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# Effect of Metallic Pollutants on Oxygen Consumption of the Fresh Water Bivalve Lamellidens Marginalis

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**Abstract:** *The toxicity effects of heavy metals (copper sulphate, mercuric chloride and cadmium chloride) on oxygen consumption of Lamellidens marginalis were studied and the observation were recorded.After acute and chronic treatment of heavymetals CuSO4, HgCl2 and CdCl2 to L. marginalis it was found that there was a decrease in oxygen consumption. It was affected most by HgCl2 and was followed by CuSO4 and CdCl2.This research stimulate a reliable indicator of the aquatic ecosystem contamination and the possible negative impact of the surrounding environment.*

## I. Introduction

Heavy metals are widespread pollutants released into the environment by weathering of rocks, volcanic activity(Klein and Goldberg,1970) and environmental concentrations are increased with the development of highly industrialized societies(Jones and Westermark,1969).Heavy metals have biological activity and have a tendency to accumulate in organisms, marking adverse effect possible at very low levels of exposure. Heavy metals pollutants affect the rate of respiratory metabolism for which oxygen is the most essential factor.

The metabolic response of an organism to changing environment is an overall indicator of adaptive capacity of the organism. Oxygen consumption is a very sensitive physiological process and the change in respiratory activity has been used as an indicator of stress in toxicant exposed animals (Schaumberg et al., 1967; Anderson 1971; and Sharp et ai.,1979).Considerable amount of literature is available showing relationship between respiratory activity and pollution stress in aquatic animals(Roberts,1972;Devis,1973 and Percy 1977). Several workers have noted alteration of Physiological process in bivalves and gastropods due to pollutants(Scott and Major,1972;Brown and Newell,1971;Lomte and Jadhav,1982;Nagabhushanam and Deshpande,1982;Dollinger et al., 1989).A few more physiological studies on snails in relation to heavy metals have shown their respiratory kinetics(Shuster and Pringle,1969;Saliba and Vella,197 .The gill tissue of Mytillus galloprovincialis is responsible for the uptake of metal ions from water. (Znidaric,M.T.,Falnoga,I,and Turk,V.2005 7).

Environmental poisoning by heavy metals has increased in recent years due to extensive use and agricultural, chemical technology and industrial processes, becoming a threat to living organisms. The effects of heavy metals on aquatic animals(marine and freshwater) have been studied extensively by many workers (Burgs, 1969; Channaya, 1971; Vernberg and Vernberg,1972;Brereton et al., 1973; Flook, 1975; Kapoor and Grifins,1976;Eisler ,1977;lomte and Jadhav,1982.)

The heavy metals when released into aquatic environment are sustained in water as apart of environment. Majority of the metal have tendency to accumulate in tissue of aquatic animals. They excess heavy metals in the environment cause damage to the behavior and physiology of living organism's especially respiratory physiology. Compared to other organisms, very little work has been done bivalves with reference to heavy metals toxicity. As Lamellidens marginalis is found in littoral zone and benthic zone of water body, the animal remains continuously exposed to metal residues. In this investigation of effect of copper sulphate, mercury chloride and cadmium chloride on the rate of oxygen consumption of Lamellidens marginalis at acute and chronic exposures of different concentrations of heavy metals was studied.

## II. Material and methods

The bivalves, L.marginalis were collected from the Godavari River at paithan. The bivalves were acclimatized to laboratory conditions upto 2-3 days, before subjecting them to experiments. Healthy active animals of approximately the same size and weight were chosen ,the acclimatized active bivalves were divided into two groups .one group of bivalves was exposed to lethal concentration($LC_{50}$ values of 96 hours) concentrations 1.9 ppm ,0.6 ppm and 3.9 ppm of $CuSO_4$, Hgcl2 and $Cdcl_2$ respectively upto 96 hours of treatment. Another group of acclimatized group of was exposed to sub lethal concentration of heavy metals, pollutants upto 20 days for chronic treatment. The oxygen consumed by treated and control bivalves was determined after an interval of 5 days.

The oxygen consumed by L. marginalis was determined by standard Winkler's method (Welsh and Smith,1961). The oxygen consumed per gm of body weight was determined. The rate of oxygen consumption was expressed in terms of ml/gm body wt/hr.

