ISSN : 2350-0743

www.ijramr.com

International Journal of Recent Advances in Multidisciplinary Research
Vol. 03, Issue 05, pp.1433-1436, May, 2016

RESEARCH ARTICLE

CHANGES IN THE BIOCHEMICAL COMPONENTS IN THE TISSUES OF FRESH WATER FISH, *CATLA CATLA* EXPOSED TO ELECTROPLATING EFFLUENT

***Ambikadevi, A.P., Binu kumari, S., Mohan kumar, M., Drishya, M.K. and Aswin, B.**

Department of Zoology, Kongunadu Arts and Science College, Coimbatore-641029, Tamilnadu, India

ARTICLE INFO

Article History:
Received 15th February, 2016
Received in revised form
20th March, 2016
Accepted 23th April, 2016
Published online 30th May, 2016

Keywords:

Protein, Carbohydrate, Lipid, Toxicity, Electroplating effluent, *Catla catla.*

ABSTRACT

Electroplating is considered a major polluting industry because it discharges toxic materials and heavy metals through waste water, air emissions and solid wastes in environment. It was found that a large amount of metals and chemicals is disposed into main stream without treatment as they have no effective measures for treatment or recovery of metals in unorganized sectors. The biochemical components like protein, carbohydrate and lipid were estimated quantitatively in the tissues of gill, liver, kidney and muscle of control and electroplating effluent treated fishes. The fishes were treated with the sublethal concentration of 0.13 ml of electroplating effluent for 24, 48, 72, and 96 hours. The protein, carbohydrate and lipid level of gill, liver, kidney and muscle of the control fish was high when compared with the treated ones. In treated fish, the protein content tissues were greatly reduced. Maximum reduction was observed at 96 hrs exposure. The carbohydrate and lipid content of the tissues are showed similar declining trend are different exposure periods.

INTRODUCTION

Continuous discharge of industrial effluents into the aquatic environment can change both aquatic species diversity and ecosystems due to their toxicity and accumulative behavior. Among industries, electroplating industries plays an important role in creating heavy metal pollution in water bodies through direct discharge of effluent in water bodies. Aquatic organisms include fish accumulate metals many times higher than in water or sediments (Madhusudan *et al*., 2003 and Olifa *et al*., 2004). The toxicity tests are necessary in water pollution evaluation because chemical and physical measurements alone are not sufficient to assess potential effects on aquatic biota (Tarzwell, 1971). In addition, it is an important step to detect the levels of toxicants to be used in the experimental studies of the accumulation and effect of these toxicants to the marine organisms. Electroplating is one of the varieties of several techniques of metal finishing. It is a technique of deposition of a fine layer of one metal on another through electrolytic process to impart various properties and attributes, such as corrosion protection, enhanced surface hardness, luster, color, aesthetics, value addition etc. The base metals involved may be copper, ferrous alloys, including stainless steels and alloys of copper, zinc, aluminum, magnesium, and lead. Effluents from various processing industries such as electroplating is reported to contain high amounts of heavy metal ions, such as nickel, iron, lead, zinc, chromium, cadmium and copper (Konstantinos *et al*., 2011). The presence of these heavy metals in industrial waste waters is of serious concern because they are highly toxic, non-biodegradable and carcinogenic and their continuous deposition into receiving lakes, streams and other water sources within the vicinity causes bioaccumulation in the living organisms. These perhaps, could lead to several health problems like cancer, kidney failure, metabolic acidosis, oral ulcer, renal failure and many more effluents from electroplating industry is serious concern because just about 30-40% of the metals used during plating processes are effectively utilized.

****Corresponding author: Ambikadevi, A.P.,***
Department of Zoology, Kongunadu Arts and Science college, Coimbatore-641029, Tamilnadu, India.

MATERIALS AND METHODS

Catla catla is a fish, found commonly in rivers and fresh water lakes in around South Asia and South East-Asia. Bulk of sample of fishes *Catla catla* ranging in weight from 10-12 gms and measuring 5-7 cm in length were procured from Aliyar fish farm. Fishes were acclimatized to the laboratory conditions for one month in large plastic tank (200 L).The fishes were fed with adlibitium, rice bran, wheat bran and oil cakes. Appropriate narrow range of concentration 0.13 ml was used to find the median lethal concentration and the mortality was recorded for every 24 hrs upto 96 hrs. It was found as 1.3 ml for 96 hrs using probit analysis method (Finney, 1971). Three groups of fishes were exposed to 0.13 ml (1/10th of 96 hrs LC_{50} value) concentration of the electroplating effluent for 24, 48 72 and 96 hrs respectively. Another group was maintained as control. At the end of the each exposure period, fishes were sacrificed and tissues such as liver, gill, muscle and kidney were dissected and removed. The tissues (10 mg) were homogenized in 80% methanol, Centrifuged at 3500 rpm for 15 minutes and the clear supernatant was used for the analysis of different parameters. Total protein concentration was estimated by the method of (Lowry *et al.,* 1951). Carbohydrate was estimated by the method of (Hadge and Hofreiter, 1962)

Cholesterol was estimated based on enzymatic method using cholesterol esterase, cholesterol oxidase and peroxidase (Richmond, 1973).

