



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

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(Received 11 Oct, 2017; Accepted 08 Nov, 2017; Published 16 Nov, 2017)

ABSTRACT: The present study was carried out to investigate Mercury induced Oxygen Consumption Rate (OCR) in a freshwater bivalve *Lamellidens corrianus*, a sentinel species in aquatic environment. The bivalves were exposed to acute and chronic dose of heavy metal, Mercury chloride. Oxygen Consumption rate for acute treatment was recorded in groups Lc0 and Lc50 concentration for 96 hour while chronic treatment was recorded for 7 day, 14 day and 21day from group Lc50/10th group. 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 corrianus*; Acute and chronic toxicity.

INTRODUCTION: The modern developmental progresses in industrial revolution and agriculture misuse, has exploited the natural resources indiscriminately leading to drainage of toxic compound in water bodies causing pollution. Heavy metals contributed a key role in pollution. They are considered as a most hazardous pollutant due to their non-degradable nature and property to affect all kinds of life in ecological system. Unfortunately, man-made activities like mining, industrial discharged, sewage sludge disposal, fertilizers and pesticides application have been raised levels of mercury, lead, cadmium and many more harmful metals in ecosystem.¹ Few metals such as copper zinc are required for metabolic activity of cells, though could be lethal at higher concentration. On other hand Mercury, cadmium, and lead are suggested as harmful metals even at very minute concentration for aquatic life.² Such polluted compounds get transferred to aquatic animals from water and easily enters the food chain. Today's world face growing hazard of mercury which does adverse health effects in animals and humans.³

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 corrianus* from Madkhol reservoir at Sawantwadi, Maharashtra.

MATERIALS AND METHODS: The freshwater bivalve *Lamellidens corrianus* were collected from Madkhol reservoir near Taluka Sawantwadi Dist Sindhudurga, Maharashtra. They were immediately brought to laboratory. The shells of bivalves were brushed and cleaned with water to removed mud, fouling algal and fungal biomass. The animals were acclimatized for 4-5 days at laboratory condition. The acclimatized equal size, healthy and active bivalve were selected for experiments.

They were divided into two exposures, acute and chronic. Acute exposure group divided into three groups. First group considered as a control. Animals of second and third groups was exposed to Lc0 (0.20 ppm) and Lc50 (2.97 ppm) concentration of mercury chloride for 96hour respectively. While chronic exposure again divided into three groups for 7day, 14day and 21day to 0.29 ppm concentration of mercury chloride equivalent to Lc50/10th. 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 measurement of rate of oxygen consumption in *Lamellidens corrianus* after acute and chronic exposure to mercury chloride showed significant decrease rate of oxygen uptake. It was represented in Table 1 and Table 2 and figure 1 and figure 2. The rate of oxygen consumption in control Group of acute exposure was (0.3193±0.0292). In Group II, Lc0 it was (0.0812±0.0074, 74.56%). Where as in Group III Lc50 showed significant decrease (0.0746±0.0042, 76.65%).

However chronic treatment, Lc50/10th concentration of mercury chloride showed a profound decrease oxygen consumption rate after every 7 days in experimental bivalve as compare to respective control Groups. On 7th day in control Group it was (0.2909±0.0321, and in experimental Group showed (0.1892±0.0187, 34.96%). Similarly on 14th day rate was declined significantly, in control Group (0.2312±0.0166) and (0.1531±0.0094, 33.78%) in experimental Group. However on 21th day, it was noted (0.2214±0.0278), in control, while in experimental Group showed significant decreased (0.0941±0.0078, 57.49%).

Respiration in bivalves could be used to evaluate mussels stress and over all fitness for survival and growth. The body sizes of bivalve also considered as important parameter, which influencing the patter of metabolic responses. Any heavy metals, especially mercury chloride do alteration in metabolic processes, which directly affect the bivalve heath. The changes in normal respiratory metabolism due to continue contact with polluted water decreased the oxygen diffusion capacity of gills.¹¹ Similarly¹⁸ stated that formation of mucoid cord on gill lamellae hindered the diffusion of gasses which decrease respiration rate. Some author have observed that heavy doses of mercury and copper decrease the level of oxygen uptake in freshwater crab.¹⁹ The rate of oxygen consumption was also affected due to nickel chloride in bivalve, *Lamellidens marginalis* was reported by researcher.⁶ Another worker studied toxicity of cypermethrin (10% EC) on oxygen consumption of *Cirrhinus mrigala* and reported increased respiratory activity, resulting in increased ventilation and increased uptake of the toxicant, due to stress.^{20, 21}

Same way other investigation made Kamble and Shinde (2012)²², they observed decreased in oxygen consumption in bivalve, *Lamellidens corrianus* exposed to organochlorine pesticides. Decrease oxygen uptake in bivalve, *Lamellidens corrianus* after exposed to thiodan was investigated by Mane *et al.*, (2012)²³.

