Impact Of Dairy Effluent On Biochemical Constituents in Gills, Liver and Muscle Of Fresh Water Fish, Blue Gourami

(*Trichogaster trichopterus*)

Nishra Banu .S [1] , Noorjahan C.M [2]

[1,2] P.G.and Research Department of Zoology , Justice Basheer Ahamed Sayeed College for Women , Teynampet , Chennai – 600018 , Tamil Nadu , India .

Abstract- Water used in domestic and industrial application can become polluted to varying degrees. The dairy industry is an important part of the overall food industry which contributes materially to fluid wastes. Hence an investigation had been carried out to study the physico chemical parameters of dairy effluent and its effect on biochemical constituents present in different organs of fish, blue gourami (Trichogaster trichopterus). The results of analysis of physicochemical parameters revealed that industry treated dairy effluent was greyish black in colour with disagreeable odour. pH was alkaline with low organic load such as EC, TSS, TDS, BOD and COD, indicating high pollution potential of the effluent. The results of impact of industry treated dairy effluent on biochemical constituents present in different organs of fish, blue gourami showed that among the different organs of fish such as gills, liver and muscle studied for biochemical estimation, gills was most affected organ which showed decreased amount of biochemical constituents than that of liver and muscle of fish and also carbohydrates was decreased drastically than lipid and protein.

Index Terms- Industry treated dairy effluent, physicochemical parameters, biochemical constituents, gills, muscle and liver, fresh water fish, blue gourami (Trichogaster trichopterus).

I. INTRODUCTION

Pollution is the introduction of contaminants into the natural environment that cause adverse change to the environment. 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. But due to the rapid growth of industries in the country, pollution of natural water by industrial waste has increased tremendously (Muthusamy and Jayabalan, 2001)[1]. Water pollution is one of the biggest environmental issues we have today.

Water is often contaminated by pollutants like fertilizers, pesticides, effluent discharged from industries, sewage and so on. Organic waste include pesticide residues, solvent and clearing fluids dissolved residue from fruits, vegetables and lignin from pulp and paper can also contain inorganic wastes such as brink salts and metals. Excessive chemicals used for the above process, when discharged, harden the texture of the soil, act as flocculating agents that deprive the soil, its water holding capacity .

The treated effluents are discharged into aquatic culture ponds where large quantities of fish are cultivated. 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 the fish. Evolution of metal based industries has lead to the contamination of environment with heavy metals (Larson et al. ,1985)[2]. With the growing industrialization and urbanization boost the economy of the century on one hand and on the other hand act as threat to environment, Sangeetha Arora et al. ,(2011) [3].

Alteration in biochemical components in response to environmental stress are authenticated by many authors which revealed that effluent treatment can cause alteration in level of biochemical components depending on the toxic ingredients, individual ingredient quantity and exposure period. keeping these views in mind, it is decided to investigate the impact of dairy effluent on biochemical constituents of fish, blue gourami *(Trichogaster trichopterus*) that is used as environmental biological indicator of pollution.

II. MATERIALS AND METHODS

2.1 Procurement of test fish

The fresh water fish, blue gourami *(Trichogaster trichopterus*) having average length 15±1 cm and weight about 40±5 gm were collected in the clean containers of 10 liters capacity from the pond, located in Chennai. ensuring that they were not harmed either physically during collection and transportation. They were brought to the laboratory and transferred to aerated aquarium for acclimatization. The fishes were fed daily with commercial fish feed.

2.2 Collection of dairy effluent

For the present study, the industry treated dairy effluent was collected from dairy industry located in Chennai, Tamilnadu, India. Dairy effluent were collected in 40 liters capacity polythene containers, stored in the refrigerator at 20º c until further analysis.

2.3 Physicochemical parameters of dairy effluent

The physicochemical parameters such as colour, odour, pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Oil and Grease (O & G), Sodium, Chloride of industry treated dairy effluent were determined by following the standard methods of APHA,(1989)[4].

2.4 Plan of Experiment

Blue gourami*(Trichogaster trichopterus*) small in size and indicating dots to represent with the same they are shorter finger lings. As practically undergone with an dilution in ml (milliliters). Since the five fishes have undergone a practical demonstration. Each fish consist of 1L of water (1L = 1000 ml) around five fishes have on an same tub with an quantity of water (5L = 5000 ml).A range 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 96 hrs and mortalities were recorded in that order of 5 % to 80 % dilutions respectively. The LC_{50} values were also calculated. The fishes were starved prior to the experiment for the period of 24 hrs. After 96 hrs, 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 biochemical estimation.

