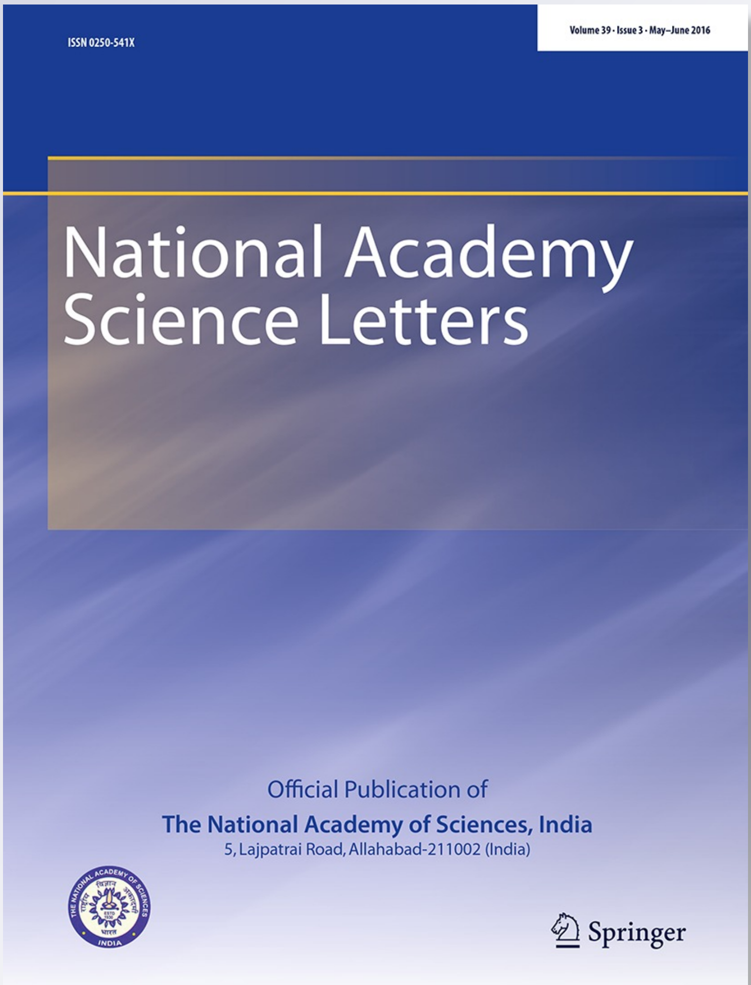
Effect of Acid Mine Drainage of Coal Mining on Total Protein Content of Muscle and Liver in a Freshwater Fish, Channa punctatus *(Bloch)*

B. Talukdar, H. K. Kalita, R. A. Baishya, S. Basumatary, A. Dutta, S. K. Srivastava & D. Sarma

National Academy Science Letters

ISSN 0250-541X
Volume 39
Number 3

Natl. Acad. Sci. Lett. (2016) 39:171-173
DOI 10.1007/s40009-016-0444-2



Springer

Natl. Acad. Sci. Lett. (May–June 2016) 39(3):171–173
DOI 10.1007/s40009-016-0444-2

SHORT COMMUNICATION

Effect of Acid Mine Drainage of Coal Mining on Total Protein Content of Muscle and Liver in a Freshwater Fish, *Channa punctatus* (Bloch)

B. Talukdar[1] · H. K. Kalita[1] · R. A. Baishya[1] · S. Basumatary[1] · A. Dutta[1] · S. K. Srivastava[2] · D. Sarma[1]

Received: 23 June 2014 / Revised: 26 December 2014 / Accepted: 22 February 2016 / Published online: 30 March 2016

Abstract The paper deals with the studies on impact of Acid Mine Drainage of coal mining on total soluble protein content of fish, *Channa punctatus*. Acid Mine Drainage of coal mines was collected from the coal mining area near Simsang River, Garohills, Meghalaya and LC_{50} value (28 % of effluent) for 96 h was determined. Fishes were treated in sub lethal concentration (one-fifth of LC_{50} value) of Acid Mine Drainage of coal mines for 24, 48, 72 and 96 h to evaluate its impact on total soluble protein in the muscle and liver. It was found that there was a decreasing trend of total protein content and maximum decrease was found at 48 and 72 h in liver and muscle respectively. However, a little rise of protein content was found at 72 h in liver and 96 h in muscle. This might be due to rise of proteolytic activity in liver suggesting the increased enzymatic activities to cope with toxic stress.