## III. Observations and Results

The freshwater bivalves, Lamellidens marginalis displayed variations ( increase or decrease in oxygen consumption) when exposed to acute treatment of lethal concentration and chronic treatment by sublethal concentration of heavy metals (mercuric chloride copper, sulphate, and cadmium chloride). The respiratory patterns exhibited by L. marginalis after exposure to various concentration of copper sulphate, mercuric chloride and cadmium chloride have been summarized in tables 1 and 2.

**(A) Effects of acute treatment of heavy metals on oxygen consumption of bivalves**

In Lamellidens marginalis the rate of respiration was measured after exposure to 1.9 ppm copper sulphate for a period of 72 hours as acute treatment. It was observed that after exposure there was a significant decrease in the rate of oxygen in treatment bivalve when compare to control bivalve. The bivalve showed the rate of consumption ranging from 0.3621 to 0.3405 ml/gm/hr/liter, in unpolluted water. Of tested heavy metals copper was found to be more effective in reducing the oxygen consumption as compare to mercuric chloride and cadmium chloride. In case of copper after a period of 24 hrs exposure, there was a continuous decrease in oxygen up to 72 hrs period .At the end of 72 hrs the bivalve showed oxygen consumption of 0.o415 ml/gm/hr/liter. The acute treatment of HgCl2 the oxygen consumption of 0.0100 ml/gm/hr/liter of at the end of 72 hrs. The bivalve showed the oxygen consumption of 0. 0522 ml/gm/hr/lit in cadmium chloride concentration at the end of 72 hrs. From the tab 1 fig 1. It is quite clear that all the metal in acute concentration reduce the oxygen consumption in L . marginalis.

**(B) Effects of chronic treatment of heavy metals on oxygen consumption of bivalve.**

It was clear that after chronic treatment of 1.2 ppm copper sulphate upto 20 days to L. Marginalis the rate of consumption decrease significantly.

In the bivalve the rate of oxygen consumption was measure after exposure to 0.39 ppm mercuric chloride for 20 days as chronic treatment. It it was observed that after chronic exposure there was significant decrease in the rate of oxygen consumption, when compare to control b bivalve. The amount of oxygen consumed by treated and control bivalve is summarized in table 2.

From the above result it is observed that the rate of oxygen consumption in L . Marginalis is concentration dependent. At acute exposure, the decrease in oxygen consumption was dependent upon the exposure period and type of pollutants.

The amount of oxygen consumed by bivalve L. marginalis after chronic treatment of heavy metals for period of 20 days is summarized in tab .2. The oxygen consumption showed by the bivalve in unpolluted water was in the range of 0.3382 to 0.2746 ml/gm/hr/liter. From the table it is evident that in the chronic treatment the heavy metals reduce the uptake, it was also observed that the oxygen consumption of the bivalve decrease as period decrease.

In heavy metals used mercury was found to be more effective in reducing oxygen consumption in chronic treatment. At the end of 5 days , the bivalve exposed to copper sulphate showed oxygen consumption of 0.0470 ml/gm/hr/liter which can decreased to 0.0470, 0.0391,0.0255 and 0.0200 ml gm/hr/liter in 5,10,15,20 days respectively. In case of mercuric chloride the bivalve showed oxygen consumption of 0.03666, 0,0236, 0.0161 and 0.0102 ml/gm/hr/liter in 5,10,15&20 days respectively. There was slow and gradual decrease in oxygen consumption after exposing cadmium chloride. The oxygen consumed by bivalve walls was 0.0714, 0.0715, 0.01563 and 0.0425 ml/gm/hr/liter in 5,10,15,20 days respectively.

**Table-1) The rate of oxygen consumption of Lamellidens marginalis after acute exposure to heavy metals CuSO4, HgCl2 and CdCl2.**

| | Average oxygen consumed + SD ml/gm/hr/lit | | |
|---|---|---|---|
| TREATMENT | 24 hrs | 48hrs | 72hrs |
| Control ± SD | 0.3621 ± 0.0089 | 0.3529 ± 0.0042 | 0.3405 ± 0.0041 |
| Acute treatment of CuSo4 ± SD | 0.0502 ± 0.001 | 0.0471 ± 0.022 | 0.0415 ± 0.007 |
| Acute treatment of HgCl2 ± SD | 0.0200 ± 0.004 | 0.0178 ± 0.0010 | 0.0100 ± 0.0016 |
| Acute treatment of CdCl2 ± SD | 0.0633 ± 0.028 | 0.0564 ± 0.018 | 0.0522 ± 0.004 |

