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ZOOLOGY

## HEAVY METAL TOXICITY TO A FRESHWATER CRAB, *BARYTELPHUSA CUNICULARIS* (WESTWOOD) FROM AURANGABAD REGION

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### Abstract

Pesticides of heavy metal salts are common pollutants of freshwater ecosystems where they induce adverse effects on the aquatic biota. *Barytelphusa cunicularis* is a key-species in Marathwada region having good nutritional value. Crabs live in close association with the sediment where accumulation of heavy metals pesticides is reported. Acute toxicity tests were conducted against the pesticides copper sulphate and mercuric chloride. Median Lethal Concentration (LC50) values of Copper sulphate were found to be 282, 258, 238 and 215 ppm respectively for 24, 48, 72 and 96 h., while those for mercuric chloride were 1.04, 0.84, 0.63 and 0.45 ppm respectively. This crab was found more sensitive to mercuric chloride than copper sulphate.

**Keywords:** Freshwater Crab, Heavy metal pesticides, Toxicity test

### Introduction

Living organisms require trace amounts of some heavy metals including iron, cobalt, copper, magnesium, vanadium and zinc for good health. Excessive amounts of these metals however can be detrimental to living organisms. Other heavy metals such as cadmium, lead and mercury have no known beneficial effect and their accumulation over the time in animals can cause illness (Hawkes, 1997).

Aquaculture industry worldwide is making significant progress in the development of technology to increase aquaculture production every year. The concept of green revolution was emphasized in the recent past to meet the demands of the increasing human population. Many different agrochemicals such as fertilizers, pesticides, fungicides, insecticides and weedicides are in common use.

The most important heavy metals from the water pollution point of view are Zn, Cu, Pb, Cd, Hg, Ni and Cr and become toxic at higher concentrations (Agrahari, 2009). Heavy metal from man-made pollution sources are continually released into aquatic ecosystem (Ozturk, *et al.*, 2008). Total concentrations of most metals in sediments are several orders of magnitude higher than aqueous concentrations (Louma, S.N. 1989). The contamination of fresh waters with a wide range of pollutants has become a matter of concern over the last few decades (Vutukuru, 2005; Vinodhini and Narayanan, 2008). The natural aquatic systems may extensively be contaminated with heavy metals released from domestic, industrial and other man-made activities (Conacher, *et al.*, 1993).

Indiscriminate use of heavy metal pesticides caused non-specific hazards to target aquatic animals of economic importance like crabs, leeches, bivalve etc. The aquatic animals are particularly susceptible to heavy metal pesticides, since their habitats are strictly confined to water bodies and are exposed more to toxic compounds dissolve in the medium.

Crabs constitute a significant portion of the freshwater ecosystem. Very often they become the victim of pesticides used against some other activity or agricultural pest. Therefore their population in this area was found decreasing during the last decade.

In the present study toxic effect of heavy metals e.g.  $\text{CuSO}_4$  and  $\text{HgCl}_2$  to freshwater crab, *Barytelphusa cunicularis* is determined due to its adaptation in polluted aquatic environment.

### Material and Method

The female crabs, *Barytelphusa cunicularis* were collected from freshwater ponds on the outskirts of Aurangabad and were brought to the laboratory in large plastic troughs and acclimatized for one week. Healthy intermoult (stage C-3) female crabs having equal size (Carapace width 30 to 35 mm) and weight (25 to 30 g) were used. Two heavy metal pesticides selected for experiment were Copper sulphate ( $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$ ) and Mercuric chloride ( $\text{HgCl}_2$ ). Stock solution of copper sulphate and mercuric chloride were prepared by dissolving appropriate amount of salts in distilled water. Test was repeated three times for each concentration and results averaged.

For the selection of test concentration, some pilot tests were carried out. The range of concentration was

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selected between 0 to 100% mortality. In order to maintain the concentration of the pesticide, water was changed after every 24 hr during the exposure.

The mortality rate of *Barytelphusa cunicularis* was recorded at 24, 48, 72 and 96 h of exposure to the heavy metal pesticide. The percentage for corrected mortality was calculated using the Abbott's formula (1952).

$$\text{Corrected mortality (\%)} = \frac{\text{Percentage living in control} - \text{Percentage living in treatment}}{\text{Percentage living in control}} \times 100$$

The corrected mortality data were analyzed to determine the LC<sub>50</sub> values for 24, 48, 72 and 96 h and were calculated by probit method of Finney (1971). By

graphical interpolation LC<sub>50</sub> values were fixed and the values of maximum and minimum fiducial limits and safe concentrations were calculated.