Keywords *Channa punctatus* · Coal mining · LC_{50} · Protein

The pollutants of agricultural and domestic activities are posing a great threat to aquatic fauna, especially to fishes [1–3] which constitute one of the major sources of protein rich food for mankind. Coal mining activities in East Garohills, Meghalaya is posing serious threats to the fish and fisheries of Simsang River, the longest River of Garohills, Meghalaya [4]. Excessive accumulation of Acid Mine Drainage due to open cast coal mining of the region since 1980 has degraded water quality as well as fish habitat of the Simsang River. The biochemical studies are good parameters which help to see the effect of toxicants on metabolism of fish [5–8]. Protein, carbohydrate and lipid contents decreased significantly in muscle, liver and intestine of *Cyprinus carpio* when exposed to sub lethal concentrations of textile mill effluent [9]. Decline in carbohydrate, protein and lipid contents of gill, liver, intestine and kidney of *C. carpio* under the toxic stress of sub lethal concentration was also reported due to the affect of composite tannery effluent [10]. Significant decrease in glycogen, total protein and lipid in both liver and muscle tissue has also been recorded on *Channa punctatus* (Bloch) with an increase in effluent concentration of distillery effluent [11]. Hence, in present investigation, an attempt has been made to find out induced effect of Acid Mine Drainage of coal mines on biochemical constituents like total soluble protein content from muscles and liver of *C. punctatus* (Bloch).

✉ D. Sarma
sarma_dandadhar@yahoo.com

B. Talukdar
bandita.talukdar88@gmail.com

H. K. Kalita
kalitahk88@gmail.com

R. A. Baishya
ratul.baishya@rediffmail.com

S. Basumatary
sudembasumatary8@gmail.com

A. Dutta
amaleshdutta@yahoo.com

S. K. Srivastava
srivastavask100@gmail.com

1 Department of Zoology, Gauhati University, Guwahati, Assam 781014, India

2 Directorate of Coldwater Fisheries Research (ICAR), Bhimtal, Nainital, Uttarakhand 263136, India

Table 1 Total soluble protein in muscle and liver in wet tissues of *Channa punctatus* exposed to sub lethal concentration

Tissue	Control	24 h	48 h	72 h	96 h
Muscle	37.58 ± 0.88	32.78 ± 0.53	22.8 ± 0.38*	15.53 ± 0.33*	19.16 ± 0.45*
Liver	66.58 ± 1.04	46.24 ± 0.37	24.33 ± 0.19*	37.60 ± 0.29*	43.27 ± 0.28*

* Significantly higher ($p < 0.05$) than the control at 95 % confidence limit

Healthy matured live fish, *C. punctatus* (weight: 30–35 g and length: 14–16 cm) were procured from market and disinfected with 1 % solution of potassium permanganate for 5 min to avoid dermal infection and acclimatized at laboratory conditions in glass aquarium for seven days. The physico-chemical parameters of water used for fish bioassay were determined according to procedure described in Standard methods [12]. The level of water quality parameters were as follows pH 2.6, salinity 1.1 mg/l, total dissolved solid 0.97 ppm, dissolved oxygen 4.5 mg/l. Acid Mine Drainage of coal mines was collected from the coal mining area near to the Simsang river and LC_{50} value (28 % of effluent) for 96 h was determined by Probit analysis method [13] and sub lethal concentration, one-fifth of LC_{50} value was considered for experiment. Experimental fishes were transferred into aquarium containing test solution. The control group of fishes was maintained simultaneously in dechlorinated tap water in separate aquarium. The experimental fishes were sacrificed after 24, 48, 72 and 96 h of treatment. The tissues of both experimental and control fishes such as liver and muscle were taken for the estimation of total proteins [14]. The readings obtained were expressed as mg protein per gram weight wet tissue. The difference in protein content of the control and treated tissue was tested for the significance using student ‘t’ test [15] and percentage decrease or increase over the control was calculated for each value.

In the present study, it was observed that there was significant decrease in total protein of muscle and liver tissues of tested fishes at different exposure period (Table 1). There was a significant decrease in soluble proteins in muscle and liver tissues of the fish after 24 h exposure compared to control. Maximum decrease in soluble proteins was observed at 72 h of exposure in muscle tissues but in liver it was at 48 h and soluble protein in liver showed maximum decrease as compared to muscle. The significant decrease observed in muscle and liver tissues might be owing to the greater activities of the organs and requirement of large amount of energy. It is believed that struggling for life in congested environment might enhance muscle activity which might probably contribute to protein degradation through proteolysis.

