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EFFECT OF COPPER SULPHATE ON RESPIRATORY METABOLISM OF FRESHWATER FISH GARRA*MULLYA*

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ABSTRACT

Existence of living organisms depends on the ability of their cells to incorporate a number of simple compounds and transform them into more complex molecules required for cellular structure and function. The energy required for these synthetic reactions must be obtained from the same substrates by suitable oxidation reactions coupled to the generation of high energy phosphate esters. The entire process ultimately depends on the availability of molecular oxygen in cellular environment. Oxygen is made available to the tissues and in turn to cells by respiration.

In Pisces respiration is a process during which the organisms obtain oxygen from external medium and use it for the purpose of energy release during oxidative metabolism. As such the process of respiration in animals is studied by determining the oxygen consumption.

KEYWORDS

Copper Sulphate, Respiratory Metabolism, Garra*mullya.*

INTRODUCTION

Respiration is a process during which the organisms obtain oxygen from external medium and use it for the purpose of energy release during oxidative metabolism. As such the process of respiration in animals is studied by determining the oxygen consumption. Oxygen is an important raw material for the release of the energy.

Oxygen consumption forms an important physiological parameter to assess the toxic stress, because it is a valuable indicator of energy expenditure in particular and metabolism in general .The heavy metals into freshwater environments is increasing resulting in environmental pollution. However very little is known of its long term effects on aquatic biota and, especially, how animals recover when retuned to pollution free waters.

Therefore the effects of lethal and sublethal effect of coppersulphate on respiratory metabolism of Garra*mullya*.

MATERIALS AND METHODS:

The freshwater fish Garra*mullya* were collected from Manjarariver near Latur and brought to laboratory without any chemical injury. The arrange weight 11±2 gm and length 9±2 cm fishes are selected for experiment. Fish were treated with 0.1% KmN04 to avoid the dermal infection. The fish were then acclimatized to laboratory conditions for about 15 days prior to the experiment. Feeding was stopped one day prior to the experimentation. The aging of water is necessary to stabilize its composition and for elimination of residual chlorine which is otherwise highly toxic to the fish. The physicochemical parameters are analysed during the experimental period, according to standard methods suggested by APHA (1998) and IAAB (1998).

Healthy fish sorted in five batches of 10 fish each A, B, C, D and E. A batch was considered as control, where the fish did not expose to the heavy metals. In other four batches, fish were exposed to different concentration of copper salphate and mercuric chloride. In B batch fish were exposed to lethal concentration of copper salphate i.e.96 hrs. LC50 value 3.0 ppm. C batch they were exposed to sublethal concentration of copper salphate is 1/10th of 96 hrs. LC50value 0.3 ppm.

In D batch fish were exposed to lethal concentration of mercuric chloride i.e. 96 hrs. LC50value 0.15 ppm and E batch they were exposed to sublethal concentration of mercuric chloride i.e. 1/10th of 96 hrs. LC50 value 0.015 ppm.

The test fish, Garramullya were exposed to lethal and sublethal concentrations of copper sulphate and mercuric chloride for the duration of 96 hrs. The rate of oxygen consumption of fishes exposed to lethal and sublethal concentration copper sulphate and mercuric chloride was detrmined after every 24 hours up to 96 hours of exposure. Estimations were also made at zero hours. Simultaneously a control was also maintained oxygen consumption of control and exposed fishes were measured by slandered Winkler's iodometric method as describe by Welsch and Smith (1953).

DESCRIPTION AND SETTING OF APPARATUS:

Take a fish in a big jar and pour 1000 ml of tap water slowly. It is allowed to settle for 10 minutes to facilitate them to reach a state of normality from a state of excitement if any.

After this equilibrium period remove all air bubbles due to handling and also to allow the animal adjust to the darkness in the black chamber during this period.

COLLECTION OF THE INITIAL AND FINAL SAMPLES:

After allowing the animal to settle in the chamber, with the help rubber tube, initial sample was collected from the respiratory chamber. After the collection of initial sample add a layer of liquid paraffin to prevent the atmospheric oxygen to enter in the respiratory chamber. After one hour take out water from the jar with a rubber tube into a reagent bottle. Completely fill the bottle and stopper it immediately and remove the air bubbles present if any.