2.6 Biochemical Methods

2.6.1 Anthrone method - Used to determine total glycogen content in tissues .Seifter et .al., (1950) [5].

2.6.2 Lowry's Method -Total protein content was determined with Folin Ciocalteau reagent. Rosenbrough et. al.,(1951). [6]

2.6.3 Sulphophosphovanillin method – Lipid were estimated by sulphosphovanillin reagent .Barnes and Blackstock (1973) .[7]

III. Results

The results obtained in the investigations are summarized in table 1 and 2. The analysis of physicochemical parameters (table -1) showed that the industry treated dairy effluent was greyish black in colour with disagreeable odour. The electrical conductivity(EC)of treated dairy effluent was 2207 µmhos/cm. TSS level of treated dairy effluent was 12 mg/L. TDS of the treated dairy effluent was 1540 mg/L. BOD levels of the treated dairy effluent was 60 mg/L. COD levels of the treated dairy effluent was 180 mg/L. Calcium content in the industrial treated effluent was 76 mg/L. Sodium content in industrial treated effluent was 325 mg/L. The sulphate content in industrial treated effluent 134 mg/L. Nitrate content in the industrial treated effluent was 44 mg/L. and Chloride content in industrial treated effluent was 267 mg/L.

The Table 2, shows the results of estimation of protein, glycogen and lipid content in different organs of gills, liver and muscle. Period dependant decrease in the biochemical constituents was observed throughout the exposure period. The toxicity of blue gourami *(Trichogaster trichopterus*) showed correlation with the concentration of industry treated dairy effluent and period of exposure.

3.1 Glycogen

The glycogen content were found to be 0.35 ± 0.04, 0.26 ± 0.04, 0.23 ± 0.03, 0.28 ± 0.02 mg/g wt of tissue in liver of fishes exposed for 24, 48, 72 and 96 hrs, respectively which were linearly decreased in comparison with control 1.3 ± 1.14 mg/g wt of tissue. The mean value of glycogen content in the muscle of experimental groups were 0.39 ± 0.47, 0.52 ± 0.07, 0.25 ± 0.05, 0.28 ± 0.04 mg/g wt of tissue for 24, 48, 72 and 96 hrs exposure of tissue and that of control groups was 0.54 ± 0.04 mg/g wt of tissue. The mean value of liver glycogen content in the experimental groups were 0.92 ± 1.10, 0.44 ± 0.33, 0.24 ± 0.06, 0.34 ± 0.22 mg/g wt. of tissue for 24, 48, 72 and 96 hrs exposure of tissue and the control group was 0.32 ± 0.055mg/g wt. of tissue.

3.2 Protein

In present investigation, total protein content in liver of control fish was found to be 4.76 ± 0.45 mg/g wt. of tissue whereas in treated fish at sub lethal concentration for 24, 48, 72 and 96 hrs were 1.25 ± 0.87, 2.3 ± 0.55, 4.53 ± 0.50, and 3.5 ± 2.30 mg/g wt. of tissue respectively, these values shows decreasing trend according to exposure period. The protein content in muscle of control fish was 3.0 ± 0.55 and that of in experimental fishes were 6.3 ± 2.8, 2.0 ± 1.26 and 2.5 ± 1.23 mg/g wt of tissue for 24 to 96 hrs. which was found to be decreased considerably, The protein content in gills of control fish was 6.9 ± 2.57 and that of in experimental fishes were 5.2 ± 0.98, 2.6 ± 0.94, 2.03 ± 0.90 and 4.8 ± 2.03 mg/g wt of tissue for 24, 48, 72 and 96 hrs exposure which was drastically decreased.

3.3 Lipid

The lipid in gill was recorded as 1.23 ± 0.16, 3.5 ± 0.15, 1.1 ± 0.67 and 1.3 ± 0.23 mg/g wt of tissue for 24 to 96 hrs respectively in experimental group which was decreased considerably when compared with control i.e. 1.66 ± 0.33 mg/g wt. of tissue. The lipid content in muscle was found to be 1.1 ± 2.86, 3.8 ± 0.15, 1.46 ± 0.09 and 2.8 ± 1.15 mg/g wt. of tissue for 24 to 96 hrs and 4.03 ± 0.15 mg/g in control fish. The lipid content in liver of control fish was 2.0 ± 0.152 mg/g and that of in experimental fishes were 2.9 ± 3.98, 2.4 ± 1.44, 1.7 ± 0.21, and 1.8 ± 0.23 mg/g wt. of tissue for 24, 48, 72 and 96 hrs. which was decreased considerably.

