

Impact of Mercury on Oxygen Consumption of Freshwater Bivalve, *Lamellidens marginalis*

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Abstract

The present study was carried out to investigate Mercury induced Oxygen Consumption in a freshwater bivalve *Lamellidens marginalis*, a sentinel species in aquatic environment. The bivalves were exposed to acute dose of heavy metal, Mercury chloride. Oxygen Consumption rate for acute treatment was recorded in groups Lc0 and Lc50 concentration for 96 hour. All results were compared with control groups of respective treatment. Our results showed that oxygen consumption rate was found to decrease with increased concentration of mercury and exposure period.

Keywords: Oxygen consumption rate; Mercury chloride; *Lamellidens marginalis*, Acute toxicity.

Introduction

Heavy metals have devastating effects on ecological balance of the recent environment and a diversity of aquatic organisms (Farombi *et. al*, 2007). In order to evaluate the adverse effect of the pollutants on aquatic organisms, there is a worldwide trend to complement physical and chemical parameter with bio markers in aquatic pollution monitoring (Abdel, *et. al.*, 2012).

In living animals respiration is most important process of life for derivation of energy in the form of ATP to perform various activities of body like movement, metabolic reaction, growth, development, muscular contraction, reproduction etc. oxygen consumption is a phenomenon which denotes the metabolic state of animals. In general, the rate of oxygen consumption is greatly influenced by size, stages in life cycle of animals along with different environmental factors such as pH, temperature, salinity, light, oxygen tension, turbidity etc.⁴⁻⁶ Therefore the activity of animals can be measured in term of oxygen uptake.

Aquatic molluscs are considered as a bioindicator of heavy metals pollution.⁷⁻⁸ Among that bivalves are good candidates for ecotoxicological studies. As they are filter feeder macro content of toxicant can pass to their respiratory surface and entered into the body. Oxygen consumption rate of whole bivalve are altered by heavy metals. Such study implies bivalve health. Some researchers have studied effect of mercury chloride and cadmium chloride on oxygen uptake in crab.⁹ Ganeshwade *et al.*, (2012)¹⁰ also observed the toxicity of pesticides on freshwater fish *Channa striatus*. Also Jadhav, (2011)¹¹ studied on respiratory physiology of bivalve *Lamellidens marginalis*. The connection between respiratory activity of animals and heavy metals has been revived by several workers.^{12,13} The effects of heavy metals on aquatic animals (marine and freshwater) have been studied extensively by many workers.¹⁴⁻¹⁶

Considerable attention has been paid towards aquatic animals like fish, prawn, bivalve, crab as they respired through gills. Survey of literature showed that little information is known on the impact of heavy metals on respiratory mechanism in freshwater bivalves. So the present study is taken on

freshwater bivalve, *Lamellidens marginalis*. from Godavari river, Paithan, district Aurangabad , Maharashtra.

MATERIALS AND METHODS:

After collection of the animals they were immediately transported to the laboratory. After bringing to the laboratory the fouling biomass and mud on shell valves were removed without disturbing the siphonal regions. The equal sized animals (90-100mm in shell length) were grouped and kept in a sufficient quantity of water (each animal / litre in aquaria with aeration for 24 hrs to adjust animals in laboratory condition (with removal of water at interval of 12 to 13 hrs). No food was given during this time and during experiment. After 24 hrs animals of equal size (90-100 mm shell length) were grouped in 10 and exposed to different test concentration of mercury chloride for acute toxicity test. Acute exposure group divided into three groups. First group considered as a control. Animals of second and third groups was exposed to Lc0 (10 ppm) and Lc50 (50 ppm) concentration of mercury chloride for 96hour respectively. After exposure period the bivalves were maintained in one liter air tight water container for one hour. The oxygen content of this water before and after one hour was estimated with control by Winkler's method.¹⁷ After measurement of oxygen consumption the bivalves were dissected, flesh was taken out from their shells, blotted, dried on filter paper and wet body weight was determined. The oxygen consumed by each animal was then calculated and expressed as mg/lit/hr/gm wet weight of the flesh. For confirmation of results all values of groups were subjected to statistical analysis using t test. Percentage differences were also calculated in experimental groups.

Results and Discussion

The rate of respiration of *Lamellidense marginalis* exposed to LC0 and LC50 concentrations of mercury chloride in different seasons under laboratory condition differed significantly than the respective control group. When compared between control and LC0 group and LC50 group and also LC0 and LC50 group on 24, 48, 72, and 96 hr.