Table 1: Rate of oxygen consumption of *Lamellidens corrianus* on acute exposure of mercury chloride.

Sr. No.	Treatment	Average oxygen consumption (mg of o2 /lit/hr/gm wet weight of the flesh)	Percentage change over control
1	Control	0.3193±0.0292	-
2	Lc0 (0.20 ppm)	0.0812±0.0074,	74.56%
3	Lc50 (2.97 ppm)	0.0746±0.0042	76.65%

Table 2: Rate of oxygen consumption of *Lamellidens corrianus* on chronic exposure of mercury chloride.

Sr. No.	Treatment	Average oxygen consumption (mg of o ₂ /lit/hr/gm wet weight of the flesh)		
		7 days	14 days	21 days
1	Control	0.2909±0.0321	0.2312±0.0166	0.2214±0.0278
2	Lc50/10th (0.29 ppm)	0.1892±0.0187	0.1531±0.0094,	0.0941±0.0078
3	Percentage change over control	34.96%	33.78%	57.49%

Each value represents a mean of three observation ± standard deviation.

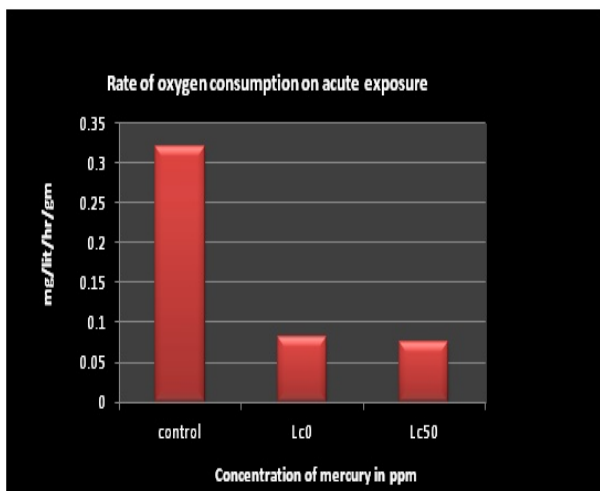


Figure 1: Rate of oxygen consumption of *Lamellidens Corrianus* on acute exposure of mercury chloride.

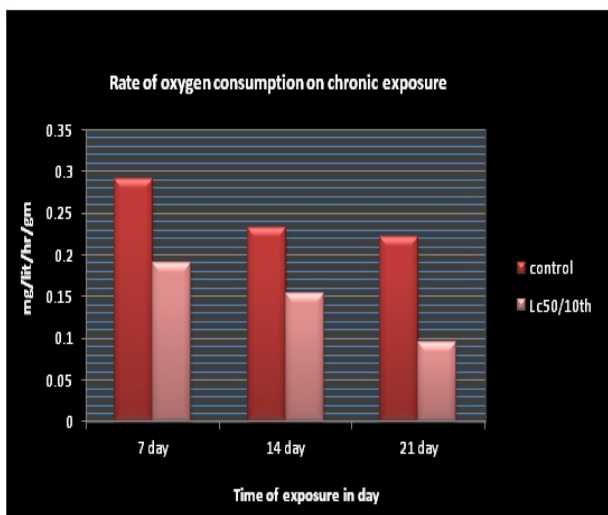


Figure 2: Rate of oxygen consumption of *Lamellidens Corrianus* on chronic exposure of mercury chloride.

Another observation made by Chinchore S. G., Mahajan P. R. (2012)²⁴ and reported that chronic treatment of Cadmium chloride, decrease rate of oxygen consumption with increase exposure period in freshwater gastropod *Bellamya bengalensis*. In the present study, the level of oxygen consumption was

gradually decreasing with increasing exposure periods as observed by Mathivanan, (2004)²⁵ in *Oreochromis mossambicus* exposed to sublethal concentrations of Quinolphos. The rate of oxygen consumption was significant over control in all the exposure periods.

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. Therefore minute concentration of heavy metals can alter respiration in aquatic animals especially bivalve. Chebbi and David, (2010)²⁸ concluded alteration in oxygen consumption increased and thereafter decreased which is a bioindicator for assessing the pesticide toxicity, which can be correlated with the present study. As we know bivalves are filter feeder and bioindicator so they are good member for ecotoxicological study.

CONCLUSION: Therefore in present investigation fresh water bivalve, *Lamellidens corrianus* showed decrease rate of oxygen consumption in acute as well chronic exposure of mercury chloride as compare to control. The decline was greater in long exposure period which might be result of metabolic stress due to heavy metal. Dense secretion of mucus was also observes which is a sign of decrease level of oxygen uptake. These results also suggest that the altered rates of respiration in *Lamellidens corrianus* may also serve as a rapid biological monitor to assess the impact of heavy metals such as Mercury chloride on other biotic communities in the water body.

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