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Sub-lethal effects of copper sulphate, zinc sulphate and cadmium sulphate on rate of heart beat of fresh water crab *Bary Telphusa Guerini*

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ABSTRACT

Crabs were exposed to sub-lethal concentration of Copper Sulphate, Zinc Sulphate and Cadmium Sulphate. Before exposure they were starved for 24 hours to eliminate nutritional effect. After 24, 48, 72, 96 hours exposure time period the rate of heart beat was studied. It was found each metal had different effect upon rate of heart beat.

Key words: Copper Sulphate, Zinc Sulphate and Cadmium Sulphate.

INTRODUCTION

Crustaceans possess an open type of circulatory system and the haemolymph flows in the blood sinuses. A dorsally situated heart is present in most of the crustaceans. Data available on the rate of heart beat in crustaceans suggest that the heart rate is influenced by a number of factors like body size, activity, respiration, stress, light, blood composition, temperature nutritional status, population density, amount and the kind of food, oxygen and carbon dioxide content of medium, moulting, diurnal cycle, PH, internal pressure etc. [1-5]. By far the best studied factor that influences heart beat rate is body size. As a general rule, it might be stated that the heart rate varies inversely with body size. Thus the rate of heart beat is faster in smaller animals of a species and slower in larger species [6]. The Q10 of the rate of heart beat is affected by sex is shown long time before [7] and it might also mean that the rate of heart beat is different in the two sexes. Effects of different heavy metals on biochemical constituents in fishes and other aquatic animals is the current topic of interest, probably because of the contamination of natural water resources by these pollutants from various industrial effluent disposals, threatening the fish culture and population [8]. Action of pesticides, heavy metals is stress on the non-target organisms which induce the changes in them. Any changes to come over the stress needs energy, normally various sources of energy metabolism are acquainted by the organisms to encounter the

stress. In this process the metabolic cycles involved in the interchange of organic constituents that are responsible for the production of energy undergo a drastic change. It is this change that determines whether the organism develops the necessary potential to counteract the stress or otherwise. The haemolymph or blood is an important tool of transport of these constituents therefore the study of haematological changes in the organism under stress induced by various pollutants assumes importance. The paucity of information has become particularly apparent in recent years as investigators have become interested in the cardiovascular system of crab with considerable success. The heart rate of land crab *Cardisoma guanhumi* during aquatic and aerial respiration was studied [9]. Recently valuable contribution has been studied the effect of three toxicants, viz. Urea, Pheno1 and ammonium chloride on the heart rate of crab *Barytelphusa cunnicularis* [10]. Studied effect of acetylcholine, atropine and nicotine on the isolated hearts of *Cancer magister* (Dana) [11]. Studied an analysis of the action of acetylcholine on heart of arthropods [12]. Action of adrenaline and certain drugs upon the isolated crustacean heart [13]. In recent year investigators divert their concentration to observe effect of toxicant such as insecticide, heavy metals, drugs and antibiotics upon such sensitive physiological system of different animals [14] [15]. The present study was undertaken to determine the effect of three heavy metals such as Copper sulphate, Zinc sulphate and Cadmium sulphate on the heart rate of freshwater crab *Barytelphusa guerini*. These toxicants are discharged in water as industrial effluents and they disturb the aquatic environment of animals by exerting their toxic effects on various metabolic, physiological activity of the organ system.

MATERIALS AND METHODS

Healthy male crabs weighing between 30 to 50 gm. were selected and were divided into different groups. Each group containing 10 animals. The animals were fed with slices of frog muscles to enable the animals from overcoming the effect of starvation and to adjust the laboratory condition. The laboratory temperature was $27 \pm 2^{\circ}\text{C}$. The animals were exposed to sub-lethal concentration of Copper sulphate, Zinc sulphate and Cadmium sulphate solution. The rate of heart beat was noted at 0, 24, 48, 72 and 96 hours. The following methods have been adopted for the investigation.

Determination of the rate of heart beat

The body with exposed heart was kept in crab ringer solution to determine the rate of heart beat. The crab ringer prepared had following composition.