The survival ability of animals exposed to stress mainly depends on their protein synthetic potential. The degradation of protein suggests the increase in proteolytic activity and possible utilization of their products for metabolic purposes and cause damage to tissues [16]. Increasing level of soluble and insoluble protein content in all tissues after 72 h may be due to the induction of microsomal enzymes for detoxification of extraneous material and other constituent enzymes of various metabolic processes [17, 18]. Significant decrease in total protein content indicates stress due to effluent treatment induces proteolysis [19]. The alteration in the tissue protein in the present study suggests disturbance in the physiological activity. Physiological status of animal is usually indicated by the metabolic status of protein [20].

References

1. Ghosh D, Datta S, Bhattacharya S, Mazumder S (2006) Perturbation in the catfish immune responses by arsenic: organ and cell specific effects. Comp Biochem Physiol 143:455–463
2. Palanichamy S, Arunachalam A, Baskaran P (1989) Effect of pesticides on protein metabolism in the freshwater catfish *Mystus vittatus*. J Ecobiol 1:90–97
3. Abdul NC, Janaiah D, Venkateshwarlu P (2010) The effect off Lihocin toxicity on protein metabolism of the freshwater edible fish *Channa punctatus* (Bloch). J Toxicol Environ Health Sci 3:018–023
4. Sarma, D, Mahanta PC, Sarma D, Dutta A (2009) Coalmines Degraded Ichthyofaunal Diversity of Simsang River, Meghalaya.—A report on climate change. Published by Directorate of Coldwater Fisheries Research. (Indian Council of Agricultural Research). Bhimtal, Nainital, Uttarakhand, India
5. Ghosh TK (1986) Effect of dimethoate on tissue glycogen content of some freshwater fish. Environ Ecol 4:554–557
6. Kajar A, Singh S, Shrivastava K (2000) Malathion induced biochemical changes in the kidney of freshwater fish *Clarias batrachus*. J Ecotoxicol Environ Monit 10:11–14
7. Jana S, Shana SS, Choudhari MA, Choudhari DK (1989) Heavy metal pollutant induced changes in some biochemical parameters in the freshwater fish *Clarias batrachus*. Acta Physiol Hung 68(1):39–44
8. Jana S, Bandopadhyaya S (1987) Effect of heavy metal on some biochemical parameters in the freshwater fish, *Channa punctatus* (Bloch). Environ Ecol 5:488–490
9. Rajan MR (1990) Sub lethal effects of textile mill effluent on protein, carbohydrate and lipid content of different tissues of fish *Cyprinus carpio*. Environ Ecol 8(1):54–58
10. Ambrose T, Cyril L, Kumar A, Vixent S, Lambert R (1994) Biochemical reponse of *Cyprinus carpio* (communis) to toxicity of tannery effluent. J Ecobiol 6(3):213–216
11. Maruthi YA, Subba Rao MV (2000) Effect of distillery effluent on biochemical parameters of fish *Channa punctatus* (Bloch). J Environ Pollut 7(2):111–113

12. APHA (2005) Standard methods for examination of water and wastewater, 21st edn. APHA, AWWA, WPCF, Washington
13. Finney DJ (1971) Probit analysis. University Press, Cambridge, p 333
14. Lowry OH, Rosenbrough MJ, Farry AL, Randoll RJ (1993) Protein measurement with folin-phenol reagent. J Biol Chem 4:265–275
15. Mahajan BK (1997) Methods in biostatistics, 6th edn. Lordson Publication, New Delhi, p 341
16. Mastan SA, Rammayya PJ (2010) Biochemical profile of *Channa gachua* (Ham) exposed to sublethal doses of Dichlorovas (DDVP). Int J Toxicol 8:27–32
17. Mukhopadhyay PK, Dehadrai PV (1980) Biochemical changes in the air-breathing catfish *q* (linn.) exposed to malathion. Environ Pollut Ser A Ecol Biol 22:149–158
18. Anand PS, Surendra S, Prabhat S, Yadav K (2010) Toxic effect of Phorate on the serum biochemical parameters of snake headed fish *Channa punctatus* (Bloch). Adv Biores 1:178–182
19. Nichol CA, Rosen F (1963) Advances in Enzyme regulation, vol 1. Pergamon Press, Oxford, p 341
20. Sathyanarayana U (2005) Biochemistry book and allied (P) Ltd. 8/1 Chintamani Das Lane, Kolkata, India