glycogen level in the tissues of fish in the present study indicates that glycogen acts as a major source of energy in fishes exposed to industry treated dairy effluent to over come the toxicity stress, This may be the reason for the decrease in glycogen content in the tissues of fish in the present study. The results of the study is in agreement with the work of Lakshmanan *et. al.,*(2013) who reported that the significant decrease in glycogen, protein and albumin in fish,*Oreochromis mossambicus* during treatment of dichlorvos.

Total Protein Content

Proteins are the most versatile and macromolecules in living systems and serve crucial function essentially in all biological process. Environmental stress invokes compensatory metabolic changes in the organs of an animal through modification of the quality and quantity of protein.

In the present study, the protein content (Table – 2) in gills of control fish were(3.13 ± 0.32, 3.10 ± 0.34 and 3.09 ± 0.36 mg/g wt of tissue) and that of in experimental fish were 1.6 ± 0.74 mg/g wt, 1.5 ± 0.2 and 1.7 ± 0.74 mg/g wt of tissue for 5, 10 and 15 days exposure whichwas drastically decreased. The protein content in liver of control fish were (3.5 ± 0.66, 3.5 ± 0.63, 3.5 ± 0.66 mg/g wt) and that of in experimental fishes were 2.5 ± 1.22, 2.3 ± 0.45 and 2.2 ± 0.5 mg/g wt of tissue for 5 to 15 days.The value of protein content in muscle of control fish was(3.6 ± 0.55, 3.4 ± 0.55, 3.3 ± 0.53 mg/g wt of tissue) and that of in experimental fish which showed 2.6 ± 0.4, 2.3 ± 0.60 and 1.9 ± 0.65 mg/g wt of tissue for 5, 10 and 15 days which was found to be decreased.

The gradual decrease of protein for 15 days of exposure of fish to industry treated dairy effluent may be due to the influence of exogenous factors like toxic environment. Veeriah, (2013) reported that the decreased trend of the protein content in most of the tissues may be due to metabolic utilization of the ketoacids to gluconeogenesis pathway for the synthesis of glucose. Hyalij , (2013) reported decrease in glycogen, protein and free amino acid in tissues of the *Lapidocephalus thermalis* due to effect of sugar factory effluent.

Total Lipid Content

Lipid is an important compound of animal tissue which plays a prime role in energy metabolism. Lipids are also important in cellular and sub cellular membranes. Lipids are an important component of diet, both as energy and essential fatty sources, which fish need for basic functions, including growth, reproduction and maintenance of healthy tissues (Sargent *et. al.,* 1989). When detergents affect lakes and ponds, the phosphate content act as a fertilizer and cause the rapid growth of algae which leads to the death of other organisms in the water. The amount of protein, carbohydrates and lipid content of *Labeo rohita* (fresh water fish) were also decreased

when exposed to detergent (Tide). (Pechiammal and Vasanthi, 2017).

In the present study the amount of lipid present (Table – 3) in gills was 3.8 ± 3.1, 3.0 ± 0.57 and 2.2 ± 2.10 mg/g wt, in the fishes exposed to 5 to 15 days respectively. The control value of fish in gills were (3.05 ± 1.65, 3.06 ± 1.68, 3.08 ± 1.64 mg/g wt of tissue). The lipid content in liver of control fish were (4.75 ± 2.93, 4.74 ± 2.90, 4.70 ± 2.91 mg/g wt) and that of in experimental fish were 1.8 ± 0.17, 1.7 ± 0.26 and 1.5 ± 0.26 mg/g wt of tissue for 5 to 15 days exposure which was decreased considerably. The lipid in muscle was recorded as 2.1 ± 0.19, 1.9 ± 0.21 and 0.9 ± 0.23 mg/g wt of tissue for 5, 10 and 15 days respectively in experimental group which was decreased considerably when compared with that of control (3.38 ± 0.96, 3.36 ± 0.92 and 3.30 ± 0.91mg/g wt of tissue).

Decrease in lipid content in tissues suggested that the lipid have been channelized to meet the metabolic demand for extra energy in order to mitigate the toxic stress (Gijare and Tanatarpale, 2014). The lipid level also decreased in the tissues of the fish exposed to the sub – lethal concentration of toxicant. The industry treated dairy effluent affects the rate of gluconeogenesis thereby the lipid level was reduced . The depletion of lipid content may also be due to increased utilization of lipid to meet additional energy requirements under a stress of low oxygen taken up (Kulkarni *et al.,* 1998).

Table 1. Levels of Glycogen in different tissues of fish, blue gourami on exposure to industry treated dairy effluent for a period of 15 days

Organs (mg/g wt. of tissue)	Exposure Periods			
		5 Days	10 Days	15 Days
Gills	Control	2.39 ± 0.56	2.34 ± 0.59	2.33 ± 0.56
	Experimental	1.3 ± 0.09	0.16 ± 0.05	0.15 ± 0.03
Liver	Control	2.39 ± 0.56	2.38 ± 0.56	2.38 ± 0.58
	Experimental	0.83 ± 0.11	0.29 ± 0.06	0.18 ± 0.02
Muscle	Control	0.31 ± 0.06	0.30± 0.05	0.29 ± 0.04
	Experimental	1.72 ± 0.06	0.19 ± 0.04	0.18 ± 0.04

Mean ± Standard Deviation

Table 2. Levels of Protein in different tissues of fish, blue gourami on exposure to industry treated dairy effluent for a period of 15 days

Organs (mg/g wt. of tissue)	Exposure Periods			
		5 Days	10 Days	15 Days
Gills	Control	3.13 ± 0.32	3.10 ± 0.34	3.09± 0.35
	Experimental	2.8 ± 0.70	2.4 ± 0.2	1.7 ± 0.74
Liver	Control	3.5 ± 0.66	3.5 ± 0.63	3.5 ± 0.66
	Experimental	2.5 ± 1.22	2.3 ±0.45	2.2 ± 0.5
Muscle	Control	3.6± 0.55	3.4± 0.55	3.3 ± 0.53
	Experimental	2.6 ± 0.4	2.3 ±0.60	1.9 ± 0.65

Mean ± Standard Deviation

Table 3. Levels of Lipid in different tissues of fish, blue gourami on exposed to industry treated dairy effluentfor a period of 15 days

Organs (mg/g wt. of tissue)	Exposure Periods			
		5 Days	10 Days	15 Days
Gills	Control	3.05 ± 1.65	3.06 ± 1.68	3.08 ± 1.64
	Experimental	2.2 ± 2.10	3.8 ± 3.1	3.0 ± 0.57
Liver	Control	4.75 ± 2.93	4.74 ± 2.91	4.70 ± 2.91
	Experimental	1.8 ± 0.17	1.7 ± 0.26	1.5 ± 0.26
Muscle	Control	3.38 ± 0.96	3.36 ± 0.92	3.30 ± 0.91
	Experimental	2.1 ± 0.19	1.9 ± 0.21	0.9 ± 0.23

Mean ± Standard Deviation

IV. CONCLUSION

From the results of the present investigation, it can be concluded that changes in glycogen, protein and lipid content in fish, indicates biochemical manifestation due to the toxic action of toxicants when fishes were exposed to dairy effluent for a period of 15 days. The changes in biochemical constituents of fish will naturally affect the nutritive value of aquatic fauna and deteriorating the value of fish and in turn it will also be great danger to human being due to continuous consumption of fish.

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