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Effect of sub lethal concentration of mercury and copper on oxygen consumption of fresh water crab, *Barytelphusa guerini.*

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Abstract
The seasonal effect of heavy metals mercury and copper on the oxygen consumption of fresh water crab, *Barytelphusa guerini* was studied for long term exposure (i.e. 10, 20 and 30 days). The effect of both the metals were observed after exposure to sub lethal concentration ($1/10^{th}$ of 96hrs LC_{50}) of $HgCl_2$ and $CuSO_4$ was 0.275, 0.250, 0.225, 0.20 ppm and 1.4, 1.35, 1.30, 1.25 ppm for monsoon. The concentrations were 0.30, 0.275, 0.25, 0.225 ppm and 1.45, 1.4, 1.35, 1.30 ppm for winter and 0.175, 0.14, 0.125, 0.115 ppm and 0.9, 0.85, 0.80 and 0.75 ppm summer season. Present investigation reveals that the rate of oxygen consumption decreased with an increase in exposure period and depends upon time of exposure and concentration of toxicants. Mercury was found high toxic than that of copper in all the seasons. The order of decrease in rate of O_2 consumption was summer > monsoon> winter season respectively.

Keywords: Chronic toxicity**,** Mercury chloride, copper sulphate, oxygen consumption, *B. guerini.*

INTRODUCTION

The massive growth of industry leads to over deposition of industrial wastes containing different chemical substances in the water of streams and rivers. Thereby polluting the water in different ways, these wastes threaten the aquatic fauna. The non-biodegradable substances have a tendency to accumulate in the bio system. Heavy metal salts constitute a very serious type of pollution in freshwater bodies because they being stable compounds and are not easily removed by oxidation, precipitation or other processes and affect the activity of the animals [1].

Generally, aquatic organisms like prawn, crab, and fishes respire through gill and sometimes with the help of skin. Such respiratory surfaces frequently encounter hazardous pollutant present in water in different forms. These pollutants may lead to the alteration in the normal respiratory area. This causes the reduction in oxygen consumption and physiological imbalance in the organism. Reported gill damage in freshwater crab, *Barytelphusa cunicularis* after exposure to fenitrothion (op) and sevin (carbamate) [2].

Respiration is the most used tool for understanding physiological action of toxicant. Changes in oxygen consumption have been measured as a response to toxicants. It seems logical that internal poisoning could change the respiration rate, although if the mode of action is not understood. Hence, measurement of oxygen consumption has been used to determine the effect of toxicants on overall metabolism of exposed organism [3, 4]. The availability of oxygen imposes limits on distribution and survival of animals.

The present work was aimed to study the alteration in the rate of oxygen consumption to investigate the relationship between the metabolic rate and various physiological and physicochemical factors of the environment in *Barytelphusa guerini* after exposure to various concentrations of heavy metals ($HgCl_2$ and $CuSO_4$) seasonally in the form of chronic experiment.

MATERIALS AND METHODS

The crabs, *Barytelphusa guerini* used in the present investigation for experimental purpose were procured from Paithan region, near Aurangabad. They were maintained in the laboratory in plastic troughs containing tap water. The crabs were fed with pieces of earthworm and bivalves and water was changed twice a day. Crabs were kept for acclimatization in the laboratory for two to three days prior to commencement of experiment. Dead animals were discarded. Only healthy, active and moderate size animals were used for experimental purpose. Experimental crabs were not fed one day before the commencement of experiment in order to avoid the difference, if any, due to differential feeding. To determine the LC_{50} value, the crabs were exposed to different concentrations of mercury chloride and copper sulphate for 24, 48, 72 and 96 hrs exposure periods. The static method is used to run the experiment of toxicity evaluation upon 96 hrs as described by Finney [5]. The bioassay experiment of each concentration was repeated with control group of animals and mortality was recorded for each concentration at the end of 96 hrs. No mortality was observed in control group of animals. Similarly crabs were exposed to sub lethal concentrations ($1/10^{th}$ of 96hrs LC_{50}) of heavy metal $HgCl_2$ and $CuSO_4$ for the period of 10, 20 and 30 days exposure.