### Results and Discussion Copper sulphate toxicity

The mean LC<sub>50</sub> values of copper sulphate for 24 (Fig.1 A), 48 (Fig. 1 B), 72 (Fig. 1 C) and 96 (Fig. 1 D) hr of exposure were estimated as 282, 258, 238 and 215 ppm respectively (Table 1 Fig. 1).

The observed data of present study indicate that the crab, *Barytelphusa cunicularis* survived well from 1 to 275 ppm for 24 hr, 1 to 250 ppm for 48 hr, 1 to 230 ppm for 72 hr and 1 to 220 ppm for 96 hr of exposure .

Fig. 1 - Empirical and Expected Probit lines for *Barytelphusa cunicularis* exposed to Copper Sulphate showing LC<sub>50</sub> values in 24, 48, 72 and 96 hrs

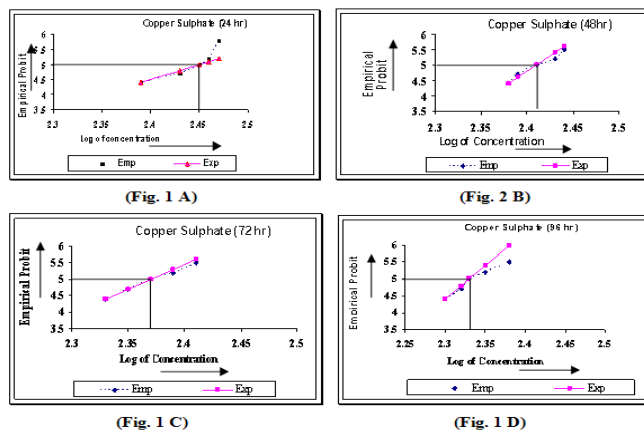


Table 1:- The LC<sub>50</sub> values and regression results for the freshwater crab, *Barytelphusa cunicularis* treated with Copper sulphate (CuSO<sub>4</sub>)

Exposure period (hr)	LC <sub>50</sub> value (ppm)	Regression results Y' = (y-bx) + bx	Chi-square (f <sup>2</sup> )	Fiducial limits up to 95% Confidence	
				M1	M2
24	282	32.6694 + 15.4323x	0.616163	2.4209	2.4667
48	258	32.4445 + 15.5137x	0.005058	2.3904	2.4369
72	238	24.0867 + 12.2476x	0.017696	2.3455	2.4041
96	215	24.2865 + 12.5218x	0.154211	2.3082	2.3669

### Mercuric chloride toxicity

The mean LC<sub>50</sub> values of mercuric chloride for 24 (Fig. 2 A), 48 (Fig. 2 B), 72 (Fig. 2 C) and 96 (Fig. 2 D) h of exposure were estimated as 1.04, 0.84, 0.63 and 0.45 ppm respectively (Table 2.).

The observed data show that the crab, *Barytelphusa cunicularis* survival well from 0.01 to 1.00 ppm for 24 hr, 0.01 to 0.80 ppm for 48 hr, 0.01 to 0.60 ppm for 72 hr and 0.01 to 0.40 ppm for 96 hr of Mercuric chloride (Table 2.).

Fig. 2 - Empirical and Expected Probit lines for *Barytelphusa cunicularis* exposed to Mercuric Chloride showing LC 50 values in 24, 48, 72 and 96 hrs

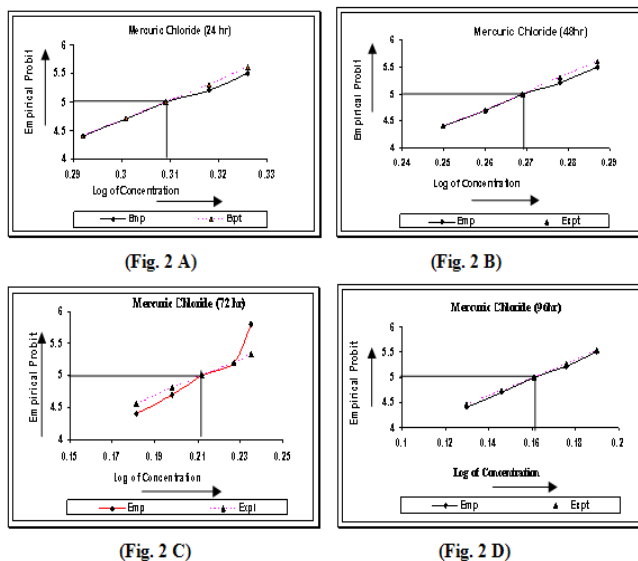


Table 2:- The LC50 values and regression results for the freshwater crab, *Barytelphusa cunicularis* treated with Mercuric chloride (Hgcl2)

