Journal of Energy Research and Environmental Technology (JERET)
p-ISSN: 2394-1561; e-ISSN: 2394-157X; Volume 6, Issue 3; July-September, 2019; pp. 205-208

http://www.krishisanskriti.org/Publication.html

# Effects of Copper and Lead on Freshwater Mollusc *Corbicula Striatella* (Deshayes, 1854)

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**Abstract—***Experimental works were carried out in the laboratory on adult freshwater bivalve Corbicula striatella (Deshayes,1854) to evaluate acute toxicity of copper (Cu) and lead (Pb). To determine different lethal concentrations (LC) of two metals acute toxicity tests of 24 – 96 hours were conducted. The mortality was recorded after every 24, 48, 72, and 96 hours. To count the bivalve as dead following criteria were selected- no movement, discharge of large amount of milky white mucus, valves remaining open, extensive protrusion of foot outside the shell and floating on the surface of the test media. Behavioral changes due to toxicity of the two metals were also observed. In C. striatella, the median lethal concentration ($LC_{50}$) values at 24, 48, 72, and 96 h of Cu were found to be 69.45, 20.91, 11.52 and 6.57 mg $L^{-1}$ and of Pb were 436.56, 325.55, 269.54 and 231.01 mg $L^{-1}$. The mollusc was found to be more sensitive to Cu compared to Pb. The outcomes of our study added information on the effects of two heavy metals on an ecologically important bivalve species inhabiting various freshwater ecosystems of Barak Valley.*

**Keywords***: Acute toxicity, bivalve, Corbicula striatella., median lethal concentration ($LC_{50}$)*

## 1. Introduction

Copper (Cu) is an essential element for most life forms. However, at high bioavailable concentrations, Cu becomes toxic[1]. With its application in industry and agriculture (e.g., Cu containing fungicides and herbicides), Cu release from these sources into the environment is substantial [2, 3]. In Asia, recent industrial and economic development has increased pressure on the environment.$Cu^{2+}$ions are known to be particularly toxic to a wide variety of aquatic organisms [4, 5, 6, 7,8, 9, 10, 11].

Lead (Pb) is ubiquitous in the environment and occurs naturally at trace levels in soils (16 $mgkg^{-1}$), water (0.02 $\mu gL^{-1}$ in the sea and 2 $\mu gL^{-1}$ in lakes and rivers) and air (0.1 $\mu g/m^3$ in rural areas and 0.3 to 2 $\mu g/m^3$ in urban areas) [12,13, 14]. The widespread dispersal of Pb through anthropogenic activities has resulted in an increase in Pb residues throughout the environment. Lead is a non-essential metal and its toxic effect is known to be higher than the essential metals [15].

Molluscs have long been regarded as promising bioindicators and biomonitoring subjects [16]. A mollusc species *Corbicula fluminea* is recognized as a bioaccumulator of contaminants [17, 18] and used as a bioindicator of trace metals in fresh water [19]. Therefore, it may be worthwhile to explore the Indian *Corbicula* spp. for their possible utility as metal biomonitors and bioaccumulators.

Experimental toxicity testing has been practiced to identify suitable organisms as bio-indicators and to derive water quality standards. In the acute toxicity test the exposure concentration which causes 50% mortality ($LC_{50}$) to test organisms during specified period of time is estimated [20].

Studies on heavy metal pollution - especially using molluscs as bioindicators - in Assam in particular and North East India as a whole, are still scarce. Therefore, it is important to conduct studies with local species that can be used to gain data on metal toxicity, to determine the organism's sensitivity, and to derive a permissible limit for water that can protect the local aquatic communities.

In this research work a trial is being made to evaluate the toxicity of metals copper (Cu) and lead(Pb) on the selected mollusc species *Corbicula striatella*(Deshayes,1854).

## 2. Materials and methods

### 2.1 Procurement of Metal

The metals used in the present study were Lead Nitrate, Molecular formula: Pb $(NO_3)_2$, and Cupric Chloride, Molecular formula: $CuCl_2.2H_2O$-manufactured by Thermo Fisher Scientific India Pvt. Ltd, Mumbai, India.