IV. Discussion

In the present study, the analysis of physico chemical parameters of industry treated dairy effluent showed that the dairy effluent was greyish black in colour with disagreeable odour, high BOD, COD, TSS and TDS which is in agreement with the work of Capoor and Singh et al. , (1998). [8] colour and disagreeable odour of the effluent could be due to decomposition of organic matter or presence of various aromatic and volatile organic compounds. The pH of dairy sample was 7.9 mg/L, which is within the CPCB (1995) [9] limit for discharge of effluents into inland surface water irrigation . Though the pH is alkaline in fresh water conditions, the waste become acidic due to decomposition of lactose into lactic acid, under anaerobic conditions and may cause corrosion of sewers Joseph(1995).[10] The electrical conductivity(EC) of industry treated

effluent was 2207 µmhos/cm and they were found to be within the permissible limits (3000µmhos/cm) issued by irrigation guidelines . Suspended solids was 12 mg/L.With regards to the TDS, the value was 540 mg/L when compared to the permissible limit (2100 mg/L). TDS level of water exceeded 500 mg/L. BOD value was 60 mg/L. which was high than the permissible limit of BOD is (30 mg/L) prescribed by CPCB (1995) for effluent discharged into inland surface waters.

The ions especially calcium, sulphate, sodium and total hardness, affect the water and make it unsuitable for drinking by the animals. It may be noted that the Ca, Na, SO_4 and including chloride were found to be less in concentration prescribed by CPCB (1995) [9]. Analysis of physicochemical parameters of the dairy effluent confirms that the waste water released from the dairy industry has higher concentration of BOD and Sodium compared to other permissible limits . Apart from BOD and Sodium other physicochemical parameter values are within the permissible limits. (Goel, 2000) [11].

With regards to acute toxicity studies of the fishes were transferred into five dilutions along with an sub lethal concentration. Sub lethal concentration which varies from 20 % to 80 % as per the dilution in the water accumulated (added). with an concentration of 20 % exposed for 96 hrs and recorded the mortality rate of the fishes. The 96-h LC_{50} values of industry treated dairy effluent on fish, blue gourami (*Trichogaster trichopterus*) was 20 % respectively. The effect of industry treated dairy effluent on biochemical constituents present in the gills, liver and muscle of experimental fish, blue gourami (*Tichogaster trichopterus*) exposed to various periods revealed a significant decrease in glycogen, protein and lipid content. . During stress, organism need sufficient energy which is supplied from reserve food material i.e. protein, glycogen and lipid. In present investigation glycogen, protein and lipid content were recorded to be decreased in various organs of fish .similar results were reported by Satyavardhan(2013) .[12], Lakhmanan (2013) .[13].

Table1 :Physico – Chemical Characteristics Of Industry Treated Dairy Effluent

Physical Examination	**CPCB(1995)**	**Industrytreated dairy effluent**
Colour	Colourless	Greyish Black
Odour	Odourless	Disagreeable
Electrical Conductivity µmhos/cm	3000	2207
Total Suspended Solids mg/L	2100	1540
Total Dissolved Solids mg/L	3000	2207
Chemical Examination		
pH	6.5 - 8.5	7.99
BOD	30	60
COD	250	180
Total hardness (as $CaCO_3$) mg / L	600	290
Calcium (as Ca) mg / L	150	76
Sodium (as Na) mg / L	200	325

V. Conclusion

Based upon the results of the present study, it can be concluded that changes in glycogen, protein and lipid content in fish, indicates biochemical manifestation due to the toxic action of toxicants. Toxicant induce its effect at cellular or even at molecular level and ultimately causes biochemical alterations as evidenced in the present study. The changes in biochemical composition of fishes 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 such fish.

VI. Acknowledgement

The author grateful to Principal and Head, Dept of Zoology, Justice Bsheer Ahamed Sayeed College for women , Chennai , for providing necessary facilities during present work.

