Eco. Env. & Cons. 26 (4) : 2020; pp. (1839-1841)
Copyright@ EM International
ISSN 0971–765X

Acute toxicity study on biochemical parameter of catfish, *Clarias batrachus* exposed to sodium arsenate

Mohnish Pichhode and S. Gaherwal

Department of Zoology, Government Holkar (Model, Autonomous) Science College, Indore, Madhya Pradesh, India

(Received 6 February, 2020; accepted 30 April, 2020)

ABSRACT

The present experiment deals with the impact of treatment of sodium arsenate, on the biochemical parameter of blood of catfish, *Clarias batrachus*. The catfish was exposed to LC_{50} of sodium arsenate in laboratory condition for determined duration. We studied the total protein level in blood of catfish alteration induced by lethal concentration of sodium arsenate. It brought significant changes in protein level as compare to control value. The biochemical study of blood of *Clarias batrachus*, total protein was decreased in sodium arsenate treated group with prominent variation in acute toxicity.

Key words : *Clarias batrachus, Protein, Sodium arsenate, Toxicity.*

Introduction

Arsenic (As) is an ubiquitous and naturally obtained element found widely in environment. Several arsenic compounds are found in the environment (Pichhode and Gaherwal, 2019a). The concentration of total arsenic (inorganic and organic) in freshwaters can vary substantially depending on the local geochemical environment and anthropogenic influences (Katare *et al.*, 2015; Asati *et al.*, 2016; Pichhode and Gaherwal, 2019b). Typically natural levels can range from 0.13–2.1 µg/L in rivers and from 0.06–1.9 µg/L in lakes. Arsenic levels in saltwater are much less variable than in freshwater, with a typical range in open water of 0.5–2.0 µg/L (Smedley and Kinniburgh, 2002). Besides the direct exposure of people to arsenic by drinking contaminated water, the As might also biologically exist to aquatic organisms, such as fish which are used as human food thereby supply a supplement source of arsenic. Therefore, studies concerned to arsenic (As) content in aquatic organisms and sea fish in especially, have interested significant attention. In the aquatic environment, arsenic exists either as, arsenite and arsenate forms which are interconverted through redox and methylation reactions. These types of arsenic can accumulate in many aquatic organisms which may catalyse the oxidation of arsenite to arsenate and promote the formation of methylarsines through biomethylation reaction (Kavitha *et al.*, 2010). Finally, oxidative stress may occur partially with arsenic toxicity (Banerjee *et al.*, 2009). In fish heavy metals and their various compounds may affect their physiology and metabolic activity and abnormalities in biochemistry (Pichhode and Gaherwal, 2019c). Although arsenic is not biomagnified through the food chain, bio concentration has been observed in various aquatic organisms such as a fish. Freshwater fish uptake arsenic is not only through diet by benthic-feeding but also with waterborne across the gill (Talas and Gulhan, 2013; Pichhode and Gaherwal, 2020). Arsenic contains both in the form of lipid soluble and water soluble arseno organic compounds. Acute

exposure can lead to immediate death because it induced increases production of mucus, causing suffocation, or direct detrimental effects on the gill epithelium. Chronic exposures can show in the accumulation of the metalloid to toxic level; the detoxification role of the liver and kidney at considerable risk (Mandal and Suzuki, 2002). Many researchers investigated reduce in protein level in liver, kidney, blood of various fish due to exposure of sodium arsenate. In the present investigation result proved the quantity of total protein in blood serum of experimental fishes was found decreased due to sodium arsenate.

