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Analysis on effects of hostathion on selected metabolic and heaematological parameters of an air breathing fish

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Abstract
The present study was an attempt to compare the toxicity between a heavy metal (copper) and a pesticide (®Hostathion) on the behavioural as well as metabolic and haematological parameters of the fish *Calarias Batrachus*. Results clearly show that pesticides have an adverse effect on the living biota in aquatic environments. Hence it is highly imperative that we should resort to biopesticides. In this paper conducted to compare the effects of the heavy metal copper and the pesticide ®Hostathion on the behavioural and physiological activities of the Air Breathing fish, *Calarias Batrachus* and thereby to study the impact of the same on this fish population.

Keywords: hostathion and heaematological

Introduction
A toxic substance is one which can create adverse or detrimental consequences in biological systems by interfering with their structure and function, thus leading to mortality. When such substances are indiscriminately introduced into various ecosystems, the quality of the environment is impaired. These environmental toxicants are also known as xenobiotics. From the point of view of toxicology, no chemical can be regarded as either absolutely safe or dangerous. The harmless or dangerous nature of toxic substances depends on the dosage of the substance and the duration for which the organisms are exposed to it.
Water pollutants are shown to affect feeding, food utilization, oxygen consumption, metabolic turnover, muscular action, endocrine coordination and enzyme action, as well as reproduction of aquatic organisms. Even at sub lethal concentrations, the pollutants affect the life of aquatic fauna which are manifested as changes in physiology, biochemistry, and activity levels of many enzymes. Pesticides and heavy metals are the most commonly found water pollutants and they originate from human activity or agricultural farming that are discharged directly or indirectly into the receiving waters. The presence of these chemicals in the environment has become a global issue. They destroy the delicate balance between species that characterizes a functioning ecosystem. They produce many physiological and biochemical changes in freshwater organisms by influencing the activities of several enzymes. Alterations in the chemical composition of the natural aquatic environment generally affect behavioural and physiological systems of the inhabitants, particularly those of fishes.
Of all the aquatic organisms, fishes are the most severely affected by water pollutants like pesticides and heavy metals. Water pollutants are also found to interfere with the respiratory metabolism of crustaceans, insects and bivalves, causing a diminution in the rate of oxygen uptake.

Materials and Methods
The fish *Calarias Batrachus* (Linn) was selected for the present study. Tilapia is the common name for nearly a hundred species of cichlid fish from the tilapiine cichlid tribe. They inhabit a variety of fresh and, less commonly, brackish water habitats from shallow streams and ponds through to rivers, lakes, and estuaries. They have pale olive to silver-grey bodies with two to five indistinct dark blotches on the side. *Calarias Batrachus (Linn)* are hardy fish and can survive temperatures between 8 and 42 ^{o}C.

dissolved oxygen. They feed mainly on plankton, insects and weed, showing that they are omnivorous in diet. They are mouth brooders, protecting the eggs and larvae from predators. Dechlorinated tap water, aerated to full saturation, was taken as the test medium. The pH of the test medium was 7.0–7.5. The addition of toxicants did not bring about any appreciable variation in the pH. All the experiments were carried out at laboratory temperature, 28 ± 1 ºC.

Two toxicants, a heavy metal and a pesticide, were used for the study. Copper as Copper Sulphate was the heavy metal selected and purchased as laboratory grade reagent from HiMedia. ®Hostathion, a commercial product of Bayer CropScience Ltd, was a broad spectrum insecticide with Triazophos as active ingredient. Its chemical name is O, O-diethylO-1-phenyl-1H-1, 2, 4-triazol-3-ylphosphorothioate.

Physically it is a light yellow to dark brown liquid with a characteristic odour of phosphoric ester. Hostathion is readily soluble in most organic solvents like aromatic hydrocarbons, alcohols, esters and ketones.

Toxicity studies

Acute toxicity tests were conducted to measure the impact of toxicants on aquatic life within a period of 96 hrs. LC_{50} is a statistical estimate of the concentration of the toxic materials in water that kills 50% of the test animals under experimental conditions at specific time intervals [1-3]. This value is ideally suited for toxicity studies as it gives a more acceptable and reproducible concentration required to affect 50% of the organism than any other value. Lethal toxicity studies.

Effects of copper and ®hostathion on behavior

Behaviour of the fishes were recorded during the course of the experiment with sub lethal concentrations of Copper and ®Hostathion up to 24 hrs post exposure. In order to study the effect of Copper and ®Hostathion, fishes were exposed to three different concentrations of Copper (0.01, 0.02 and 0.03 ppm) and ®Hostathion (0.0001, 0.0002 and 0.0003 ppm) respectively along with the control and the following parameters were recorded at 2 hr, 6 hr, 12 hr and 24 hr post exposure - nature of opercular beat, nature of body movement and deposition of mucus over the body.