### 2.2 Sampling

*C. striatella* of approximately similar size were handpicked from the Ghagra river, Cachar, Assam, India, during February – April, 2017 and brought to the laboratory in a plastic bucket with some river water in it.

### 2.3 Acclimatization

Molluscs were acclimatized in an aquarium in the laboratory for 7 days withaeration and without food.

### 2.4 Acute Toxicity

After acclimatization, a range finding test was conducted with two selected concentrations before the definitive test which enables to know the appropriate range of concentrations. A static-with-renewal 96 h bioassay test was performed with renewal of test solution every 48 h[21]. Groups of experimental organisms of average size (length 9 ± 0.2 mm; breadth 7 ± 0.4 mm; and weight 0.217 ± 0.1 g) consisting of 7 individuals each were selected at random and used in the control and each metal treatment concentrations. Food was withheld one day prior to the experiment, and the test organisms were not fed during the experiment.Similarly, controls were also maintained in which no metal was added. Mortality was recorded at 24, 48,72 and 96 h, and dead organisms if any, were removed. The lethal concentrations (LC) for all the test species were estimated by log probit analysis [22] with the help of SPSS 20 statistical software for Windows.

The end points of mortality in acute toxicity test were - no movement, discharge of large amount of milky white substance, valves remaining open,extensive protrusion of foot outside the shell andmolluscs floating on the surface of the test media.

The following concentrations were used in the experiments:

1) Cu (37.2, 66.96, 96.72 and 126.48mg $L^{-1}$),

2) Pb (1250, 1750, 2000 and 2250 mg $L^{-1}$).

## 3. Results and Discussion

### 3.1 Acute toxicity

The $LC_{10}$, $LC_{25}$, $LC_{50}$, $LC_{75}$ and $LC_{90}$ values of Cu for *C.striatella*at 24, 48, 72 and 96 h were found to range from 12.289 – 392.508, 5.236 – 83.542, 2.925 – 45.375 and 2.952–14.616 mg $L^{-1}$, respectively (Table 1). The median lethal concentration ($LC_{50}$) values of Cu at 24, 48, 72 and 96 h for *C. striatella* were found to be 69.452, 20.914, 11.521 and 6.569 mg $L^{-1}$(Figure1).

The $LC_{10}$, $LC_{25}$, $LC_{50}$, $LC_{75}$ and $LC_{90}$ values of Pb for *C.striatella* at 24, 48, 72 and 96 h were found to range from 278.198 – 685.072, 228.172 – 464.48, 208.532 – 348.394 and 170.588–312.819mg $L^{-1}$, respectively (Table 2). The median lethal concentration ($LC_{50}$) values of Pb at 24, 48, 72 and 96 h for *C.striatella* were found to be 436.561, 325.548, 269.539 and 231.005 mg $L^{-1}$(Figure 2).