Materials and Methods

The freshwater catfish *Clarias batrachus* were used as an experimental animal and it was collected from Indore local fish market, Indore, M.P. and after that acclimatized it in the laboratory for approx. 7 days. The analytical grade sodium arsenate ($Na_2HAsO_4 \cdot 7H_2O$) (CAS No.: 10048-95-2) was ordered from Spectrum chemical mfg. corp., Mumbai, India and used without further purification for the experiment. For determining the lethal concentration (LC_{50}) of sodium arsenate, catfish (*Clarias batrachus*) were selected from the stock and exposed to different concentrations of sodium arsenate in different tanks. For determining LC_{50}, ten fishes (10) were kept in each tank and water was replaced daily with fresh sodium arsenate mixed water to maintain a constant level of sodium arsenate during the exposure period. The survival or mortality of catfish was observed at the end of 24 hours and the concentration at which 50% mortality of fish occurred was taken as the lethal concentration (LC_{50}) (Kumari *et al.,* 2017). The blood was collected from cardiac puncture of *Clarias batrachus* by disposable syringe and needles and kept in appropriate sterilized vials then processed for total protein analyses (Dacie and Lewis, 1975). In the present investigation experimental fishes were divided into two groups control and sodium arsenate treated group. Ten (10) fishes were kept in control group and exposed to normal water and in experimental group forty (40) fishes were exposed to concentration of sodium arsenate at different time intervals. In both control and experimental group fishes were exposed to maximum 96 hours (Pichhode and Gaherwal, 2019d). The estimation of total protein was determined by adopting biuret method (Harris, 2003). The total serum protein was expressed as gram per cent (%) protein.

Results and Discussion

Due to exposure of sodium arsenate, the quantity of total protein in blood serum of experimental fishes was found decreased. The decreased total protein concentration in blood of experimental fishes was after 96 hrs. 18.07 percent. The decreased in protein value of blood after 24, 48 and 72 hrs. were 7.30, 8.46 and 15.00 percent respectively.

In the present investigation due to effect of sodium arsenate total protein was decreased as compared to control value at 24, 48, 72 and 96 hrs. The decrease in protein level may be due to their degradation and also to their possible utilization for metabolic purposes. Proteins are primarily involved in the architecture of the cell, which is the chief source of nitrogenous metabolism. The depletion of protein fraction may have been due to their degradation and possible utilization for metabolic purposes. Enhanced protease activity and decreased protein level have resulted in marked elevation of free amino acid content in fish tissues (Nelson and Cox, 2005).

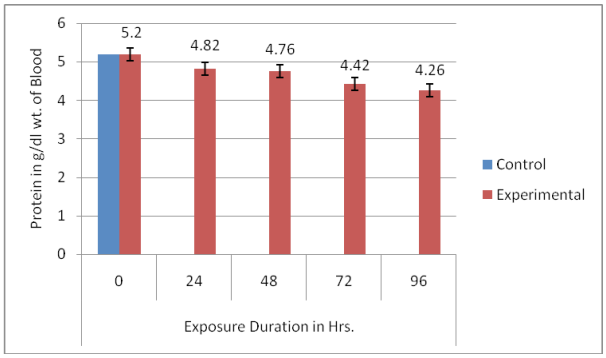

Fig. 1. Showing total protein in the blood of *C. batrachus* exposed to sodium arsenate for different duration, vertical bars represented mean±S.D.

Arsenic induced toxicity is related to its high capability of reacting with protein and non-protein thiol groups resulting in an alteration of critical cellular pathways. Plasma proteins were decreased significantly with exposure period of arsenic compound (Habib *et al.,* 2007). Due to sodium arsenate this could be attributed to renal excretion or impaired protein synthesis or liver disorder (Kori-Siakpere and Ubogu, 2008; Pichhode *et al.,* 2020).The biochemical study of blood of *Clarias batrachus*, total

protein was decreased in sodium arsenate treated group with prominent variation in acute toxicity.

Conclusion

The present investigation demonstrated alteration in blood protein of catfish, *Clarias batrachus* after exposure of sodium arsenate during the experimental duration 24, 48, 72 and 96 hrs. as compare to control. The biochemical parameters also can use as capable biomarkers of acute arsenic toxicity to the economically important catfish in environmental bio monitoring.

Aknowlwdgement

The authors are thankful to Head, Department of Zoology, Govt. Holkar Science College, Indore, M.P., India for help in carrying out the work on biochemical parameters of catfish and providing necessary laboratory facilities.

References

Asati, A., Pichhode, M. and Nikhil, K. 2016. Effect of heavy metals on plants: An overview. *Int. J. Appl. Innov. Eng. Manage.* 5 : 2319-4847.