The dissolved oxygen content of water sample was determined by Winkler's method. The difference in the oxygen content between the initial and final sample will give the amount of oxygen consumed by the animal during the period of experimentation. The oxygen consumed by the normal and experimental fish was determined accordingly. After experimentation the fish was individually weighed and their unit metabolism was calculated and expressed as oxygen consumed by fish in ml/hr/gm wet weight/liter at NTP.

A minimum of 5 observations were made in each case and value were expressed as mean±SD.

Table No.1: Effect of lethal &sublethal concentration of copper sulphate on rate of oxygen consumption of Garra*mullya*

Sr. No.	Time of exposure (Hrs)	Control	Lethal Concentration (3.0 ppm)	Sublethal Conc. (0.3 ppm)
1.	24	0.1835±0.03	0.2270±0.04	0.2059±0.048
2.	48	0.1873±0.035	0.2947±0.02	0.2167±0.036
3.	72	0.1853±0.04	0.0782±0.073	0.1824±0.001
4.	96	0.1895±0.05	0.0758±0.039	0.1578±0.004

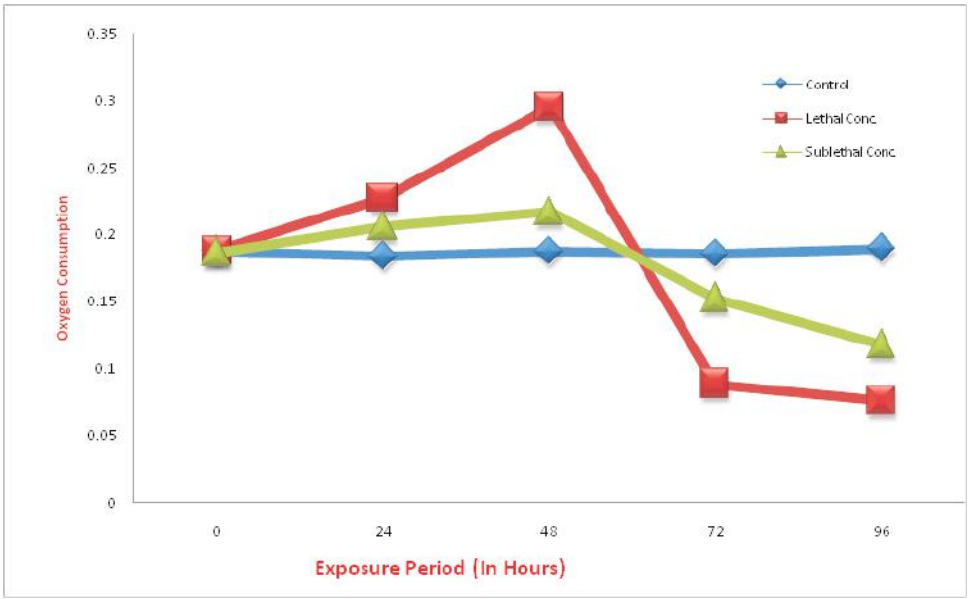

Fig. No. 1: Effect of lethal and sublethal concentration of copper sulphate on oxygen consumption of Garra*mullya.*
(Values are expressed in ml of oxygen/liter/hr/gm body weight.)

RESULT AND DISCUSSION

The freshwater fish Garra*mullya* showed variation in the rate of oxygen consumption and total oxygen consumption when exposed in lethal and sublethal concentration of copper salphate and mercuric chloride.

In the present investigation it was showed that the oxygen consumption in the animal exposed to lethal and sublethal concentrations of copper sulphate and mercuric chloride was initially increased at 24 & 48 hours and then gradually decreased in oxygen consumption up to 96 hours on compared with control.

CONTROL:

The rate of oxygen consumption in control fish showed at 24 hrs 0.1835±0.03ml of oxygen /gm wet weight / hr, 0.1873±0.035 at 48 hrs, 0.1853±0.04 at 72 hrs and 0.1895±0.05 at 96 hrs.

