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Research Article

TOXIC EFFECT OF ARSENIC TRIOXIDE ON BIOCHEMICAL RESPONSE IN CATFISH, CLARIAS BATRACHUS

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ABSTRACT

Arsenic is a widespread ubiquitous toxicant in the world and its toxicity in chemical form, with inorganic forms being referred more toxic than the organic form. The impact of toxicity of arsenic trioxide on certain biochemical parameters of the catfish, *Clarias batrachus* has been analysed following exposure of lethal concentration (LC_{50} value- 84 mg/l) of arsenic trioxide for 24, 48, 72 and 96 hours. To estimated serum glutamate oxaloacetate transaminase (SGOT) and serum glutamate pyruvate transaminase (SGPT) were observed in both control and arsenic trioxide exposed catfish. The level of SGOT and SGPT were significantly increased to control value during the treatment of arsenic trioxide.

INTRODUCTION

Arsenic (As) is the most widespread environmental ubiquitous contaminant which arising through natural phenomenon such as the weathering of geochemical sources and from anthropogenic activities such as mining, metal working and coal burning. Arsenic and their compounds cannot be destroyed in the environment. It can only change its state, or become attached to or separated from particles. It may change its form by reacting with oxygen or other molecules present in air, water, or soil, or by the action of bacteria that live in soil or sediment. Many arsenic compounds can be water soluble. Thus, arsenic can get into rivers, lakes, or underground water by dissolving in rain or snow or through the discharge of industrial wastes. Some of the arsenic will stick to particles in the water or sediment on the bottom of rivers or lakes, and some will be carried along by the water. Ultimately, most arsenic ends up in the soil or sediment. Although some fish and shellfish take in arsenic, which may build up in tissues, most of this arsenic is in an organic form called arsenobetaine (commonly called "fish arsenic") that is much less harmful (Asati *et al.,* 2016; Pichhode and Nikhil, 2015; Zhang *et al.,* 2012). Perhaps because of the widespread nature of this toxic component, biological systems have evolved a mechanism which permits them to survive the presence of reasonable levels of the element by its methylating (Talas *et al.,* 2014).

Arsenic contamination in natural water resources has become a great task throughout the world which poses serious human health problems, being the toxic agent in the ecosystem (Aruljothi *et al.,* 2013; Ahrar *et al*., 2014). Arsenic induces its toxicity through a variety of mechanisms including loss of cellular respiration, disengagement of oxidative phosphorylation and by inhibition of different mitochondrial enzymes (Mashkoor *et al.,* 2013; Magellan *et al.,* 2014).

Analysis of serum biochemical parameters especially useful to identify target organs of toxicity as well as the general health status of animals, and is advocated to provide early signs of critical modifications in stressed organisms (Folmar, 1993; Jacobson-Kram and Keller, 2001).Besides, biochemical investigations were used to illustrate the toxicity on different tissue systems. Hence, this investigation is aimed at studying the changes in haematological as well as biochemical status of the blood tissue of arsenic exposed *Clarias batrachus*. The elevated level of serum glutamate pyruvate transaminase (SGPT) and serum glutamate oxaloacetate transaminase (SGOT) are markers of functions of liver. SGOT and SGPT are the two essential and important enzymes occur in all tissues.

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SGOT and SGPT liberated into blood in pathological terms and therefore are of clinical importance and their presence in blood plasma can give message on tissue injury or organ dysfunction. SGOT and SGPT catalyse the transfer of amino group ($-NH_2$) from glutamic acid to either pyruvic acid or oxaloacetic acid. Therefore increased level of serum transaminase related to interruption of normal metabolism which is due to extensive alteration in the liver histology and indicates liver damage (Joyce *et al.,* 1989; Gautam *et al.,* 2013).

The liver plays a main role in detoxification and degradation of pollutants. Alanine aminotransferase (ALT) plays a key role in formation and deamination of amino acids during stress imposed situations to accomplish high-energy demand of the organisms (Samanta *et al.,* 2014). In the present study, evaluating arsenic trioxide toxicity to enzymatic activities of catfish, *Clarias batrachus* is critical to preserve these fauna and to prevent contaminations.

MATERIAL AND METHODS

Experimental Animal

The healthy catfish *Clarias batrachus* were used as an experimental animal and it was collected from local fish market of Indore and acclimatized in the laboratory for one week.

Test Chemical

The analytical grade arsenic trioxide (As_2O_3) (CAS No.: 1327-53-3) (Anhydrous) with 98% purity was taken from Spectrum chemical mfg. corp., Mumbai, India and used without further purification for the experiment.

Determination of Lethal Concentration of Arsenic trioxide

To determine the lethal concentration (LC_{50}) of arsenic trioxide, fish (*Clarias batrachus*) were randomly selected from the stock and exposed to different concentrations of arsenic trioxide in different tanks. Ten fish were kept in each tank and water was replaced daily with fresh arsenic trioxide mixed water to maintain a constant level of arsenic trioxide during the exposure period. The mortality or survival of fish 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).

Collection of Blood Sample

The blood collected by disposable syringe and needles from cardiac puncture of *Clarias batrachus* and kept in sterilized appropriate vials then processed for various biocheical analyses (Dacie and Lewis, 1975).

Experimental Design and Duration

In the present investigation experimental fishes were divided into two groups control and arsenic trioxide 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 arsenic trioxide at different time intervals. In both control and experimental group fishes were exposed to maximum 96 hours.