A specially designed apparatus was used for the determination of oxygen consumption, in which the respiratory chamber consisted of wide mouth bottle of one liter capacity. The chamber was closed with a rubber stopper, which was provided with

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inlet and outlet. The dissolved oxygen content of the sample water was determined by following the method of Winkler as described by [6]. From initial and final difference, we can calculate the oxygen content of the sample and oxygen consumed by the crab in one hour. Repeat the same experiment thrice time to get the accurate result. The results can be expressed in ml O_2/gm/hrs/lit.

Table1.The rate of oxygen consumption in *B. guerini* after exposure to sub lethal concentration of $HgCl_2$ and $CuSO_4$ in monsoon season.

Treatment	10 days	20 days	30 days
Control	0.100 ± 0.002	0.0906 ± 0.00152	0.0776 ± 0.00251
Mercuric chloride	0.05 ±0.002 (50.0%)***	0.045 ±0.003 (50.00%)***	0.037±0.002 (51.94%)***
Copper sulphate	0.056 ±0.0028 (44.0%)***	0.05 ±0.002 (44.44%)***	0.044 ±0.0036 (42.85%)***

Each value is a mean of three-observation ± S.D.
Bracket values indicate percent variations over control.
Values are significant at *** P< 0.001

Table 2.The rate of oxygen consumption in *B. guerini* after exposure to sub lethal concentration of $HgCl_2$ and $CuSO_4$ in winter season.

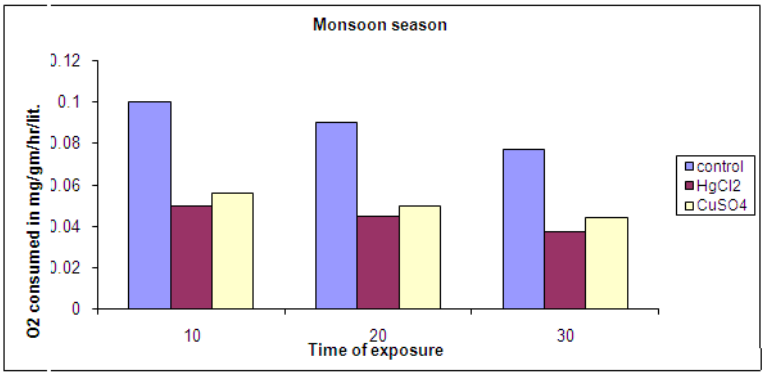
Treatment	10 days	20 days	30 days
Control	0.100 ± 0.0025	0.0893 ± 0.003	0.0733 ± 0.003
Mercury chloride	0.0586 ±0.00152 (42.0%)***	0.05 ±0.002 (43.82%)***	0.04±0.002 (45.61%)***
Copper Sulphate	0.0646 ±0.00251 (36.0%)***	0.056±0.00251 (37.07%)***	0.048 ±0.002 (34.24%)***

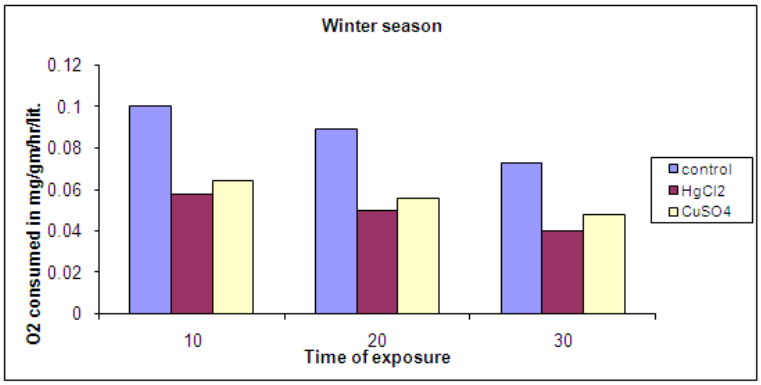
Each value is a mean of three-observation ± S.D.
Bracket values indicate percent variations over control.
Values are significant at *** P< 0.001

Table 3. The rate of oxygen consumption in *B. guerini* after exposure to sub lethal concentration of $HgCl_2$ and $CuSO_4$ in summer season.