Banerjee, P., Bhattacharyya, S. S., Bhattacharjee, N., Pathak, S., Boujedaini, N., Belon, P. and Khuda-Bukhsh, A. R. 2009. Ascorbic acid combats arsenic-induced oxidative stress in mice liver. *Ecotoxicology and Environmental Safety*. 72 (2) : 639-649.

Dacie, V. and Lewis, S. M. 1975. In: *Practical Haematology,* ELBS, Longman, Singapore.

Habib, G. M., Shi, Z. and Lieberman, M. W. 2007. Glutathione protects cells against arsenite-induced toxicity. *Free Radic. Biol. Med*. 42 : 191-201.

Harris, D. 2003. *Quantitative Chemical Analyses.* 6th ed.; W. H. Freeman and Company: USA.

Katare, J., Pichhode, M. and Kumar, N. 2015. Effect of Different Mining Dust on the Vegetation of District Balaghat, MP-A Critical Review. *International Journal of Science and Research*. 4(8) : 603-607.

Kavitha, C., Malarvizhi, A., Kumaran, S. S. and Ramesh, M. 2010. Toxicological effects of arsenate exposure on haematological, biochemical and liver transaminases activity in an Indian major carp, *Catla catla*. *Food and Chemical Toxicology*. 48(10) : 2848-2854.

Kori-Siakpere, O. and Ubogu, E. O. 2008. Sub-lethal haematological effects of Zinc on the freshwater fish, *Heteroclarias* sp. (*Osteichthyes: Clariidae*). *Afr. J. Biotechnol*. 7 (12) : 2068-2073.

Kumari, B., Kumar, V., Sinha, A. K., Ahsan, J., Ghosh, A. K., Wang, H. and DeBoeck, G. 2017. Toxicology of arsenic in fish and aquatic systems. *Environmental Chemistry Letters*. 15(1) : 43-64.

Mandal, B. K. and Suzuki, K. T. 2002. Arsenic round the world: a review. *Talanta.* 58 (1) : 201-235.

Nelson, D. L. and Cox, M. M. 2005. *Lehininger Principles of Biochemistry.* 3rdEdn., Macmillan Worth Publishers, New York.

Pichhode, M. and Gaherwal, S. 2019a. Biochemical response of heavy metal, sodium arsenate exposure in catfish, *Clarias batrachus*. *Int. J. Current Adv. Res.* 8(08): 19676-19678.

Pichhode, M. and Gaherwal, S. 2019b. Study of sodium arsenate induced haematological changes in catfish, *Clarias batrachus*. *Pranama Res. J.* 9 (08) : 163-169.

Pichhode, M. and Gaherwal, S. 2019c. Toxic effect of arsenic trioxide on biochemical response in catfish, *Clarias batrachus*. *Int. J. Recent Sci. Res.* 10 (08) : 34033-34036. DOI: http://dx.doi.org/10.24327/ijrsr.2019.1008.3804

Pichhode, M. and Gaherwal, S. 2019d. Toxicological effects of arsenic trioxide exposure on haematolical profile in catfish, *Clarias batrachus*. *International Journal of Current Research and Review*. 11 (16) : 9-12.

Pichhode, M. and Gaherwal, S. 2020. Effect of heavy metal toxicity, arsenic trioxide on the biochemical parameter of fresh water fish, *Clarias batrachus. Pollution Research.* 39 : 123-125.

Pichhode, M., Gaur, P., Khan, H. R., Dudwe, J. and Gaherwal, S. 2020. Histological alteration caused by arsenic trioxide in catfish, *Clarias batrachus*. *Journal of Xidian University*. 14 (3) : 124-137.

Smedley, P. L. and Kinniburgh, D. G. 2002. A review of the source, behaviour and distribution of arsenic in natural waters. *Appl. Geochem.* 17: 517–568.

Talas, Z. S. and Gulhan, M. F. 2013. Effects of various pollen concentrations on some biochemical and haematological parameters and paraoxanase activity in rainbow trout (*Oncorhynchus mykiss*). *Iranian Journal of Fisheries Sciences*. 12 (4) : 928-938.