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REVIEW ARTICLE

TOXICITY OF NICKEL ON THE PROTEIN CONTENT OF CERTAIN TISSUES OF FRESHWATER FISH, *CATLA CATLA*

***Sudhasaravanan, R. and Binukumari, S.**

Department of Zoology, Kongunadu Arts and Science College, Coimbatore-641 029, T. N., India

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ABSTRACT

Environmental pollution due to toxic heavy metals in air, soil and water is a major global problem. Heavy metals cannot be degraded or destroyed; hence they are persistent in all parts of the environment. The fish, as a bio indicator species, plays an increasingly important role in the monitoring of water pollution because it responds with great sensitivity to changes in the aquatic environment. Fishes were treated with nickel for 24, 48, 72 and 96 hrs in water containing sub lethal concentrations of 2.5ppm respectively. At the end of each exposure period, fishes were sacrificed and tissues such as liver, kidney, muscle and gills were removed and analysed for Protein content. It showed decreased value of protein content in all the tissues when compared to control. Therefore, it is essential to study the toxic effects of Heavy metals on living organisms. The objective of the present work was to observe the effect of nickel on Protein content in gill, liver, kidney and muscle of fresh water fish *Catla catla.*

INTRODUCTION

Pollution of the aquatic ecosystem is recognized as a potential threat to all living organisms. It is produced by man himself therefore pollution and its effects are considered man's greatest crimes against himself. Water quality is being unswervingly affected by man activities towards development. Maximum aquatic pollutants come from industrial effluents and agricultural run-off. The world suffers from deficiency of protein sources. Fish are considered as an important source of high quality animal protein as they contain large amount of essential amino acids. Also, fish contain crude lipids, which supply the body with energy and essential fatty acids that are necessary for life and play an important role in regulation of the cardio-vascular system and for reducing cholesterol level in the blood. Moreover, fish are rich in fat-soluble vitamins, iodine and phosphorous (Mohammed, 1999). The problems of environmental pollution Industrial discharges containing toxic and hazardous substances, including heavy metals (Dhanapakiam and Ramasamy, 2001) harm tremendously to aquatic ecosystem Heavy metals are natural trace components of the aquatic environment but their levels have been increased due to domestic, industrial and agricultural wastes. It causes greatest threat to the health of Indian ecosystem (Rani *et al*., 2001). Discharge of heavy metals into the aquatic environment can change both aquatic species diversity and ecosystem due to their toxic and accumulative behavior. Aquatic organisms including fish accumulate metals many times higher than present in water or sediments.

Corresponding author: Sudhasaravanan, R.,
Department of Zoology,Kongunadu Arts and Science College, Coimbatore-641 029, T. N., India.

The heavy metals water soluble, non-degradable, vigorously oxidizing agents and strongly bind to many biochemical units and hence entered in food chains. Nickel is amongst those metals which are listed under priority pollutants; it is accepted as hazardous and noxious heavy metal having potential danger to human health and the biota in combine and metallic form. Pollution of aquatic habitats seems to be an inevitable problem of universal nature and the intrusion of various pollutants into the aquatic environment affects the survival growth and reproduction of the biological organisms present in the environment. The increasing use of heavy metals in industry in the modern world unfavorably affects the aquatic environment. Heavy metal contamination may have devastating effects on the ecological balance of the recipient environment and a diversity of aquatic organisms. Environmental stress invokes compensatory metabolic activity in the organs of an animal through modification and modulation of the quantity and quality of problems. Nickel and nickel compounds have many industrial and commercial uses, and the progress of industrialization has led to increased emission of pollutants into ecosystems. Although Nickel is omnipresent and is vital for the function of many organisms, concentrations in some areas from both anthropogenic release and naturally varying levels may be toxic to living organisms. Aquatic pollution by industrial effluent is considered as a serious problem to aquatic inhabitants. The chemicals present in the industrial effluent affect the normal life of animal (Baskaran *et al*., 1989).

MATERIAL AND METHODS

Test organisms

Bulk of sample fishes, a *Catla catla* ranging in weight from 4-5 grams and measuring 5-7 cm in length were procured from

Aliyar Dam. Fishes were acclimatized to laboratory conditions for 2 weeks in a large Syntax tank. The water was changed twice in a day to maintain the oxygen content and to remove the excreta of fishes. The fishes were fed regularly with conventional diet rice bran and oil cake 1:1 ratio. Feeding was stopped two days prior to the experiment in order to keep the animal more or less in the same state of metabolic requirement. Fish were not fed during the toxicity tests. Fishes about the same size irrespective of sexes were selected for the experiment

Acute toxicity tests

One set of fishes were maintained as control in tap water. Appropriate narrow range of concentration was used to find the median lethal concentration, using a minimum of 10 fishes for each concentration and the mortality was recorded for every 24 hours up to 96 hours. In 2.5ppm out of 10 fishes 5 are died at 96 hours. The LC50values for 24, 48, 72 and 96h exposure to nickel were obtained using Probit Analysis (Finney, 1971). Thus 2.5 ppm is selected as LC50. Four groups of fishes were exposed in 2.5ppm concentration of the nickel 24, 48, 72 &96 hours respectively. Another group was maintained as control at the end of the each exposure period.

Sampling

At the end of experimental period, the surviving fish were sacrificed by decapitation, dissected and tissues (liver, muscle, gills and kidney) were isolated from control as well as the experimental fish. The tissues were homogenized with 80% methanol, centrifuged at 3500 rpm for 15 minutes, and the clear supernatant was used for analysis of protein.