Sodium chloride	16.100 gm
Potassium chloride	0.4162 gm
Calcium chloride	0.3403 gm
Magnesium chloride	0.0804 gm
Sodium sulphate	1.5261 gm
Sodium Phosphate (Tribasic)	0.0358 gm
Glucose	0.6000 gm
Distilled water	1000 ml

Only analar grade reagents were used to prepare the ringer solution. The PH of the solution was adjusted to 7.7 by adding 10-15 ml. of PH 7.7 tribuffer. Suitable amounts of glucose were added

to the ringer just before use. The ringer when kept in cold could be used up to 15 days. This ringer was found quite satisfactory and the heart maintained a constant beat for considerable time (2-3 Hours). Frequent changing of the fluid also enhanced the viability of preparation. After noting down the weight and sex of the animal, it was cut through the lateral side and the dorsal carapace was removed to expose the heart. The preparation was kept in finger bowl filled with crab ringer and maintained for 10 minutes to allow the animal to recover from shock effects and for the heart beat to get stabilized. The heart beat was seen visually and the time taken for 10 heart beats was determined with the help of stop watch. Two more reading were taken and average value of three observations was used for calculating the rate of heart beat expressed in terms of No. of heart beats/seconds. The heart beat frequency was determined at the laboratory temperature (27-28°C.) and between 11.00 a.m to 12 noon to avoid fluctuations due to diurnal rhythmicity. The rate of heart beats was plotted in relation to time exposure in three solutions like copper sulphate, cadmium sulphate, zinc sulphate and cadmium sulphate.

RESULTS AND DISCUSSION

Table-1 : Changes due to the effect of metallic pollutants on the rate of heart beat of freshwater crab *Barytelphusa guerini* after exposure to sub-lethal concentrations of Copper sulphate, Zinc sulphate and Cadmium sulphate.

Sr. No.	Exposure Time in Hours	Sub-lethal concentration of metallic pollutants		
		CuSO ₄ 666.6 PPM	ZnSO ₄ 500 PM	CdSO ₄ 133.3 PPM
1.	0	28.58 ±2.15	28.58 ± 2.15	28.58 ± 2.15
2.	24	24.99 ± 2.04	14.94 ± 2.67	16.14 ± 1.45
3.	48	18.05 ± 2.00	22.88 ± 1.866	13.70 ± 1.38
4.	72	14.99 ± 1.94	17.21 ± 2.86	24.58 ± 2.56
5.	96	13.17 ±1.85	15.21 ± 1.96	16.56 ± 1.56

The rate of heart beat, expressed in terms of beat/seconds is the average of 6 observations ± S.D.

Results presented in table showed that the heart rate exhibits differential effects on exposure to three metallic salts solution such as copper sulphate, Zinc sulphate and cadmium sulphate. On exposure to sub-lethal concentration of copper sulphate solution the rate of heart beat gradually decreasing up to 96 hours which shows that animals try to settle down into the toxic medium. Under the treatment of zinc sulphate solution the rate of heart beat exhibits differential results from copper sulphate exposed animals, it showed steep decrease in heart rate of the animals at 24 hours, but later the rate of heart beat was accelerated at 48 hours and again decreased up to 96 hours. The animals which were exposed to cadmium sulphate solution, the rate of heart beat showed initial decrease upto 48 hours and increased at 72 hours and again decreased at 96 hours.

In zinc sulphate solution, the rate of heart beat was accelerated at 48 hours, while incadmium sulphate the rate of heart beat was accelerated at 72 hoursis due to increase in metabolic activity of heart at cellular level because of shock of toxicants but gradually it recovers which is followed by decrease in heart rate of animals up to 96 hours.

CONCLUSION

Results clearly indicates that effect of toxicants, initially inhibits the heart rate which indicates animal try to settle down in to the toxic medium but later on effect of toxicants accelerates the metabolic activity of the animal which accelerates the rate of heart beat in crabs after their treatment.

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