Exposure period (hr)	LC <sub>50</sub> value (ppm)	Regression results Y'= (y-bx) + bx	Chi-square (f <sup>2</sup> )	Fiducial limits up to 95% Confidence	
				M1	M2
24	1.04	4.7475 + 15.5112 x	0.002690	-0.0067	0.0395
48	0.86	5.8508 + 12.8136 x	0.003616	-0.0944	-0.0384
72	0.63	6.7537 + 8.3251 x	0.520714	-0.2475	-0.1625
96	0.45	9.0083 + 5.2904 x	0.018373	-0.4202	-0.2842

Not only in India, but globally the pollution is a scare-word (Hatai, *et al.*, 2005). Extensive studies have been carried out all over the world on for the effects of pesticides on aquatic organisms (Ramana Rao, *et al.*, 1987; Cripe, 1994; Shanmugam, *et al.*, 2000). Heavy metals are natural components of the earth's crust. They can enter the water and food cycles through a variety of chemical and geochemical processes (Tinsley, 1979; NDES, 1999).

The freshwater female crab, *Barytelphusa cunicularis* (Westwood) is abundantly found in Marathwada region and is a good source of food and has high market value. People prefer them due to high content of protein. Maharashtra Pollution Control Board (IS, 10500, 1991) has reported the presence of heavy metals in different freshwater bodies around Aurangabad above the maximum permeable limit (MPL: Copper Sulphate:-5.0 ppb and Mercuric chloride: - 1.0 ppb).

The toxicity of pesticides depends on many factors such as weight, size (Sherkar 1986, Pickering *et al.*,

1968) developmental stages (Kamaldeep and Toor, 1977), time of exposure, temperature (Macek *et al.*, 1969), pH, Hardness of water (Henderson *et al.*, 1959) and dissolved oxygen content of the medium (Ester, 1970). Pesticide affects behavior and gets accumulate in the test animals reduces their survival rate.

Results of pesticide toxicity are reported by other authors (Galli *et al.* 1994; Kaiser and Devillers, 1994; Ruiz *et al.*, 1997; Amoros, *et al.*, 2000). Variations in the degree of toxicity of different pesticides have also been reported by other workers (Ramana Rao *et al.*, 1987).

Saksena (1987) has reported 96 hr. LC 50 value of mercuric chloride on *Clarias batrachus* and *Puntius ticto* as 0.15mg/l and 0.1mg/l respectively and further observed that *Puntius ticto* is more susceptible to the toxicant with much less tolerance than *Clarias batrachus*.

Through toxicity tests, Mean LC<sub>50</sub> values, lethal concentration, safe concentration, fiducial limit etc have been calculated. Regression line and regression

equation have been calculated. An attempt has been made to simplify this intractable process for a biologist to understand, since it alone provides the basis for the calculation of LC<sub>50</sub>, chi square values for reliability of data, fiducial limits, lethal and safe concentration of pollutants etc.

The contamination of heavy metals is a serious threat because of their toxicity, long persistence, bioaccumulation and biomagnifications in the food chain. Freshwater crab, *Barytelphusa cunicularis* can be considered as one of the most significant indicators of pollution in freshwater systems.

### Conclusion

Therefore future eco-toxicological investigations that characterized the use of *Barytelphusa cunicularis* as well as implementation of environmental policy to regulate untreated pollutant discharges into freshwater and maintain sanitation are recommended. Furthermore, this study recommends futuristic investigations on biodegradability of biocides, bio-concentration of biocides and time profile of biocides quality discharge into freshwater ecosystems.

The toxicity for heavy metal pesticides is dependant on time of exposure and nature of heavy metal pesticides. In present study HgCl<sub>2</sub> (Mercuric Chloride) is found to be more toxic than CuSO<sub>4</sub> (Copper Sulphate) to a freshwater crab.

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