Uttar Pradesh J. Zool. 32(1) : 59-65, 2012 ISSN 0256-971X

EFFECT OF DYE INDUSTRY EFFLUENT ON GROWTH AND BIOCHEMICAL CHANGES OF COMMON CARP *CYPRINUS CARPIO VAR. COMMUNIS*

M.R. RAJAN AND P. PALPANDI
DEPARTMENT OF BIOLOGY
GANDHIGRAM RURAL INSTITUTE, DEEMED UNIVERSITY
GANDHIGRAM-624 302, INDIA.
(e-mail : mrrrajan1961@yahoo.co.in)

The present study deals with the effect of dye industry effluent on growth and biochemical changes of common carp *Cyprinus carpio var. communis* grown for a period of 40 days. The dye industry effluent was collected from Chinnalapati, Dindigul, Tamil Nadu, India. Physico-chemical characteristics of dye industry effluent such as colour, pH, electrical conductivity, total solids, total dissolved solids, total suspended solids, total hardness, alkalinity, sodium, potassium, calcium, chloride, dissolved oxygen, dissolved carbon dioxide, BOD and COD were estimated. For the present study common carp *C. carpio* (1.24 ± 0.2 g) was collected from Pandian Fish Farm, Dindigul, Tamil Nadu, India. Trainee feed and experimental feed were prepared based on the protein content. Different concentrations of dye industry effluent on the survival of the carp shows that the LC_{50} at 96 hr exposure was found as 63%. Different sub-lethal concentrations of dye industry effluent such as 5, 10, 15 and 20% were utilized for growth studies. Feed consumption was higher in control and lower in Ex. IV containing 20% of dye industry effluent. Feed conversion efficiency, feed conversion ratio, growth, percentage growth, relative growth rate, assimilation, gross and net growth efficiency were lower in Ex. IV. Metabolism was higher in Ex. IV containing 20% dye industry effluent. Protein, carbohydrate and lipid content in the muscle of *C. carpio* was decreased when the concentration of effluent increased. From the results it is inferred that the feed utilization parameters of Common carp was decreased with increasing concentration of dye industry effluent.

Key words : Dye industry effluent, survival, growth, biochemical changes, common carp.

INTRODUCTION

India is the second largest producer of cotton yarn and silk and third largest producer of cotton and cellulose fiber in the world. An estimate shows that textiles account for 14% of India's industrial production and around 27% of its export earning (Ministry of Textiles, 2004). Many textile processing units in Tamil Nadu use a number of unclassified chemicals that are likely to be from the Red list Group which is said to be harmful and unhealthy (Ravikumar & Dutta, 1996). Dyes, chemicals and heavy metals from textile industries enter in to the water bodies affect the organisms including fishes. Generally fish have ability to bio-accumulate metals in their bodies (Varshney, 1991) and also alter the physico-chemical characteristics of the receiving aquatic bodies and affect flora and fauna Baruah *et al.*, 1993). The growth and breeding of common carp was affected due to the continuous discharge of effluents from industries including dye industries. The studies related to the effect of dye industry effluent on growth and biochemical changes of common carp *Cyprinus carpio var. communis* is totally wanting. Hence the present study was undertaken.

MATERIALS AND METHODS

For the present study *Cyprinus carpio* (1.24 ± 0.2g) fingerlings were collected from Pandian Fish Farm, Dindigul, Tamil Nadu, India and transported to the laboratory in

polythene bags filled with aerated drinking water. The fish were acclimated in the laboratory in round plastic aquaria (60 cm dia.) at 28 ± 2° C. During laboratory acclimation, the fish were fed with trainee feed. After a period of 15 days, fish were used for experiments.

Dye industry effluent was collected at Chinnalapati, Dindigul District, Tamil Nadu, India and transported to the laboratory in plastic containers (20 l).Immediately after transportation to the laboratory, physico-chemical characteristics such as colour, electrical conductivity, total solids, total dissolved solids, total suspended solids, hardness, alkalinity, chloride, dissolved oxygen and carbon dioxide, BOD, COD, sodium, potassium and calcium were estimated (APHA, 1990).