RESULTS AND DISCUSSION

In the present investigation, the effect of electroplating effluent on biochemical nature of protein, carbohydrates and cholesterol has been studied in the different tissues (liver, kidney, gills and muscles) of the fresh water fish, *Catla catla.* The results were tabulated (1-3) and statistically analyzed.

Liver recorded 1.7, 1.4, 0.9 and 0.4 mg/gm, Kidney recorded 1.2, 0.8, 0.6 and 0.2 mg/gm, Gills recorded 2.45, 2.00, 1.4 and 0.7 mg/gm, Muscle recorded 3.2, 2.4, 1.0 and 0.7 mg/gm of protein in 0.13 ml concentration of electroplating effluent in 24, 48, 72 and 96 hours exposures. The control values were noted as 2.1, 1.5, 2.8 and 4.3 mg/gm in Liver, Kidney, Gills and Muscles respectively. In the present study, sublethal concentration of electroplating effluent seems to have brought a maximum decline of protein in all the tissues which suggests an intensive proteolysis and decreased protein synthesis.

Table 1. Changes in the Protein content (mg/g) in the tissues of *Catla catla* exposed to 0.13 ml of Electroplating effluent on short term duration

Sample (mg/g wet tissue)	EXPOSURE PERIODS				
	CONTROL	24HRS	48HRS	72HRS	96HRS
GILL	2.80 ± 0.42	2.45 ± 0.31	2.00 ± 0.23	1.4 ± 0.13	0.7 ± 0.03
‘t’ value		2.19*	2.47*	5.63**	6.48**
% Change		-12.49	-28.57	-50	-74.99
LIVER	2.1 ± 0.35	1.7 ± 0.18	1.4 ± 0.05	0.9 ± 0.03	0.4 ± 0.01
‘t’ value		2.32*	4.64**	6.47**	8.38**
% Change		-19.04	-33.33	-57.14	-80.95
KIDNEY	1.5 ± 0.29	1.2 ± 0.09	0.8 ± 0.12	0.6 ± 0.03	0.2 ± 0.01
‘t’ value		1.32ns	3.80*	6.52**	4.74**
% Change		-20.00	-46.66	-60	-86.66
MUSCLE	4.3 ± 0.59	3.2 ± 0.42	2.4 ± 0.54	1.0 ± 0.25	0.7 ± 0.13
‘t’ value		2.984*	5.73**	8.57**	14.49**
% Change		-25.58	-44.18	-76.74	-83.72

Values are mean ± SD , n=5, Figures in parenthesis are percentage decrease over control.
* - Significant at 5% (t<0.05)** - Significant at 1% (t<0.01)NS – Non Significant

Table 2. Changes in the Carbohydrate content (mg/g) in the tissues of *Catla catla* exposed to 0.13 ml of Electroplating effluent on short term duration

Sample (mg/g wet tissue)	EXPOSURE PERIODS				
	CONTROL	24HRS	48HRS	72HRS	96HRS
GILL	15.2 ± 1.50	14.0 ± 0.71	13.2 ± 0.91	12.0 ± 0.05	10.0 ± 0.07
‘t’ value		0.104ns	4.64**	4.21**	7.628*
% Change		-7.89	-13.15	-21.05	-34.21
LIVER	26.0 ± 2.35	22.4 ± 0.6	20.2 ± 1.05	19.0 ± 0.03	17.4 ± 0.11
‘t’ value		8.47ns	4.048**	8.32**	8.21**
% Change		-13.84	-23.07	-26.92	-33.07
KIDNEY	21.0 ± 3.18	19.3 ± 0.89	17.1 ± 0.82	15.2 ± 0.05	13.0 ± 0.15
‘t’ value		1.283ns	5.861**	13.01**	10.53**
% Change		-8.09	-18.57	-27.61	-38.09
MUSCLE	25.2 ± 1.49	24.0 ± 1.20	22.7 ± 0.74	20.1 ± 0.12	19.3 ± 0.03
‘t’ value		2.889*	8.621**	6.53**	11.97**
% Change		-4.76	-9.92	-20.23	-23.41

Values are mean ± SD , n=5, Figures in parenthesis are percentage decrease over control.
* - Significant at 5% (t<0.05)** - Significant at 1% (t<0.01)NS – Non Significant