Effects of copper and ®hostathion on opercular beat

To study the effect of copper and ®Hostathion on the opercular beat of *Calarias Batrachus*, healthy and disease free fishes with body weights ranging from 15–25g were selected. Three groups each with five fishes were exposed to different concentrations of copper and ®Hostathion along with a control. The different concentrations of copper were 0.01, 0.02 and 0.03 ppm, and that of ®Hostathion were 0.0001, 0.0002 and 0.0003 ppm. Opercular beats per minute were recorded from the beginning of the experiment followed by 2, 6, 12 and 24 hrs post exposure.

Results and Discussion

Lethal toxicity of copper and ®Hostathion for *Calarias Batrachus)* was studied and the results are as follows. The 96 hr LC_{50} values for copper and ®Hostathion were found to be 1.6 ppm and 0.01 ppm respectively. The concentrations selected for sub lethal toxicity studies were 0.01,0.02 and 0.03 ppm for copper which roughly corresponds to 1/160,1/80 and 1/53 of the 96 hr LC_{50} value for copper and 0.0001, 0.0002 and 0.0003 for ®Hostathion which corresponds to 1/100, 1/50 and 1/33 of the 96 hr LC_{50} value for ®Hostathion respectively.

Effects of copper and ®hostathion on behaviour

Behavioural responses involved unrhythimic, irregular body movements and aggressive nature at higher concentrations of copper and ®Hostathion. The effects of copper and ®Hostathion on the pattern of opercular beat of *Calarias Batrachus* are shown in Table-1 and 2 respectively.

Table 1: Pattern of opercular beat shown by *Calarias batrachus* exposed to different concentrations of copper

Conc.	Time period			
	2 Hour	6 Hour	12 Hour	24 Hour
Control	Normal	Normal	Normal	Normal
0.01 ppm	Slightly fast	Fast	Slowed down	Slowed down
0.02 ppm	Fast	Fast	Slowed down	Slowed down
0.03 ppm	Fast	Slowed down	Slowed down	Slowed down

Table 2: Pattern of opercular beat shown by *Calarias batrachus* exposed to different concentrations of ®hostathion

Conc.	Time period			
	2 Hour	6 Hour	12 Hour	24 Hour
Control	Normal	Normal	Normal	Normal
0.0001 ppm	Slightly fast	Fast	Fast	Normal
0.0002 ppm	Slight Fast	Very Fast	Slowed down	Slowed down
0.0003 ppm	Slight Fast	Very Fast	Slowed down	Occasional

Effects of copper and ®hostathion on opercular beat

The opercular beats/min in control fishes were in the range of 58 – 65 throughout the period of exposure. In 0.01 ppm copper exposed fishes, there was a slight increase in the number of beats towards 6 hrs post exposure. Then the values declined. In 0.02 ppm copper exposed fishes also the net result was the same with an initial increase followed by a decrease in value. In 0.03 ppm copper exposed fishes a sudden decline in the opercular beat was noticed just after an initial increase. The decline in the value started just after 6 hrs post exposure.

The effect of ®Hostathion on the opercular beat was more severe than that of copper. In 0.0001 ppm ®Hostathion exposed fishes, there was an initial increase in the number of beats followed by a decrease in value only after 12 hrs post exposure. But in 0.0002 and 0.0003 ppm ®Hostathion exposed fishes, after an initial increase a drastic decrease in the number of beats was observed after 12 hrs of exposure.

Effects of copper and ®hostathion on oxygen consumption

The results on oxygen consumption per hour showed an increase in the rate of consumption as the toxicant concentrations increased. In control fishes the rate of oxygen consumption was 0.080 mg/l/hr/body weight, while in 0.01 ppm, 0.02 ppm and 0.03 ppm copper exposed fishes the rate of oxygen consumption increased to 0.095, 0.135 and 0.165 mg/l/hr/body weight respectively. Similarly in fishes exposed to 0.0001 ppm, 0.0002 ppm and 0.0003 ppm ®Hostathion, the rate of oxygen consumption was 0.136, 0.141 and 0.144 mg/l/hr/body weight respectively. But the control value was 0.074 mg/l/hr/body weight.

Effects of copper and ®hostathion on total erythrocyte count

In the control fishes the TEC ranged between 4.68–4.82 million/mm^3. In fishes exposed to 0.01 ppm and 0.02 ppm copper, a significant decrease in the count was observed only for 24 hr post exposure. But a significant decrease of about 3.60 million/mm^3 and 2.86 million/mm3 were observed in

0.03 ppm copper exposed fishes at 12 hrs and 24 hrs post exposure respectively ($P < 0.05$). Figures 1 and 2 depict the effect of varying concentrations of copper on the Total Erythrocyte count of *Calarias Batrachus*.

In the case of 0.0001 ppm ®Hostathion exposed fishes, there was only a slight decrease in the count till 24 hrs post exposure but without any significance. But in 0.0002 ppm exposed fishes a significant decrease in the number of erythrocytes was noticed from 12 hrs post exposure.