Experimental design for survival studies : For survival studies, the effluent was diluted in to different concentrations. Considering the original Effluent as 100%, the effluent was diluted to 10 to 100% with tap water. Different concentrations of dye industry effluent were taken in plastic aquaria (45 cm L x 30 cm B x 15 cm H). The volume of the medium in plastic aquaria was maintained as 8 liters. In each concentration of effluent 10 fish were introduced. The mortality of fish in each concentration was observed at a regular interval of 24 hr up to 96 hr exposure and was expressed in terms of percentage. From these observations the sub lethal, medium lethal and lethal concentrations were found.

Feed preparation : The raw materials are selected based on their ability to supply nutrients such as protein, carbohydrate and lipids at low cost. The ingredients used in the present study are indicated in Table I. After knowing the protein content by Micro-Kjeldhal method (Jeyaraman, 1992) (Table II) the feeds were prepared according to square method (Ali, 1980). The components used for feed preparation are dried, powdered and sieved through 450 micron sieve. The ingredients were weighed and mixed thoroughly with 130-150 ml of distilled water. The mixed feed stuff was put in autoclave for 15 min. at 108° C and cooled. After cooling, extrude with the help of pelletizer. The pellets were dried in room temperature. This formulated feed was kept in air tight container at 20° C until used to prevent contamination (Table III).

Experimental design for growth studies : For rearing experiments effluent concentrations such as 5, 10, 15 and 20% were prepared since the sub lethal concentration was 62%. These media was taken in plastic aquaria (45 cm L x 30 cm B x 15 cm H). The volume of medium in each aquaria was maintained as 8 liters. In each concentration 10 fish in the weight range of 1.24 ± 0.2 g were reared. The control fish were reared in fresh water (effluent free water).During rearing the fishes were fed on ad-libitum diet of prepared feed twice a day for 1 hour each from 9-10 am and 4-5 pm. The unfed were collected after one hour of feeding without disturbing the fishes. The unfed was dried to constant weight. The faecal matter was collected daily before changing the water with least disturbance to the fishes and dried at 95° C. Approximately 70% of water in the tank was replaced with different concentration of effluent. The experiment was continued for 40 days and on the 41st day the fishes were weighed in live condition. Feed utilization parameters such as condition factor, feed consumption, feed conversion efficiency, feed conversion ratio, growth, percentage growth, relative growth rate, assimilation, metabolism, net and gross growth efficiency were calculated. Protein (Lowry *et al.*, 1951), carbohydrate (Roe, 1955) and lipid (Folch *et al.*, 1957) content of

Table I : Ingredients used in the feed.

S. No.	INGREDIENTS
1.	Fish meal
2.	Groundnut oil cake
3.	Wheat flour
4.	Tapioca
5.	Fish oil
6.	Sunflower oil
7.	Supplevite – Mix*
8.	Sodium chloride
9.	Sodium benzoate

*Supplevite-Mix (Manufactured by Changule Industries, Mumbai)

Vitamin A	- 5000,0000 IU	Iron	- 0.75 g
Vitamin D9	- 0.2 g	Calcium	- 0.75 g
Vitamin B12	- 0.6 mg	Cobalt	-0.45 g
Vitamin D	- 1,00,000 IU	Calcium Pantothenate	- 0.25 g
Vitamin E	- 75 Units	Choline chloride	- 0.15 g
Vitamin K	- 0.1 g	Zinc	- 1.5 g
Nicotinamide	- 1.0g	Copper	- 1.0 g
Iodine	- 1 g	Manganese	- 2.75 g

Table II : Protein levels of major ingredients.

S. No.	Ingredients	Protein (%)
1.	Fishmeal	56
2.	Groundnut oil cake	44
3.	Wheat flour	14
4.	Tapioca	3

Table III. Composition of different ingredients in the Experimental feed (g/100g)

S. No.	Ingredients	Composition of Ingredients (g)
1.	Fishmeal	34.15
2.	Ground nut oil cake	34.15
3.	Wheat flour	10.85
4.	Tapioca powder	10.85
5.	Fish oil	2
6.	Sunflower oil	2
7.	Supplevite- Mix	4
8.	Sodium chloride	1
9.	Sodium benzoate	1

the fish muscle were estimated after the culture period.