Table 3. Changes in the Lipid content (mg/g) in the tissues of *Catla catla* exposed to 0.13 ml of Electroplating effluent on short term duration

Sample (mg/g wet tissue)	EXPOSURE PERIODS				
	CONTROL	24HRS	48HRS	72HRS	96HRS
GILL	28.7 ± 1.89	24.2 ± 1.11	22.3 ± 2.21	20.00 ± 1.05	17.3 ± 0.17
‘t’ value		5.929**	14.18**	12.3**	21.525**
% Change		-15.67	-22.29	-30.31	-39.72
LIVER	30.4 ± 2.26	27.5 ±	24.3 ± 2.15	21.5 ± 1.23	19.2 ± 0.21
‘t’ value		1.1455.62**	5.048**	9.347**	9.15**
% Change		-39.72	-20.06	-29.27	-36.24
KIDNEY	21.5 ± 2.18	18.3 ± 0.89	15.1 ± 2.12	13.4 ± 1.35	10.2 ± 1.15
‘t’ value		1.283ns	5.861**	12.45**	19.60**
% Change		-14.88	-29.76	-37.67	-52.55
MUSCLE	37.1 ± 4.53	32.4 ± 0.53	30.7 ± 2.42	26.3 ± 2.24	24.1 ± 1.03
‘t’ value		4.241**	11.641**	16.96**	25.27**
% Change		-12.66	-17.25	-29.11	-35.04

Values are mean ± SD , n=5, Figures in parenthesis are percentage decrease over control.
* - Significant at 5% (t<0.05)** - Significant at 1% (t<0.01)NS – Non Significant

Fall in the tissue protein content might be attributed to the diversification of energy to meet the impending energy demands when the fish is under stress or altered enzyme activities (Saradamani and Binu kumari, 2011). The decrease in the proteins could be due to their breakdown for metabolic utilization and energy production in response to toxicant. David and Kartheek, (2014) reported that the decrement in the total, structural and soluble proteins suggests the possible shortage in the protein biosynthesis by sublethal concentration of Sodium Cyanide. The lethal and sublethal concentration of electroplating effluent seems to have brought a maximum decline of protein in all the tissues which suggest an intensive proteolysis and decreased protein synthesis, reported by Juginu *et al.* (2015).

In Short term duration, Carbohydrate content was found to decrease from control in all tissues in all exposures. Liver tissue was found to contain 22.4, 20.2, 19.0 and 17.4 mg/gm, kidney tissue was found to contain 19.3, 17.1, 15.2 and 13.0 mg/gm, gill tissue was found to contain 14.0, 13.2, 12.0 and 10.0 mg/gm, muscle tissue was found to contain 24.0, 22.7, 20.1 and 19.3 mg/gm of carbohydrate in 0.13 ml concentration of electroplating effluent in 24, 48 72 and 96 hours respectively. The control values were noted as 26.0, 21.0, 15.2 and 25.2 mg/gm in Liver, Kidney, Gills and Muscles respectively. In the present study, significant decrease in the carbohydrate content has been noticed in the gill, liver, kidney and muscle as the duration pronounced in fish groups exposed to electroplating effluent for short and long term exposure periods. Muthukumaravel, (2013) studied the biochemical changes in the liver of *Oreochromis mossambicus* when it is exposed to Lambda Cyhalothrin and reported that glycogen content was found to depleted in the liver tissue at all periods of exposure. Paritha Bhanu and Deepak, (2015) have observed that due to cypermethrin toxicity, increased level of glucose, decreased level of albumin and globulin and elevated level of urea and creatinine were found due to liver and kidney dysfunction in *Cyprinus carpio.* Sudhasaravanan and Binu kumari, (2015) reported that glycogen showed maximum decrease as (-76.08%) in kidney during 30 days of exposure and minimum as (-13.55%) in muscles during 10 days of exposure in the fish, *Epidocephalichthyes thermalis* when exposed to detergent Rin. Vijaya Kumar *et al.* (2015) studied the effect of Ekalux on the fish *Labeo rohita* and reported that carbohydrates showed the maximum decrease as (-64.96%) in liver during 72 hours exposure and minimum as (-7.69%) in kidney during 24 hours exposure. Liver recorded 27.5, 24.3, 21.5 and 19.2 mg/gm, Kidney recorded 18.3, 15.1, 13.4 and 10.2 mg/gm, Gills recorded 24.2, 22.3, 20.0 and 17.3 mg/gm, Muscle recorded 32.4, 30.7, 26.3 and 24.1 mg/gm of Cholesterol in 0.13 ml concentration of electroplating effluent in 24, 48, 72 and 96 hours exposures. The control values were noted as 30.4, 21.5, 28.7 and 37.1 mg/gm in Liver, Kidney, Gills and Muscles respectively. The low level of lipid recorded in the exposed fish, which might have been used for energy production for other metabolic functions in which these products play a vital role during stress conditions. Saradhamani and Binu kumari, (2011) reported that the percentage decreased was found to be more in gill. Decrease in lipid contents in the tissues indicates that lipid hydrolysis might be accelerated to derive energy to overcome pesticide toxicity. Juginu and Binu Kumari, (2015) reported that there is drastic decrease in the lipid content in all tissues especially in liver of the cement factory effluent treated fish *C.mrigala.* Sudhasaravanan and Binu kumari, (2015) studied the effect of detergent in the fish, Epidocephalichthyes *thermalis* and reported that Cholesterol showed the maximum percentage decrease as (-81.93%) in kidney during 30 days of exposure and minimum as (-48.38%) in muscles during 10 days of exposures.