®Hostathion proved to be more toxic to the fish when they were exposed to 0.0003 ppm showing a significant decrease in the erythrocyte count even from 6 hrs post exposure ($P < 0.05$).

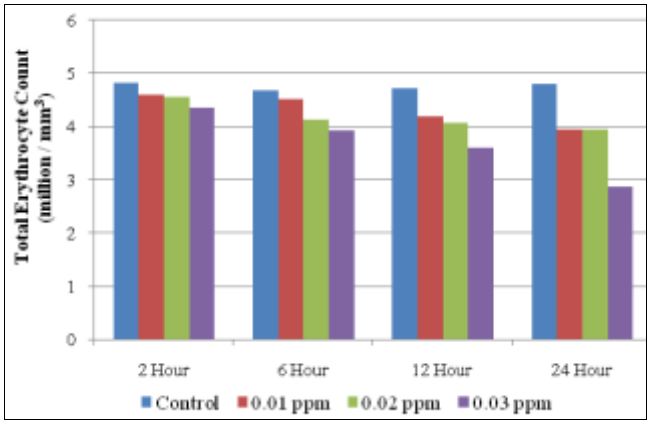

Fig 1: Total erythrocyte count (million/mm^3) in *Calarias batrachus* exposed to sub lethal concentrations of copper

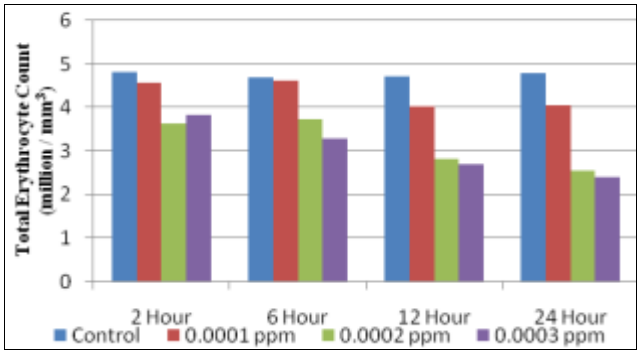

Fig 2: Total erythrocyte count (million/mm^3) in *Calarias batrachus* exposed to sub lethal concentrations of hostathion

The present study was an attempt to compare the effects of two pollutants, an organophosphorus pesticide ®Hostathion and a heavy metal copper on selected physiological activities of the fresh water fish, *C. Batrachus*.

Among the pollutants used, Hostathion was found to be more toxic than copper to *C. Batrachus*. 96 hr LC_{50} value of copper for *C. Batrachus* was found to be 1.6 ppm and that of ®Hostathion was 0.01 ppm. From 96 hr LC_{50} value, three sub lethal concentrations were selected for the present study. The sub lethal concentrations of copper selected were 0.01, 0.02, 0.03 ppm and that of ®Hostathion were 0.0001, 0.0002, 0.0003 ppm.

The opercular beats/min showed an initial increase at 2 and 6 hrs post exposure followed by a decline towards 12hrs and 24hrs post exposure in all the three sub lethal concentrations of both the pollutants. Similarly an initial aggressiveness was observed in body movements followed by occasional movements at later time periods in higher concentrations. In Hostathion exposed fishes, mucus production started at 6 hrs post exposure in 0.0002 ppm and 0.0003 ppm and prolonged to 24 hrs post exposure. In 0.0001 ppm exposed fishes, the mucus production occurred only at 6 hrs post exposure and there was no further change till 24 hrs post exposure. Mucus production started at 24 hrs post exposure in 0.02 and 0.03 ppm exposed fishes. These behavioural responses may be due to the stress caused by the pollutants and in order to overcome the stress, respiratory centre may be activated resulting in an increase in opercular beat at early periods of exposure. It was reported that during the intoxication period, there is an initial increase in opercular beat rate but as the duration is increased, the opercular beat rate gradually decreased. The opercular beat per minute showed progressive decrease with increase in the concentrations of the pollutants.

A similar result was observed by Mohammad Noor Alam while studying the toxic effects of Matacid 50 on *Channa punctatus.* Fishes showed gradual loss of their balance and strength in the body and finally sank to the bottom. Such reports have also been made by Santhakumar *et al*., Khilare and Sancho *et al*., [4-9].

Conclusion

Pesticides occupy a rather unique position among the many chemicals that man encounters daily, in that they are deliberately added to the environment for the purpose of killing or injuring some form of life. Ideally their injurious action would be highly specific for undesirable target organisms and non-injurious to desirable, no target organisms. In fact, however, most of the chemicals that are used as pesticides are not highly selective but are generally toxic to many no target species, including man, and other desirable forms of life that co inhabit the environment. Therefore, lacking highly selective pesticidal action, the application of pesticides must often be predicated on selecting quantities and manners of usage that will minimize the possibility of exposure of no target organisms to injurious quantities of these useful chemicals

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