RESULTS AND DISCUSSION

Physico-chemical characteristics of the dye industry effluent is presented in Table IV. The survival of *Cyprinus carpio* in different concentrations of dye industry effluent is presented in Table V. The results indicated that 61% of effluent was sublethal. As the

Table IV : Physico-chemical characteristics of Dye industry effluent.

S. No.	Parameters	Values
1.	Colour	Reddish Brown
2.	pH	8.2
3.	Electrical Conductivity	33800 m S /cm
4.	Total Solids	16000 mg / l
5.	Total Dissolved Solids	14950 "
6.	Total Suspended Solids	1050 "
7.	Chloride	630 "
8.	Hardness	560 "
9.	Alkalinity	6400 "
10.	Dissolved Oxygen	3.232 "
11	Dissolved Carbon dioxide	44 "
12.	Biological Oxygen Demand	65 "
13.	Chemical Oxygen Demand	744 "
14.	Sodium	9.29 ppm
15.	Potassium	0.21 "
16.	Calcium	5.34 "

Table V : Effect of different concentrations of dye industry effluent on the survival of *Cyprinus carpio* as function of exposure time. Mortality is expressed in terms of percentage.

Effluent Concentration (%)	Exposure Time			
	24	48	72	96
61	-	-	20	30
62	-	-	30	40
63	-	20	40	50
64	-	-	50	60
65	-	-	60	80
66	-	50	90	100
67	-	50	100	-
68	50	100		-
69	50	100		-
70	100	-		-

Table VI : Condition Factor (K) of *Cyprinus carpio.*

S. No.	Effluent Concentration (%)	Initial	Final
1.	O (Control)	2.65 ± 0.17	3.40 ± 0.18
2.	5	2.72 ± 0.17	3.20 ± 0.24
3.	10	2.70 ± 0.16	2.94 ± 0.16
4.	15	2.77 ± 0.09	2.91 ± 0.11
5.	20	2.61 ± 0.15	2.83 ± 0.13

concentration increased mortality of fish increased. The lethal concentration at 24 hr exposure was 70%. The mortality at any concentration was as a function of exposure time. The LC_{50} at 96 hr exposure was found as 63%. Similar report was given by Haniffa & Porchelvi (1985) when a fish was exposed to distillery effluent. Also reported in different effluents by different authors (Rajan & Balasubramanaian, 1985; Rajan *et al.*, 1996). Condition factor of *C. carpio* reared in different concentrations of effluent is Table VI. The initial condition factor is 2.65, 2.72, 2.70, 2.77 and 2.61 for control, Ex.I

Table VII : Effect of different concentration of Dye industry effluent on Feed utilization and Growth common carp. Each value is average (± S.D) performance of 10 fish reared in triplicate for a period of 40 days.

S. No.	Parameters	Effluent concentration (%)				
		0 (Control)	5	10	15	20
1.	Feed Consumption(FC) (g/g live wt/40 days)	1.12 ± 0.008[a]	1.024 ± 0.003[b]	0.981 ± 0.022[c]	0.936 ± 0.003[d]	0.932 ± 0.002[e]
2.	Feed Conversion Efficiency (FCE)	0.399 ± 0.025	0.280 ± 0.072	0.179 ± 0.015	0.176 ± 0.007	0.159 ± 0.013
3.	Feed Conversion Ratio (FCR)	2.506 ± 0.164	3.786 ± 0.878	4.73 ± 0.502	5.676 ± 0.232	6.263 ± 0.559
4.	Growth (G) (g/g live wt/ 40 days)	0.447 ± 0.026[a]	0.287 ± 0.073[b]	0.171 ± 0.011[c]	0.161 ± 0.001[d]	0.145 ± 0.008[e]
5.	Percentage Growth (PG)(%)	3.83 ± 0.517	2.322 ± 0.672	1.39 ± 0.112	1.229 ± 0.067	1.190 ± 0.095
6.	Relative Growth Rate (RGR)	0.223 ± 0.013	0.143 ± 0.036	0.084 ± 0.006	0.080 ± 0.009	0.072 ± 0.004
7.	Assimilation (A)	1.02 ± 0.008	0.935 ± 0.003	0.895 ± 0.022	0.856 ± 0.003	0.855 ± 0.002
8.	Metabolism (M)	0.572 ± 0.031	0.624 ± 0.074	0.727 ± 0.021	0.686 ± 0.015	0.709 ± 0.006
9.	Gross Growth Efficiency (GGE)(%)	39.95 ± 0.525[a]	28.07 ± 0.291[b]	17.25 ± 0.157[c]	18.13 ± 0.296[d]	15.62 ± 0.901[e]
10.	Net Growth Efficiency (NGE)(%)	43.20 ± 0.906[a]	30.72 ± 0.906[b]	18.95 ± 0.912[c]	18.95 ± 0.216[d]	17.02 ± 0.979[e]