Nitrate (as NO_3) mg / L	50	44
Chloride (as Cl) mg / L	750	267
Sulphate (as SO_4) mg / L	750	134

Table 2 : Effect of industry treated dairy effluent on the biochemical constituents in different organs of fish, blue gourami (Trichogaster trichopterus)

Tissue	Biochemical Constituents	Control	24 hrs	48 hrs	72 hrs	96 hrs
Gill	Glycogen mg /g wt. of tisse	1.3 ± 1.14	0.35 ± 0.04	0.26 ± 0.04	0.23 ± 0.03	0.28 ± 0.02
	Protein mg/g wt. of tissue	6.9 ± 2.57	5.2 ± 0.98	2.6 ± 0.94	2.03 ± 0.90	4.8 ± 2.03
	Lipid mg/g wt. of tisse	1.66 ± 0.33	1.23 ± 0.16	3.5 ± 0.15	1.1 ± 0.67	1.3 ± 0.23
Liver	Glycogen mg /g wt. of tissue	0.32 ± 0.055	0.92± 1.10	0.44 ± 0.33	0.24 ± 0.06	0.34 ± 0.22
	Protein mg/g wt. of tissue	4.76 ± 0.45	1.25± 0.87	2.3 ± 0.55	4.53 ± 0.50	3.5 ± 2.30
	Lipid mg /g wt. of tissue	2.0 ± 0.152	2.9 ± 3.98	2.4 ± 1.44	1.7 ± 0.21	1.8 ± 0.28
Muscle	Glycogen mg / g wt. of tissue	0.54 ± 0.04	0.39 ± 0.47	0.52 ± 0.07	0.25 ± 0.05	0.28 ± 0.04
	Protein mg/ g wt. of tissue	3.0 ± 0.55	6.3 ± 2.8	2.0 ± 1.26	1.66 ± 0.96	2.5 ± 1.25
	Lipid mg/g wt. of tissue	4.03 ± 0.15	1.1 ± 2.86	3.8 ± 0.15	1.46 ± 0.09	2.8 ± 1.15

± - Satandard deviation

REFERENCES

[1] Muthusamy, A. and Jayabalan, N. Effect of factory effluent on physiological and biochemical contents of *Gossypium hirsutum* L. J. Environ. Biopl. 22 (4) : 237 – 242. (2001).

[2] Larson. A and Haux, C. Altered carbohydrate metabolism in fish exposed to sublethal levels of cadmium J. environmental biology. 3: 71 -81.(1982).

[3] Sangeetha L Arora (2011) et.al., Research of Environmental Toxicology, 5(2) , 125 – 132.

[4] APHA, Standard methods for the examination of water and wastewater, 17th edition.

[5] Seifter S., Dayton S., Novic B., Muntwyler E. The estimation of glycogen with the anthrone reagent, Arch, BioChem. Biophy., 25(1), pp 191 – 200, (1950).

[6] Lowry O.H; Rosenbrough N.J; Farr A.L and Randall R.J. protein measurement with the Folin – phenol reagent ; J. Biol.Chem., 193 : 265 - 273, (1951).

[7] Barnes, H. and Blackstock, Z.J. Estimation of lipids in marine and tissue. Detailed investigation of the phosphovanillin method for total lipids. Journal of Experimental Marine Biology and Ecology, 12, pp. 103 – 118, (1973).

[8] Capoor and Singh et al., Fermentation of whey modifications issued their under central pollution control board, New Delhi. (1995).

[9] CPCB, Pollution control : acts, rules and modifications issued their under central pollution control board , New Delhi. (1995).

[10] Joseph, K. Pollution control in dairy industry , paper presented at Tamil Nadu, veterinary and animal sciences university at veterinary college on 10th Oct (1995), sponsored by institute of food and dairy technology and Tamil Nadu, pollution control board.(1995).

[11] Goel, P.K. Water pollution causes, effects and control . New age international (P) Ltd., publishers, New Delhi . (2000).

[12] Satyavardan K. Effect of fenvalarate and malathion on biochemical constituents of fish , *Ctenopharyngodon idella* World Applied sciences Journal, 27(5): 649 –655, (2013).

[13] Lakshmanan S., A. Rajendran, C. Sivasubramaniyan Impact of Dichlorvos on tissue glycogen and protein content in freshwater frr Aingerlings, Oreochromis mossambicus (peter)., International Journal of Research in Environmental Science and Technology: 3(1) : 19 – 25 (2013).

AUTHORS

First Author – Nishra Banu .S, P.G.and Research Department of Zoology , Justice Basheer Ahamed Sayeed College for Women , Teynampet , Chennai – 600018 , Tamil Nadu , India, E-Mail I.D – cmnoorjahan@gmail.com, Mobile - 9444886585.

Second Author – Noorjahan C.M, .G.and Research Department of Zoology , Justice Basheer Ahamed Sayeed College for Women , Teynampet , Chennai – 600018 , Tamil Nadu , India