Biochemical Analysis (Estimation of SGOT and SGPT)

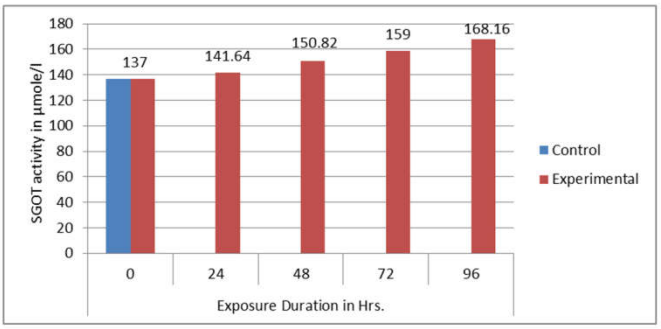
The activity of serum glutamate oxaloacetate transaminase (SGOT) and serum glutamate pyruvate transaminase (SGPT) were determined by adopting the method of Boyer (2000). The activities of SGOT and SGPT were expressed as µmole/l.

RESULT

In the present investigation biochemical estimation of control and arsenic trioxide (LC_{50} value- 84 mg/l) treated fishes were completed. The biochemical parameters were SGOT (serum glutamate oxaloacetate transaminase) and SGPT (serum glutamate pyruvate transaminase) of control fish were 137.00 µmole/l and 42.42 µmole/l respectively.

Serum Glutamate Oxaloacetate Transaminase Activity (SGOT) of Arsenic Trioxide Treated Group

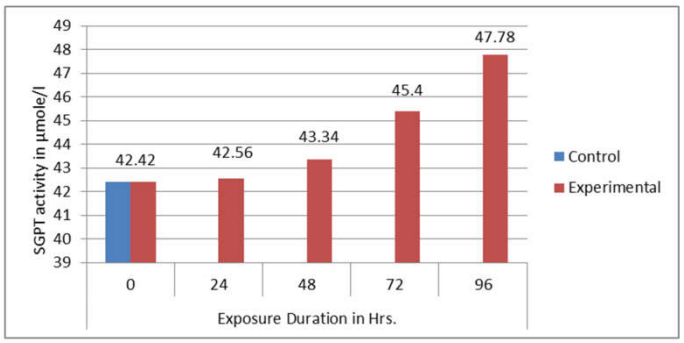
The SGOT activity was found increased as the duration of exposure of arsenic trioxide increased. The increased SGOT activity after 24, 48, 72 and 96 hrs. of exposure of arsenic trioxide was 141.64, 150.82, 159.00 and 168.16 µmole/l respectively.



Graph 1 Showing SGOT activity of *C. batrachus* exposed to arsenic trioxide (84 mg/l) for different duration

Serum Glutamate Pyruvate Transaminase Activity (SGPT) of Arsenic Trioxide Treated Group

The SGPT activity was found increased as the duration of exposure of arsenic trioxide increased. The increased SGPT activity after 24, 48, 72 and 96 hrs. of exposure of arsenic trioxide was 42.56, 43.34, 45.40 and 47.78 µmole/l respectively.



Graph 2 Showing SGPT activity of *C. batrachus* exposed to arsenic trioxide (84 mg/l) for different duration

In the present experimental investigation due to effect of arsenic trioxide Serum glutamate oxaloacetate transaminase activity (SGOT) and Serum glutamate pyruvate transaminase activity (SGPT) was increased as compared to control value at 24, 48, 72 and 96 hours.

DISCUSSION

In the present experimental investigation due to effect of arsenic trioxide serum glutamate oxaloacetate transaminase activity (SGOT) and serum glutamate pyruvate transaminase activity (SGPT) was increased as compared to control value at 24 hours interval. The increase activity of glutamate-pyruvate transaminase and glutamate-oxaloacetate transaminase indicates disorder in structure and integrity of cell organelles, like endoplasmic reticulum and membrane transport system. (Karatas and Kalay, 2002).

The change in enzyme activities in arsenic trioxide treated fish is due to increased permeability of the cell as well as the direct effect of the compound on the tissues (Roy, 2002). Therefore, substantial depletion of enzymes in the *Clarias batrachus* exposed to arsenic trioxide may be attributed to increased level of arsenic in the tissues. Moreover, the accumulation of arsenic in muscles and liver could be the conceivable reason for variation of enzyme activities. In fishes, liver is the prime location of biotransformation. The liver is removed harmful substances in blood with assist of specific enzymes after their metabolic detoxification. SGPT and SGOT are extremely specific indices of hepato-cellular injury. These enzymes exhibit two types of response i.e., initially the SGPT and SGOT level increases as a protective response against toxicity and stress by increasing the rate of metabolism but for chronic exposure the activity level of these enzymes was found decreased on account of hepato-cellular disturbance (Babu and Jothi Narendiran 2016; Susan *et al.,* 1999). Changes in the activity of enzyme are widely responsible to detect tissue damage and biomarkers of animals exposed to chronic concentrations of a toxicant (Ozmen *et al.,* 2006).

CONCLUSION

In conclusion, we have shown that arsenic trioxide concentration (LC_{50}- 84 mg/l) in an aquatic fauna are harmful to catfish, *Clarias batrachus* and this significantly increases the activity of enzymes (SGOT and SGPT).

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