EFFECT OF LETHAL CONCENTRATION OF COPPER SALPHATE :

The exposure period at 24 hours it was found to be 0.2270±0.04 ml of oxygen/ gm wet wt./ hr. and at 48 hrs. it showed an increase to 0.2947±0.02. The lethal concentration of copper sulphate was then found to

suppress the metabolic activity causing sudden drop in the oxygen consumption at 72 hrs. 0.0782±0.073 and 0.0758±0.039 at 96 hrs.

EFFECT OF SUBLETHAL CONCENTRATION OF COPPER SULPHATE :

At sublethal concentration of copper sulphate, the rate of oxygen consumption showed a slightly increase by 24 and 48 hours but after words, it was found to decrease the rate of oxygen consumption which was slightly below the control level.

The values recorded were 0.2059±0.048 at 24 hrs, 0.2167±0.036 at 48 hrs, 0.1824±0.001 at 72 hrs and 0.1578±0.004 at 96 hrs.

In present study, oxygen consumption was affected in heavy metals exposed fish to different degrees depending upon the heavy metal concentrations and duration of exposure, indicating that the change in the rate of oxygen consumption for successive intervals of 24, 48, 72 and 96 hours.

In this experiment, it was observed that the rate of oxygen consumption was initially up to 24 hours & 48 hours and than there was decline to 72 hrs and 96 hrs of lethal and sublethal concentrations of copper sulphate and mercuric chloride.

Increase in rate of oxygen consumption indicates the mobilization of metabolic reserve and hence an increased demand for oxygen in response to heavy metal stress. The freshwater fish Garra*mullya* exhibits decrease in the rate of oxygen consumption on exposure of sublethal and lethal concentrations of heavy metals. This decline from of graphical representation indicates that a long term exposure upto 96 hrs in the pollutants causes decrease in osmotic work of the animals at cellular level resulting in reduced oxygen consumption. At specific periods of exposure, animal shows slight elevation in the rate of oxygen consumption with different inorganic pollutants.

In present experiment the significant increase in the oxygen consumption was observed. James (1990) explored the sublethal effects of heavy metals on behaviour and respiratory response of fish, Oreochromismossambicus. He observed that the rater of oxygen consumption and opercula exposed to chosen metal individually.

It is clear that exposure of various species of fishes to heavy metals in the environment is associated with obvious structural damage to the gill epithelium for example, Skidmore and Tovell (1972) demonstrated that exposure of rainbow trout (salmogairdoneri) to 40 ppm Zn2+for approximately 3 hr resulted in severe curling and edema of the secondary lamellae and disturb the metabolic rate of oxygen consumption.

Jones (1947) has reported an initial increase and then gradual decrease in oxygen consumption in Gasterosteusaculeatus after exposed to lethal concentration of zinc, lead, copper and mercury salts.

In the present study, it shows that decrease in oxygen consumption for 96 hrs, which might be the result of heavy metal stress. Similar result was reported by Ellis et al., (1937), he pointed that the breathing distress in fish resulted partly by clogging of gill due to precipitated mucus and partly by damage to gill caused by heavy metals ions. Singh and Singh (1979) studied the effect of oxygen consumption on the silariod fish Mystusvittatus. The result showed a decreased in oxygen consumption with an increased in copper concentration.

Oxygen consumption decreased probably due to reduce in efficiency of the gills. The death occurred because of suffocation imposed by coagulation of mucus film. Similar result has been reported by Burton et al., (1972) in Rainbow trout when exposed to zinc, change occurred in the respiratory epithelium of gill would probably affect the rate of oxygen consumption. There may be possibility of accumulation of zinc chloride in the gill filament and in muscle. There fore the rate of oxygen consumption decreased. Similar work is done by Alam and Moughan (1995) Sultana and Lomte (1999). According to Usha Rani (1999),Mazonet al.,(2002), Fuare,(2002), heavy metal damage the gill lamellae and resulted decrease the

rate of oxygen consumption in lethal and sublethal concentrations.

The result showed a decreased in oxygen consumption with an increased in copper sulphat concentration.

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