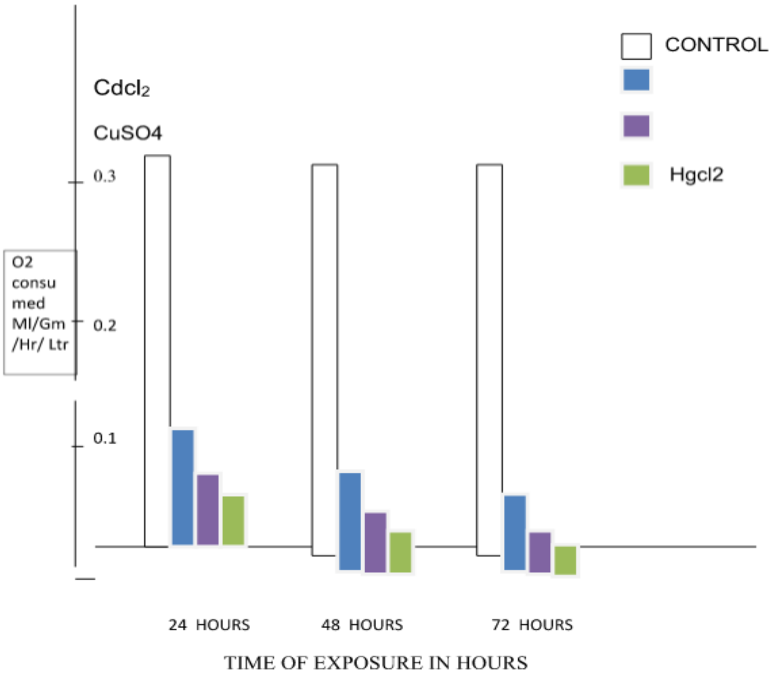
Each value is a mean of three observation

**Table-2)** The rate of oxygen consumption of Lamellidens marginalis after chronic exposure to heavy metals CuSO4, HgCl2 and CdCl2.

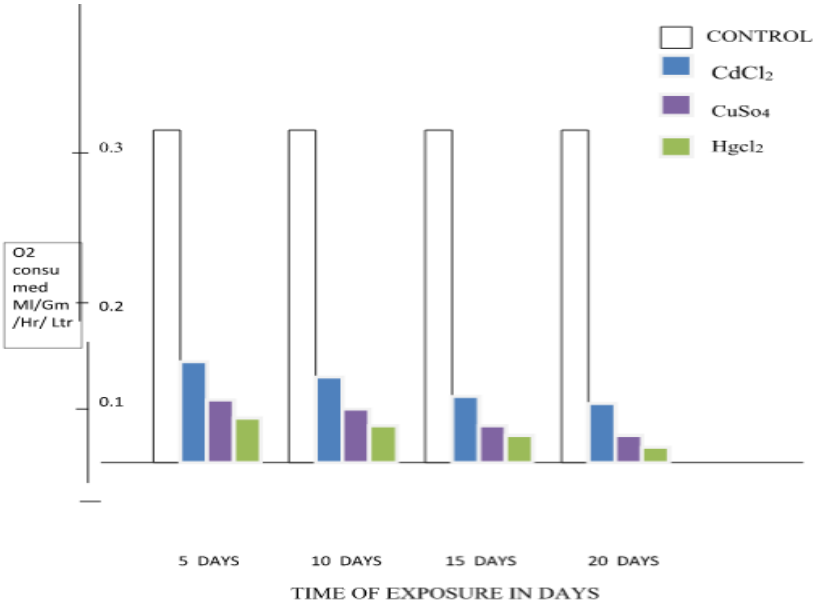
| TREATMENT | Average oxygen consumed + SD ml/gm/hr/lit | | | |
|---|---|---|---|---|
| | 5 days | 10 days | 15 days | 20 days |
| Control ± SD | 0.3382 ± 0.004 | 0.3103 ± 0.006 | 0.3002 ± 0.017 | 0.2746 ± 0.007 |
| chronic treatment of CuSo4 ± SD | 0.0470 ± 0.002 | 0.0391 ± 0.003 | 0.0255 ± 0.006 | 0.0200 ± 0.003 |
| chronic treatment of HgCl2 ± SD | 0.0366 ± 0.0034 | 0.0236 ± 0.0041 | 0.0161 ± 0.001 | 0.0102 ± 0.002 |
| chronic treatment of CdCl2 ± SD | 0.0714 ± 0.039 | 0.0715 ± 0.023 | 0.0563 ± 0.004 | 0.0425 ± 0.001 |

Each value is a mean of three observations.