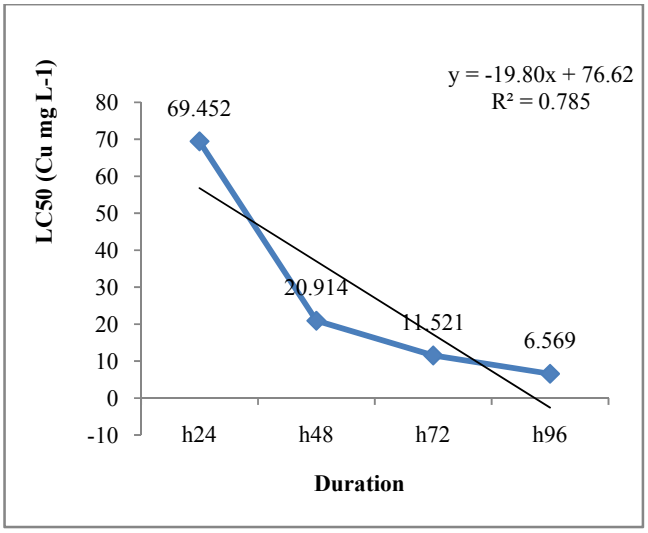


**Figure 1: 24 – 96h $LC_{50}$ values of Cu for Corbicula striatella.**

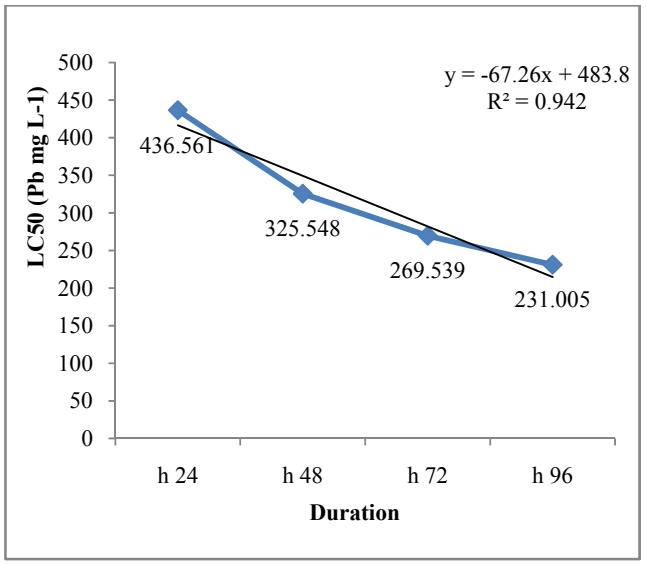


**Figure 2: 24 - 96 h $LC_{50}$ values of Pb for Corbicula striatella.**

**Table 1: LC values of copper for Corbicula striatella**

| Duration (hours) | LC 10 | LC 25 | LC50 | LC 75 | LC 90 |
|---|---|---|---|---|---|
| 24 | 12.289 | 27.914 | 69.452 | 172.804 | 392.508 |
| 48 | 5.236 | 10.09 | 20.914 | 43.35 | 83.542 |
| 72 | 2.925 | 5.599 | 11.521 | 23.703 | 45.375 |
| 96 | 2.952 | 4.312 | 6.569 | 10.007 | 14.616 |

**Table 2: LC values of lead for *Corbicula striatella***

| Duration (hours) | LC10 | LC25 | LC50 | LC75 | LC90 |
|---|---|---|---|---|---|
| 24 | 278.198 | 344.391 | 436.561 | 553.399 | 685.072 |
| 48 | 228.172 | 270.009 | 325.548 | 392.511 | 464.48 |
| 72 | 208.532 | 235.486 | 269.539 | 308.517 | 348.394 |
| 96 | 170.588 | 196.934 | 231.005 | 270.97 | 312.819 |

The obtained $LC_{50}$ value of Cu at 96 h (6.569 mg $L^{-1}$) of *C. striatella* of our study is higher from the results of Rodgers et al. [23] of *Corbiculafluminea* (0.09 mg $L^{-1}$), and of Harrison et al. [24] of *Corbicula manilensis* (2.6 mg $L^{-1}$) (Table 3).

The present study$LC_{50}$ value of Pb at 96 h (231.005 mg $L^{-1}$) of *C. striatella*is lower than the value reported by Labrot et al. [25] in *Corbicula* (1023.32 mg $L^{-1}$). The difference may be due to the difference in type of species.

### 3.2 Behavioral changes

Some behavioral changes such as discharge of milky white mucus, absence or reduction of movement, and reduction in valve opening were observed during the acute toxicity tests with Cu and Pb in *C. striatella.* There was no discharge of milky white mucus observed in the molluscs kept in control. Similar kind of behavior responses in freshwater bivalve *Lamellidensmarginalis* due to cypermethrin and mercury toxicity were also reported by Kumar et al. [26] and Yasmeen and Begum [27].

## 4. Conclusions

From the results we may conclude that high concentrations of copper and lead are found toxic to *C. striatella*, with copper being more toxic to the species than lead. Copper and lead were found to cause mortality and behavioral changes in *C. striatella* in the present study. Further studies on metal accumulation and physiological mechanisms would certainly provide better understandingof metal toxicity in freshwater molluscs in general, and this species in particular.

## 5. Acknowledgements

NBthanks University Grants Commission, India, for providing a Basic Scientific Research Fellowship to her. The authors also thank Zoological Survey of India, Kolkata, India, for identification of the test species. The e-library facility provided under DELCON at Bioinformatics Centre, Assam University, Silchar, India is acknowledged.

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