Estimation of tissue protein in tissue

Protein content in the tissue were estimated by the method (Lowry et al., 1951). The tissue was isolated and 2% homogenate was centrifuged at 3,500 rpm for 15 minutes. The supernatant was discarded and the residue was suspended in 1.0 ml of 0.1 N sodium hydroxide solution, 0.5 ml of this solution equivalent to 10 mg of tissue was transferred to a clean test tube and 4 ml of copper carbonate solution was added. The contents were mixed by lateral shaking and 0.4 ml of folin phenol (1:1 dilution) reagent was added. The thoroughly mixed contents were kept at room temperature for 30minutes, the colour developed was read at 600 nm against a UV visible spectrophotometer (Jasco Model-650).

Statistical analysis

All measurements were performed in average of three replicates. Data obtained was analyzed using the SPSS/PC+ Statistical package (ver.11.5). Significant difference between control and experimental groups were determined using Duncan's test for multiple range comparisons (Duncan D.B., 1955).

RESULTS AND DISCUSSION

The level of protein was found to be decreased in all tissues compared to control. The decrease in protein content was muscle > kidney> liver> gill on 96 hours exposure (Table 1). Table 1 shows the maximum decreased value of protein content in gill as 1.63, 1.20, 0.98 and 0.71 mg/g in 2.5ppm of metal Nickel exposure and 1.84 mg/g in control after 24, 48, 72 and 96 hours exposures. Muscle tissues showed 5.16, 4.78, 3.35 and 2.17 mg/g of protein in 2.5ppm of Nickel and 6.10 mg/g of protein in control after 24, 48, 72 and 96 hours exposures. In kidney tissues 3.10, 2.71, 2.27 and 2.03 mg/g of protein in 2.5ppm of metal Nickel exposure and 3.51 mg/g in control after 24, 48, 72 and 96 hours respectively. The protein level in liver is also reduced. In control the protein level is 2.49 mg/g. It is decreased to 2.12, 1.81, 1.40 and 1.29 mg/g in 2.5ppm of metal nickel exposures for 24, 48, 72 and 96 hours.

Table1. Changes in protein content (mg/g) in the tissues of *cyprinus carpio* exposed to electroplating effluent for different exposure periods

Tissues mg/g	Exposure Periods				
	Control	24 Hours	48 Hours	72 Hours	96 Hours
Gill t value % change	1.84±0.03	1.63±0.05 37.15** 11.41	1.20±0.05 30.99** 34.78	0.98±0.06 27.95** 46.73	0.71±0.05 48.76** 61.41
Liver t value % change	2.49±0.05	2.12±0.06 21.11** 14.86	1.81±0.08 27.79* 27.30	1.40±0.07 37.90** 43.77	1.29±0.06 59.51** 48.19
Kidney t value % change	3.51±0.08	3.10±0.06 12.89** 9.11	2.71±0.03 36.38** 22.79	2.27±0.05 41.24** 35.32	2.03±0.04 57.50** 42.16
Muscle t value % change	6.10±0.05	5.16±0.6 16.80** 15.40	4.78±0.06 58.55** 21.64	3.35±0.06 97.14** 45.08	2.17±0.04 127.43** 64.42

Results are mean (±SD) of 5 observations % = Parenthesis denotes percentage increase/decrease over control.

** - Significant at 1% level, NS- Non Significant, *- Significant at 5% level

All metals and metal compounds have a certain level of toxicity and may cause adverse effects on living organisms. Nickel is one of the heavy metals. The main sources of nickel come from hydrogenation of oil industry and paint factories, motor vehicle, air craft industry, printing and in some cases the chemical industry. It is also used extensively in electroplating as nickel sulphate and nickel hydroxide is used in nickel cadmium batteries (Nanda *et al*., 2000). The result of the present study showed significant decrease in protein content in the tissues studied. The percentage decrease of protein is greater in muscle. The reduction in the protein content after exposure to nickel chloride may be due to protein synthesis, which is considered the primary biochemical parameter for early indication of stress.

A significant decrease in protein content of gill, brain, intestine, liver, kidney and muscle was observed in nickel treated fish (Joseph Thatheyus *et al*., 1992). The amino acids are the building blocks of protein. There are twenty four naturally occurring amino acids and proteins vary in accordance with the number and sequence of amino acids (Linder, 1985). The experimental animal body synthesized its known protein from the free amino acids that are produced as a result of proteolysis of the dietary proteins. The decrease in protein level observed in the present study may be due to their degradation and also to their possible utilization for metabolic purposes. The physiological status of animal is usually indicated by the metabolic status of proteins (Nelson and Cox, 2005). The fish can get the energy through the catabolism of proteins (Jrueger *et al*., 1968). (Singh *et al.,* 1996) observed the decreased protein level resulted in marked elevation of free amino acid content in the fish tissue.

The alteration in the tissue protein, in the present study suggests disturbance in the physiological activity. Decrease in the level of tissue protein may be due to excessive proteolysis to overcome the metabolic stress, as deposited protein in the cytoplasm can easily be used to replace the loss of proteins that occur during physiological stress (Patil, 2011). The decreased protein content might also be attributed to the destruction or necrosis of cells and consequent impairment in protein synthesis machinery (Bradbury *et al*., 1987). The heavy metals are known to elicit changes in the biochemical constituents of fish there by altering the metabolic pathway (Sarkar and Medda, 1993). Toxic exposure of organisms interferes with organ integrity at the biochemical level and unlimitedly gives rise to affect at the individual levels (Smolders *et al*., 2002)

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Conclusion

The present study reveals that metals are highly toxic to fish, leading to affect the nutritive value of the fish and all the metabolites studied are found to be sensitive which reflect changes in the normal activities of various functional systems. Thus biochemical alterations in fish can be considered as biomarkers to access the health status of the fishes as well as aquatic bodies polluted by toxicants. Thus environmental protection is the major requirement of the society.

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