Comparison of rate of oxygen consumption of Lamellidens marginalis after **acute** exposure to copper sulphate , mercuric chloride and cadmium chloride.




Comparison of rate of oxygen consumption of Lamellidens marginalis after **chronic** exposure to copper sulphate ,mercuric chloride and cadmium chloride.




## IV. Discussion

Heavy metals effect the metabolism of the freshwater bivalve L. marginalis. Alteration in metabolic process following exposure to heavy metal stress has always been use as indicator of stress. But there is a vast difference in the pattern of metal induces physiological alteration from metal to metal animal and to animal.

In present investigation the rate of oxygen consumption decreases in higher concentration after acute treatment. After chronic treatment it also decreases in copper sulphate, mercuric chloride and cadmium chloride exposed animals. Lomte and Jadhav (1982) showed in Corbicula regularis that the rate of oxygen consumption decrease in different concentrations of toxic compound such as copper sulphate, sodium cyanide etc .Alam and Lomte (1984) in Viviparous bengalensis showed the initial elevation in rate of oxygen consumption. It may be due to pollutant stress and may be an indicator new steady state of metabolism to compacient the enhanced physiological activity . there was an increase in respiratory rate during lower concentration when the greatest demand was made on respiratory system. The decline was greater in higher concentration which might be the result of the failure state of metabolism owing to toxicant stress . The decrease might be due to the penetration of the pollutant molecule and there action alters metabolic cycle at the subcelluler levels. Suchitra and Fang (1966) suggested that decrease in oxygen consumption was brought about by the savering of links between oxidative and phosphorelative processes. Pollutants of any nature are known to be effective at chronic levels, where they accumulate in low concentration in tissue , there by disturbing the normal histological build up. Respiratory ineffecency and total respiratory breakdown can also be due to the formation of mucus on respiratory organs. The concentration of iron in different soft tissues and byssus and also studied the potential role of the byssus as an excretion route for iron in P. viridis(Yap CK, Tan SG 2007).

Rao et al (1988) noted that in bivalve Indonia caeruleus when expose to $HgCl_2$ , the rate of respiration decrease in both normal and lethal concentrations. In general the decrease was more at all periods in lethal concentrations.

L. marginalis the rate of oxygen consumption was observed to be decreased in higher concentration and was increased in lower concentration as compared to the control. Similar effects were noted by Brokovic Propovic (1977) and Dalla et al (1989) the possible explaination could be that low doses of copper sulphate mercuric chloride and cadmium chloride active detoxification mechanism which requires an increase oxygen demand for the synthesis. In contrast high copper sulphate, mercuric chloride and cadmium chloride doses may causes severe disturbances of the metabolism in the animal. Chronic treatment of L. marginals at lower concentration of copper sulphate, mercuric chloride and cadmium chloride showed decrease in oxygen consumption. vacuolisation and necrosis of lamellar epithelial cells ,congestion of central lamellar vein and hyperplasia of lamellar epithelial cells was evident in gill of fish exposed to lead (V.R.Chavan and D.V.Muley, 2014) The capacity of the metal binding metallothionein like protein seems to be exhausted and excess cadmium is taken up by high molecular weight fraction. Cadmium is widely distributed at low level in the environment and most foods have an inherently low level of Cd which has been shown to bind to the protein and accumulate significantly in higher level(FDA 2011). At the same time zinc is displaced from Metallothionein like protein and moves to fractions of very low molecular weight (Dallinger et al. , 1989). .in L . Marginalis the capacity of detoxification by forming Metallothionein like protein might be exhausted due to chronic exposure to copper sulphate , mercuric chloride and cadmium chloride and it result in continuous fall in oxygen consumption during chronic exposure.

## V. Conclusion

Oxygen consumption changes in bivalve L.marginalis due to effects of heavy metals can be used as a sensitive model to monitor the aquatic pollution and are widely used in water quality monitoring programmers in many countries. The current results indicate that heavy metal contamination definitely affects effluent (detoxification) before discharging to the resources to avoid negative impact on aquatic biota. The present research work served as an experimental tools and bio indicators for the first line evaluation of environmental pollution.

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