Conclusion

From the present study it is concluded that the above biochemical parameters are the one important and specific biomarkers with regard to effects of toxicants on organisms. So it is also suggested that adequate care should be taken to neutralize and detoxify the toxicants present in the effluent and follow the treatment procedure before let out into aquatic systems.

Acknowledgements

The authors are grateful to Department of zoology, Kongunadu Arts and Science College for guiding and providing necessary help for conducting this research studies.

REFERENCES

David, M. and Kartheek. R.M. 2014. Sodium cyanide induced biochemical and histopathological changes in fresh water fish *cyprinus carpio* under sublethal exposure. *International Journal of Toxicology and Applied Pharmacology,* 4 (4): 64-69.

Finney, D.J. 1971. Probit analysis, 3rd edition, (London : Cambridge University press), P.20.

Hedge, J.E. and Hofriter, B.T. 1962. Determination of redusing sugars, method in carbohydrate chemistry, M.L., academic press, New York 1:388-389

Juginu, M.S., Binu Kumari, S. and Mohan kumar, M. 2015. Biochemical study on the effect of cement factory effluent on the fresh water fish, *cirrhinus mrigala. International Journal of Recent Advances in Multidisciplinary Research,* 02 (11): 0958-0960.

K. Vijaya Kumar, K., Binu kumari, S. and Mohan Kumar, M. 2015. The Effect of Ekalux on Biochemical Parameters of the Fresh Water Fish, *"Labeo Rohita. IOSR Journal of Environmental Science, Toxicology and Food Technology. 58-60.*

Konstantinos, C. and Valsamidou. A. V. 2011. Removal of Nickel, Copper, Zinc and Chromium from Synthetic and Industrial Wastewater by Electro coagulation. *Int. J Environ*. Sci. 1(5): 698-703

Lowry, O.H., Rose Brough, N.J., Farr, A.L. and Randall, R.J. 1951. Protein measurements with the folin phenol reagent. *J. Biol. chem.,* 193: 265-275.

Madhusudan, S., Fatma, L. and Nadim, C. 2003. Bioaccumulation of Zn and Cd in fresh water fishes. *Indian J. Fish*. 50(1):53-65

Muthukumaravel, K. ., Sivakumar, B., Kumarasamy, P. and Govindarajan, M. 2013. Studies on the toxicity of pesticide monocrotophos on the biochemical Constituents of the freshwater fish *labeo rohita. International Journal of Current Biochemistry and Biotechnology*, 2 (10): 20-26,

Olaifa, F., Olaifa, A.K., Adelaja, A.A. and Owalabi, A.G. 2004. Heavy metal contamination of | Clarias garipinus from a lake and fish farm in Ibaden, Nigeria, African J. *Biomed.Res*., 7:145-148.

Paritha Bhanu, A. and Deepak, M. 2015. Impact of cypermethrin on biochemical aspects of clinical importance in the blood of freshwater fish *Cyprinus caIrpio. Journal of Entomology and Zoology Studies*, 3 (1): 126-128.

Richmond, W.1973. Preparation and properties of a cholesterol oxidase from *Nocardia sp*. and its application to the enzymatic assay of total cholesterol in serum.*Clin.Chem.,* 19: 1350-1356.

Saradamani, N. and Binukumari.S. 2011. Impact of insecticide (Chloroyrifos) on the biochemical components of the fish, *Oreochromis mossambicus. current.Biol.* 5(1):79-84.

Sudhasaravanan, R. and Biukumari, S. 2015. A study on the effect of detergent rin on the chronic toxicity of the fresh water fish *epidocephalichthyes thermalis World journal of pharmacy and pharmaceutical sciences.,* 4 (2): 450-456.

Tarzwell, C. M. 1971. Bioassays to determine allowable waste concentrations in the aquatic environment. I. Measurement of pollution effects on living organisms. Proc. Research Society London B., 177: 279.

****