In control group, the rate of respiration fluctuated between 0.199 ± 0.001 (measured on 96 hr) and 0.346 ± 0.004 (measured on 48 hr). On 48 hr it sharply increased. From 72 hr onwards there was a decrease in the rate of respiration (i.e. from 0.158 ± 0.002 to 0.274 ± 0.006) till 96 hr. in LC0 group the rate of respiration, fluctuated between 0.95 ± 0.002 (measured on 96 hr) and 0.220 ± 0.004 (measured on 48 hr). The rate of respiration on 24 hr rate was increased significantly (61.67%) while, it was decreased on 48 hr significantly (39.56%). On 72 hr the rate of respiration significantly decreased (79.62%) and also on 96 hr it decreased significantly (29.35%). In LC50 group, the rate of respiration fluctuated added between 0.064 ± 0.001 (measured on 96 hr) and 0.084 ± 0.007 (measured on 48 hr). in LC50 group when it was compared to control, the rate of respiration decreased significantly on 24 hr (65.32%), on 48 hr it was decreased significantly (76.92%) which was followed by sudden increased on 72 hr being significantly (646.83%). On 96 hr there was decrease by the rate of respiration (221.60%). In LC50 group when it was compared to LC0 the rate of respiration change significantly on 24 hr (9.5%), on 48 hr there was increased in the

rate of respiration, being significant (61.81%) from 72 hr. Onwards the rate of respiration decreased significantly (16.83% and 93.26% on 72 hr and 96 hr. respectively).

The need of oxygen is always continuous throughout the life of an active animal. The production of ATP in large amounts requires continuous supply of oxygen. The rate of supply depends on anatomical and physiological characteristics of the organs of respiration and transport pigment could be a limiting factor while other environmental variation like temperature or pH and salinity may impose extra demands for oxygen or affects the rate of exchange. Each of the atmospheric gases gets dissolves in water according to its partial pressure, its solubility coefficient and the temperature. Rising temperature reduces the solubility of gases. In addition, the solubility of gases is also altered by the presence of dissolved solids. Heavy metals also affect gill structure of animals which also contributed decrease oxygen consumption observed by Marigoudar *et al.*, (2009).²⁶ Also some toxic compound alters respiration in bivalve studied by Jadhav (2012).²⁷

Time	Body Size	Summer		
		Control Group (wet wt.= 20.5)	LC0 Group (wet wt.= 18.5)	LC50 Group (wet wt.= 19.5)
24hr	90-100 mm	0.274 ±0.006	0.105±0.005 (61.67%) ***	0.095±0.003 (65.32%) *** (9.5%)0
48hr	90-100 mm	0.346 ±0.004	0.220±0.004 (39.56%) ***	0.084±0.007 (76.92%) *** (61.81%) 000
72hr	90-100 mm	0.158 ±0.002	0.101±0.004 (79.62%) *	0.118±0.006 (646.83%) *** (16.83%) 00
96hr	90-100 mm	0.199 ±0.001	0.95±0.002 (29.35%) **	0.064±0.001 (221.60%) *** (93.26%) 000

Changes in the rate of respiration of *Lamellidens marginalis* after exposure of acute tests of Mercury in different time hours in summer.

Oxygen uptake in aquatic organisms is the mostly used tool for understanding the physiological action of the pollutants. The respiration rate of organism is an indicative for the physiological state and changes in the respiration rates may be an indicative for environmental stress. Biological responses of organisms to pesticides in the aquatic environment are usually understood through determining their rate of survival and changes in the levels of various physiological phenomena.

Also a factor responsible for decreased oxygen uptake was coagulation of mucus on gill due to mercury exposure. Coagulation of mucus causes reduction in the effective transfer of oxygen to internal tissue, adversely affects the absorption of oxygen from ambient medium. The stiff suppression in the rate of oxygen consumption was probably due to the reduced efficiency of gill. In the present study, considerably mucus secretion was found in lethal concentration during experimental period. These fluctuations of oxygen in fresh water mussel exposed to mercury are due to variations in gill ventilation rate coupled with the concentration of pollutant in water and efficiency of assimilation of oxygen via the gills and also the length of time during which the shell valve is closed. Reduction in oxygen consumption was reported in LC50 group of fresh water *Lamellibranch marginalis* from Godavari.

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