Feed Consumption Efficiency	Growth	Gross Growth Efficiency	Net Growth
a Vs b (P >0.05) S	a Vs b (P >0.05) S	a Vs b (P >0.05) S	a Vs b (P >0.05) S
a Vs c (P >0.05) S	a Vs c (P >0.05) S	a Vs c (P >0.05) S	a Vs c (P >0.05) S
a Vs d (P >0.05) S	a Vs d (P >0.05) S	a Vs d (P >0.05) S	a Vs d (P >0.05) S
a Vs e (P >0.05) S	a Vs e (P >0.05) S	a Vs e (P >0.05) S	a Vs e (P >0.05) S

S : Significant

Table VIII : Biochemical changes of Common carp.

Effluent Concentration (%)	After the Experiment		
	Protein (mg/mg)	Carbohydrate (mg/mg)	Lipid (mg/mg)
0 (Control)	0.83	0.98	0.28
5 (Ex. I)	0.74	0.92	0.26
10(Ex.II)	0.65	0.85	0.25
15(Ex.III)	0.58	0.79	0.24
20(Ex.IV)	0.50	0.68	0.22

presented (5%), Ex.II (10%), Ex.III (15%) and Ex.IV (20%) respectively. The final condition factor is gradually increased in all concentrations.

But when comparing with different concentrations the condition factor gradually decreased with increasing concentrations of effluent. The different feed utilization and growth parameters are presented in Table VII.

Feed consumption of *Cyprinus carpio* is lower in Ex. IV containing 20% of dye industry effluent. The feed consumption was decreased significantly with increasing concentration of effluent. Similar decrease in feed consumption was reported in *C. carpio* reared in textile industry and tannery industry effluent (Rajan & Balasubramanian, 1988; Rajan *et al.*, 1996). Feed conversion efficiency of *C. carpio* was lower in Ex.IV. Feed conversion efficiency gradually decreased when the concentration of the effluent increased. Feed conversion ratio was increased with increase in concentration of dye industry effluent. The growth and relative growth rate was decreased in Ex.IV. The same result was reported in *O. niloticus* reared in different concentration of Phenol Naheed & Saad, 2008). The growth significantly decreased with increase in concentration of the effluent. Assimilation was lower in Ex.IV. The assimilation gradually decreased from the control to Ex.IV. Metabolism was higher in Ex.IV. Verma *et al.* (1989) reported that the normal metabolism was disturbed due to the effect of Phenol. The metabolic rate increased with increase in concentration of the effluent and such increase in metabolic rate may be due to the stress excreted by the chemical substances present in the effluent. Similar result was reported by Rajan & Balasubramanian (1988) in *C. carpio* reared in different concentration of textile effluent. Gross growth efficiency and net growth efficiency were lower in Ex.IV and higher in control. The gross and net growth efficiency were gradually decreased due to the stress excreted by dye industry effluent. Such a reduction was also reported. The protein, carbohydrate and lipid content of *C. carpio* reared in different concentrations of dye industry effluent is presented in Table VIII. The level of protein, carbohydrate and lipid content in the muscle of fish decreased when the level of dye industry effluent increases. Similar result was also reported in *C. carpio* reared in sub lethal effects of textile mill effluent (Rajan, 1990). When the effluent concentration was increased it will affect the nutritive value of protein, carbohydrate and lipid of aquatic organisms (Sekar *et al.*, 2009). From the results, it is inferred that the feed utilization parameters such as growth, relative growth rate, gross and net growth efficiency were lower in Ex. IV containing 20% of dye industry effluent and also biochemical changes of *C. carpio* are altered due to the effect of dye industry effluent.

