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HEXAVALENT CHROMIUM INDUCED ALTERATIONS IN THE NUCLEIC ACIDS AND PROTEIN METABOLISM IN THE LIVER OF THE FINGERLINGS OF FRESHWATER SILUROID, *MYSTUS (M.) VITTATUS* (BL.)

Anuradha Shukla and J.P. Shukla

P.G. Department of Zoology, S, Kisan P.G. College, Basti (U.P.) India.

Key words:

Hexavalent chromium; RNA; DNA; Protein; *Mystus (M.) vittatus* (Bl.).

Correspondence to Author:

Anuradha Shukla

P.G. Deptt. of Zoology, S, Kisan P.G. College, Basti (U.P.) India

Email: shuklaanu2010@gmail.com

ABSTRACT: Fingerlings of *Mystus (M.) vittatus* (Bl.) a freshwater siluroid when subjected to a sublethal concentration of 2.4 mg/l hexavalent chromium for 20 days elicited significantly decreased RNA and protein in the liver. However, 10 days of exposure under the same stress produced no significant alteration neither in the protein content nor in the nucleic acids (DNA, RNA) content of the liver. Results are discussed in relation to pollutional stress of hexavalent chromium.

INTRODUCTION: Metallic elements are environmentally ubiquitous, readily dissolved in and transported by water and readily taken up by aquatic fauna. Fishes are at the higher levels of the food web and may accumulate various metallic pollutants revealing index of toxicity. A good deal of information is available on the alteration caused by hexavalent chromium on biochemical composition of different metabolites and enzymes in mammals^{1, 2} as well as in fishes³⁻¹⁶. Yet very little is known about its deleterious effect, if any, on the nucleic acids (RNA, DNA) and consequent protein metabolism in juvenile stage of fishes.

In the life cycle toxicity test carried out with several chemical pollutants, the embryo larval and juvenile stage of freshwater fishes have been demonstrated to be the most sensitive^{5,17-19}

Keeping this in view, toxic effect if any, of hexavalent chromium on the nucleic acids and protein metabolism in the liver of the fingerlings of *Mystus (M.) vittatus* (Bl.) a freshwater siluroid has been contemplated.

MATERIALS AND METHODS:

Fingerlings of *Mystus (M.) vittatus* (Bl.) (average length 34.2±2.33 mm and average weight 2215.3±5.30 mg) were procured from local lake. They were acclimatized for seven days in the tap water having DO= 6.38 mg/l; hardness as CaCO₃= 124.0 mg/l; electrical conductivity= 594.0 µmho/cm; temperature= 22.3°C and pH= 7.21. Fingerlings were disinfected with 0.1% KMnO₄ solution before keeping them into the experimental media.

A sublethal concentration 2.4 mg/l of hexavalent chromium was selected for short term experimentation (10 & 20 days). To avoid mortality, fingerlings were supplied oxygen for 4-5 hours daily with the help of stone diffusers in control and treated batches. Estimation of nucleic acids (DNA & RNA) and the protein in the liver was made following the methods adopted by^{20, 21}

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respectively. The data obtained in this study were statistically analyzed using student's 't' test. The experiment was conducted in laboratory condition prior to the preparatory phase in the month of late September, 2015.

RESULTS AND DISCUSSION:

In the liver of fingerlings of *Mystus (M.) vittatus* hardly any significant alteration was observed in the nucleic acids (DNA- RNA) and protein content exposed to a sublethal concentration of hexavalent chromium after short term exposure (10 days), However, significant decline in biomolecules (RNA- Protein) but not in the DNA was observed after 20 days of exposure in the same concentration.

Meagre references are available on the adverse effect of metallic pollutants on the various metabolites during early stages of fishes which seems to be a pressing need of the time, since varieties of chemical pollutants get their way into the aquatic bodies. Also little information pertaining to alterations in the nucleic acid metabolism in the fishes due to heavy metals are available^{4, 22-24}. Inhibition in the DNA under various chemical Pollutational stress has been reported to be associated with the chromosomal abnormalities viz; chromosomal pulverization or substitution of phosphorus^{25, 26} causing weak bond in the DNA chain eliciting decreased DNA level. Decrease in the DNA metabolism in the fish gonads following arsenic stress resulting lesser RNA synthesis²². In the present study though a quantitative decline of the liver's DNA has been unusually least affected when exposed to a sublethal concentration of hexavalent chromium. Presently it may, however, be inferred that hexavalent chromium may reduce DNA dependent RNA polymerases resulting a significant decreases in the RNA level and subsequent reduction in total protein content in the liver of fingerlings of *Mystus (M.) vittatus* (Table 1) is obvious.

It is interesting to record that quantitative decline in the RNA and protein appear to be exposure dependent that 10 days of exposure produced insignificant alterations, while 20 days exposure under hexavalent chromium (SLC) brought a significant decrease in the RNA ($P < 0.02$) and

protein ($P < 0.001$) of liver of fingerlings which provides an additional support to the findings of^{22, 24, 27}. Our study primarily dealing with the alterations in the RNA level exposed to a sublethal concentration of hexavalent chromium appears recent and provides an opportunity to the environmental scientists to discuss the change going on at subcellular level due to hexavalent chromium contamination in any aquatic body.