Treatment	10 days	20 days	30 days
Control	0.05 ± 0.0015	0.047 ± 0.0025	0.034 ± 0.002
Mercury chloride	0.039 ±0.0045 (22.0%)**	0.029 ±0.0025 (38.29%)***	0.019 ±0.003 (44.11%)**
Copper Sulphate	0.029 ±0.0023 (42.0%)***	0.034 ±0.0025 (27.65%)**	0.024 ±0.0025 (29.41%)**

Each value is a mean of three-observation ± S.D.
Bracket values indicate percent variations over control.
Values are significant at ** P<0.01 and *** P< 0.001





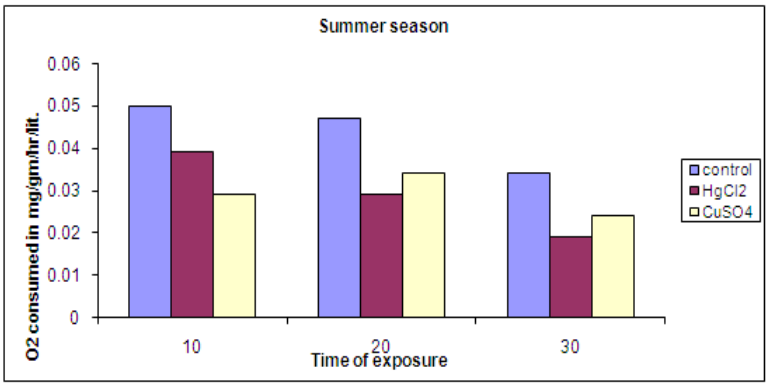


Fig 1. The rate of oxygen consumption of *Barytelphusa guerini* after chronic exposure to mercury chloride and copper sulphate in monsoon, winter and summer season.

RESULTS AND DISCUSSION

The rate of oxygen consumption of *Barytelphusa guerini* was studied and measured after chronic exposure to heavy metals $HgCl_2$ and $CuSO_4$. Crabs were exposed to sub lethal concentrations ($1/10^{th}$ of 96hrs LC_{50}) of heavy metal $HgCl_2$ and $CuSO_4$ was 0.275, 0.250, 0.225, 0.20 ppm and 1.4, 1.35, 1.30, 1.25 ppm for monsoon. The concentrations were 0.30, 0.275, 0.25, 0.225 ppm and 1.45, 1.4, 1.35, 1.30 ppm for winter and 0.175, 0.14, 0.125, 0.115 ppm and 0.9, 0.85, 0.80 and 0.75 ppm for summer season respectively. The rate of oxygen consumption was measured at the end of 10, 20 and 30 days. The results are expressed in the table 1, 2 and 3. The comparative results are expressed graphically in fig.1. It is observed that the rate of oxygen consumption is affected and showed initial increase and gradual decrease in all experimental solutions when compared with that of control crabs. Bodkhe has reported an initial increase and then gradual decrease in oxygen consumption in freshwater crab, *Barytelphusa cunicularis* after exposure to sevimol. Copper sulphate was found to be less toxic for *Barytelphusa guerini* than that of mercuric chloride. The rate of oxygen consumption was found continuously decreased as concentration of toxicants decreased with increasing exposure period in monsoon, winter and summer season respectively.

Changes in oxygen consumption are valuable indicators of stress and are being used widely to evaluate the metabolic stress caused by changes in environmental conditions brought by both natural and anthropogenic processes. In the present study the oxygen level decreased with increasing concentration. Similar observations were made by [7, 8, 9]. Alteration in the metabolic processes following exposure to heavy metals has always been used as an indicator of stress. Copper is reported to be inhibitory to many enzymes and it affects respiration rate [10, 11].

CONCLUSION

From the above result it is very clear that the rate of oxygen consumption was found decreased in all the season upon exposure to $HgCl_2$ and $CuSO_4$. It is observed that the rate of oxygen consumption was very low in summer season than in monsoon and winter season in both the metal exposed animals. Similarly high rate of oxygen consumption was found in winter season as compared to summer and monsoon season. Results showed that toxicant mercury is found to be more toxic as compared to copper. From the above results, it is clear that the rate of oxygen consumption in *Barytelphusa guerini* is depends upon time of exposure and concentration of toxicants.

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