ACKNOWLEDGEMENT

Authors are thankful to Department of Biology, Gandhigram Rural Institute-Deemed University, Gandhigram for offering facilities to carry out this research work.

REFERENCES

ALI, S.A.1980.Feed formulation method. Manuel of research methods for fin fish and shell fish nutrition.*CMFRI Special publication* No. **8**. p. 98.

APHA.1990. *Standard methods for the examination of water and waste water* (16th edition). American Public Health Association, Washington, D.C.

BARUAH, A.K., SHARMA, R.N. & BORAH, G.C. 1993. Impact of sugar mill and distillery effluent on water quality of river Galabil, Assam. *Ind. J. Envl. Hlth.* **35** : 288-293.

FOLCH, J., LEES, R & STANLEY, G.H.1957. A simple method for the isolation and purification of total lipids from animal tissues. *Biol. Chem.* **226** : 497-508.

HANIFFA, M.A & PORCHELVI. 1985. Effect of distillery effluent on oxygen consumption of fresh water fish *Sarotherodon ossambicus. J.Envi. Bio.* 6 : 17- 23.

JEYARAMAN, J. 1992. *Laboratory Manuel In Biochemistry.* Wiley Eastern Ltd, New Delhi. 4th reprint. pp.75-78.

LOWRY, O.H., ROSEBROUGHT, N.J., FARR, A.L. & RANDALL, R.J. 1951. Protein measurement with Folin-phenol reagent. *Biol.Chem.* **193** : 265-275.

MINISTRY OF TEXTILES 2004. Government of India, Annual Report, 2003-2004. pp.21-22.2.

NAHED, S. & AMAL S. SAAD. 2008. Effect of Environmental pollution by Phenol on some physiological parameters of *Oreochromis niloticus. Global Veterinaria.* **2**(3) : 312-319.

RAJAN, M.R.1990. Sublethal effects of textile mill effluent on protein, carbohydrate and lipid contents of different tissues of fish *Cyprinus carpio. Envir. & Ecol.* **8**(1) : 54-58.

RAJAN, M.R & BALASUBRAMANIAN, M.P. 1988. Effect of sublethal concentration of Textile industry effluent on feed utilization and growth of the fish *Cyprinus carpio. Envir. & Ecol.* **6**(4) : 997-984.

RAJAN, M.R., THILAGAVATHY DANIEL & JEYAPUSPHARANI., C. 1996. The effect of sublethal concentrations of Tannery effluent affected water on the survival and feeding survival and feeding energetics of *Cyprinus carpio var. communis. Int. J. Ecol. & Envir. Sci.* **22** : 297-302.

RAVIKUMAR, A & DUTTA, P.K.1996. Are Textiles Finishing the Environment. *Indian J. Science & Technology.* **16**(7) : 499 -501.

ROE, J.R.1955. The determination of sugar in blood and spinal fluid with anthrone reagent. *J. Biol. Chem.* **20** : 335-343.

SEKAR, P., HARIPRASAD,S. & DECCA RAMAN, M. 2009.Effect of textile dye industry effluent on the nutritive value of fresh water female Crab. *J. Appl. Sci. Res.***5**(11) : 2041-2048.

VARSHNEY, C.K.1991. *Effect of heavy metals on aquatic organisms. Water, pollution and Management.* Willy Eastern Ltd Publication, New Delhi. pp.88-89.

VERMA, S.R., RANMI., S., TYAGI, A.K. & DALELA, R.C. 1989. Evaluation of acute toxicity of phenol and its chloro and nitro derivatives to certain teleosts. *Water, Air and Soil Pollution* **14** : 95-102.