Available literatures reveal that aquatic organism including fishes can tolerate the chromium compounds at a fairly wide concentration in water^{28, 29} yet more data must be examined before such generalization can be reliably stated.

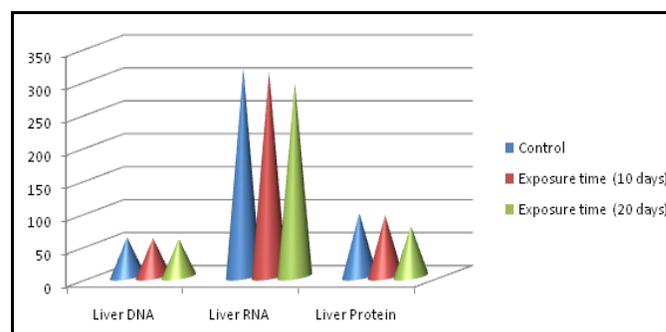
TABLE 1: ALTERATIONS IN THE NUCLEIC ACID (RNA-DNA) IN ($\mu\text{gm}/100 \text{ mg}$) AND PROTEIN CONTENT IN mg/gm OF WET WEIGHT OF LIVER OF THE FINGERLINGS OF *MYSTUS M. VITTATUS* EXPOSED TO A LOW SUBLETHAL CONCENTRATION OF HEXAVALENT CHROMIUM (2.4 mg/l); mean \pm S.E. n=5

Parameters	Control	Exposure time	
		10	20
Liver DNA	59.69 \pm 2.76	57.97 \pm 3.13*	56.84 \pm 2.81*
Liver RNA	316.08 \pm 5.07	310.57 \pm 4.96*	294.37 \pm 5.02**
Liver Protein	96.32 \pm 3.06	92.91 \pm 4.06*	76.67 \pm 4.31***

*= non significant ($P > 0.05$)

**= $P < 0.01$

***= $P < 0.001$



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CONCLUSION: Fingerlings of *Mystus (M.) vittatus* (Bl.) a freshwater siluroid when subjected to a sublethal concentration of 2.4 mg/l hexavalent chromium for 20 days elicited significantly decreased RNA and protein in the liver. However, 10 days of exposure under the same stress produced no significantly alteration neither in the protein

content nor in the nucleic acids (DNA, RNA) content of the liver. Results are discussed in relation to pollutional stress of hexavalent chromium.

The results reveal a profound impact of hexavalent chromium on RNA and protein content in the liver of fingerlings of *Mystus (M.) vittatus*. It may well be concluded that quantitative decline though takes place in the DNA content of the liver, however, is apparently insignificant in 10 and 20 days of exposure under hexavalent chromium stress

REFERENCES:

- Merali Z.; Keaw, S. and Singhal, R.L.: Response of hepatic carbohydrate and cyclic AMP metabolism to cadmium treatment in rats. *Can. J. Physiol. Pharmacol.* 1975; 53: 174-184.
- Norton, K.B. and Kench, J.E.: Effect of Cadmium on ribosomal protein synthesis in Rat liver. *Env. Res.* 1977; 13: 102-110.
- Dubale, M.S., and Shah, P.: Biochemical alteration induced by Cadmium in the liver of *Channa punctatus*. *Env. Res.* 1981; 26: 110-118.
- Shukla J.P. and K. Pandey: Zinc induced changes in the nucleic acids and protein metabolism in the fingerlings of *Channa punctatus*. *Acta Hydrochim Hydrobiol.* 1986; 14 (2): 195-197.
- Shukla J.P. and K. Pandey: Toxicity and long term effect of a sublethal concentration of cadmium on the growth of fingerlings of *Ophicephalus punctatus* (Bl.) a freshwater murrel. *Acta Hydrochim Hydrobiol.* 1988; 16: 537-540.
- Khargarot, B.S.; Rathore, R.S.; Tripathi, D.M.: Effects of chromium on humoral and cell mediated immune response and host resistance to disease in a freshwater catfish, *Saccobranchus fossilis* (Bl.). *Ecotox. Environ. Safety.* 1999; 43: 11-20.
- Delemos, C.T.; Rodel, P.M.; Terra, N.R.; Erdtman, B.: Evaluation of basal micronucleus frequency and hexavalent chromium effects in fish erythrocytes. *Environ Toxicol Chem.* 2001; 20 (6): 1320-1324. [PubMed: 11392142].
- Vutukuru, S.S.: Chromium induce alterations in some biochemical profiles of the indian major carp, *Labeo rohita* (Hamilton). *Bull Environ. Contam. Toxicol.* 2003; 70 (1): 118-123.
- Roberts, A.P. and Oris J.T.: Multiple biomarker response in rainbow trout during exposure to hexavalent chromium. *Compar. Biochem. Physiol. Part C Toxicol Pharmacol.* 2004; 138: 214-228.
- Cavas, T.; Ergene, G.S.: Induction of micronuclei and nuclear abnormalities in *Oreochromis niloticola*. Following exposure to petroleum refinery and chromium processing plant effluent. *Aqua Toxicol.* 2005; 74: 264-271.
- Sterolli, M.M.; Barone, G.; Sterolli, A.; Macrotrigiano, G.O.: Trace metals in tissue of Mugilids, (*Mugil auratus*, *M. capito* & *M. labrous*) from the Mediterranean sea. *Bull. Environ. Contam Toxicol.* 2006; 77: 43-50.
- Karadede, A. H.; Unlu, E.: Heavy metal concentration in water, sediment, fish & some benthic organism from Tigris River, Turkey. *Environ. Monit. Assess.* 2007; 131: 323-337.
- Mishra, A.K. and B. Mohanty: Histopathological effects of hexavalent chromium in the ovary of a freshwater fish *Channa punctatus* (Bl.). *Bull. Contam. Toxicol.* 2008; 80: 507-511.
- Vinodini, R. and Narayanan: The impact of toxic heavy metals on the hematological parameters in common carp, (*Cyprinus carpio*). *Iran. J. Environ. Hlth. Sci. Eng.* 2009; 6(1): 23-28.
- Yilmaz, A.B.; Cemal, T. and T. Toker: Uptake and distribution of hexavalent chromium in tissue (gill, skin and muscle) of a freshwater fish, Tilapia (*Oreochromis aureus*). *Env. Chem. & Ecotoxicol.* 2010; 2(3): 28-33.
- Shukla, J.P.; A. Shukla and R.K. Dubey: Deleterious effect of hexavalent chromium on the blood pyruvate level in the fingerlings of *Channa punctatus* (Bl.), a tropical freshwater murrel. *Int. J. Pharm. Bio Sci.* 2012; 3 (4): 789-794.
- Mckim, J.M.: Evaluation of tests with early life stages of fish for predicting long term toxicity. *J. Fish. Res. Bd. Canada.* 1977; 1148-1154.
- Pandey, K. and J.P. Shukla: Deleterious effect of arsenic on the growth of fingerlings of a freshwater fish, *Colisa fasciatus* (Bl. & Schn.). *Acta Pharmacol. et Toxicol.* 1982; 50: 398-400.
- Pandey, K. and J.P. Shukla: Acute toxicity of carbamide and its long term effects on the growth of fingerlings of a tropical freshwater teleost, *Colisa fasciatus* (Bl. And Schn.). *Acta Hydrochim Hydrobiol.* 1983; 11: 145-149.
- Schneider, W.: Determination of nucleic acid in tissue by pentose analysis. *Methods in Enzymology.* Colowick, S.P. and Kaplan, N.O. (Eds.) 1975; 680-684.
- Lowery, O.H.; N.J. Rosebrough; A.L. Furr and R.J. Randall: *Methods in enzymology*, Colowick, S.P. and Kaplan, N.O. (Eds.) 1951; 3: 448-450.
- Shukla J.P. and K. Pandey: Altered Nucleic acid metabolism in the ovary exposed under arsenic stress in a freshwater fish, *Colisa fasciatus* (Bl. And Schn.). *Acta Hydrochim Hydrobiol.* 1984a; 12: 217-219.
- Shukla J.P. and K. Pandey: Arsenic induced cellular and biochemical changes in the testicular cycle of a freshwater perch, *Colisa fasciatus* (Bl. And Schn.). *Cellular and Molecular Biology.* 1984b; 30: 227-231.
- Shukla J.P. and K. Pandey: Toxicity and long term effects of arsenic on the gonadal protein metabolism in a tropical freshwater fish *Colisa fasciatus* (Bl. And Schn.). *Acta Hydrochim Hydrobiol.* 1985; 13: 127-131.
- Freed, J.J. and Schatzis, S.A.: Chromosomes aberrations in cultured cells deprived of single essential amino acids. *Exp. Cell. Res.* 1969; 55: 393-396.
- Palmer, K.A.; Green, S. and Legator, M.S. (1972): Cytogenetic effect of DDT and derivatives of DDT in cultural mammalian cell line. *Toxicol. Appl. Pharmacol.* 22: 355-358.
- Shukla, J.P.; Diwedi U.N.; Tewari P. and Prasad, M.: Deleterious effects of Arsenic on the nucleic acids and protein metabolism in the liver of *Heteropneutes fossilis* (Bl.). a freshwater teleost. *Acta Hydrochim Hydrobiol.* 1985; 13: 611-614.
- Clearly, J.E. and Coleman, R.L.: Cadmium toxicity and bioconcentration in large month bass and blue gill. *Bull. Environ. Contam. Toxicol.* 1974; 11: 146-149.
- Sangalang, G.B. and Freeman H.C.: Tissue uptake of cadmium in brook trout during chronic sublethal exposure. *Arch. Env. Contam. Toxicol.* 1979; 9: 77-84

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