

# Monitor the Median Lethal Concentration (96 Hours) of Cadmium and Lead in *Meretrix casta*

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## ABSTRACT

Metals are essential for animal life and physiological functions. Some metals are essential elements required by humans, and most metals are used in electrical and electric equipment, cars and catalysts. The heavy metals can enter the bodies to a small extent via food, drinking water and air. The excess quantities of heavy metals are detrimental as these destabilize the ecosystems because of their bioaccumulation in organisms, and elicit toxic effects on biota and even death in most living organisms. In the present study was done to find out the impact of cadmium and lead in *M. casta* within a short period. In the present investigation LC<sub>50</sub> value of cadmium is higher than that of lead. It is suggested that the toxicity response may vary from species to species.

## 1. Introduction

Toxicity testing is paramount in the screening of newly developed drugs before it can be used on humans. Toxicity testing is the determination of potential hazards a test substance may likely produced and the characterization of its action, most of the toxicity testing is carried out on experimental animals. The advantages of using animal models in toxicity testing are enormous. These advantages include the possibility of clearly defined genetic constitution and their amenity to controlled exposure, controlled duration of exposure, and the possibility of detailed examination of all tissues following necropsy (Cunny, 2002). The information obtained can serve as the basis for hazard classification and labeling of chemicals in commerce. The essence of toxicity testing is not just to check how safe a test substance is; but to characterize the possible toxic effects it can produce. Toxicity testing was given much attention following early 1960s thalidomide catastrophe; with thousands of children born worldwide with severe birth defects. After this incidence many countries of the world have resolved to go for toxicity testing and teratogenicity in both sexes so as to prevent further tragedies (Agrawal and Paridhavi, 2007).

Toxicity of heavy metal to aquatic organisms has been studied extremely by numerous researchers (Khallaf et al., 2003; Filho et al., 2004; Kalpaxis et al., 2004; Shaw et al., 2006). The manifestation of heavy metals in the environment has been greater than before in some areas to levels, which jeopardize the well-being of aquatic and terrestrial organisms including human (Honda et al., 2008). Therefore, it is a key challenging task to envisage the effects of contaminants on aquatic organisms and to institute toxicity standards for tolerable levels of chemical contamination (Bat et al., 2001). A reason for curiosity in heavy metals and behaviour in aquatic communities is that; heavy metals may have dissimilar behavioural effects at concentrations much smaller; compared to which they have lethal effects. This is suggesting that regulatory pollution limits based upon standard toxicological studies may be too high to avert damage to aquatic

communities through the sublethal behavioural effects (Klaschka, 2008). Hence, in the present study was done to find out the impact of cadmium and lead in *M. casta* within a short period.

## 2. Materials and methods

### Collection of sample

Estuarine clams *M. Casta* were collected from Agniar estuary and were brought to the laboratory in collection bags with habitat water. Clams were cleaned and maintained in the habitat water for a couple of days in order to acclimatize to the laboratory conditions.

### Preparation of stock solution

The stock solution of heavy metals cadmium and lead were prepared by suitably diluting the cadmium sulphate lead nitrate. Test concentrations were prepared appropriately by diluting the stock solution.

### Preparation of concentrations

Preliminary toxicity test was conducted by ascertain the lethal and sub-lethal concentrations of cadmium and lead. A range of test concentrations (ppm) as indicated by preliminary toxicity tests were prepared 2, 4, 6, 8, 10 and 12 for cadmium; 4, 8, 12, 16, 20, 24, 28 & 32 for lead.

### Preliminary toxicity tests

Ten healthy clams were introduced into each concentration. Duplicates were maintained for each of the test concentrations and for the controls. Mortality was recorded at 24-hours intervals during 96 hours period. LC<sub>50</sub> value was calculated from the cumulative percentage mortalities using Log-Probit method of Litch field, WillCoxon (1949) and Finney (1971).

## 3. Result

The results of acute toxicity of cadmium and lead are depicted in the Fig. 1 & 2. Among the test concentrations

prepared from the preliminary toxicity test the mortality of 50% of the population after 96 hours of exposure was observed in  $6.5 \text{ mg}^{-1}$  concentration ( $\text{LC}_{50}$ ) for cadmium and  $18 \text{ mg}^{-1}$  for lead.

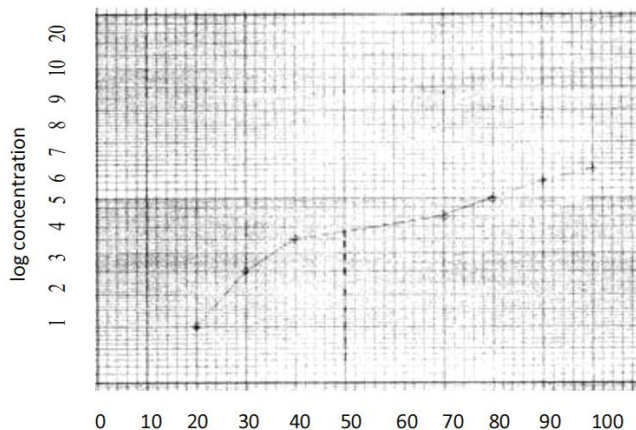


Figure 1: Log dose profit mortality graphs for cadmium tested against *M.casta* (Probit mortality)

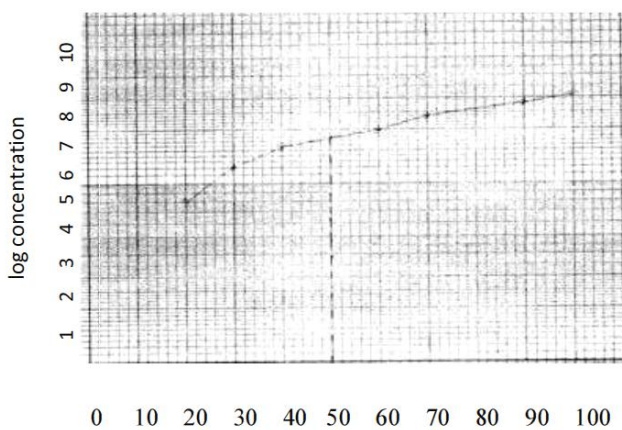


Figure 2: Log dose profit mortality graphs for lead tested against *M.casta* (Probit mortality)

#### 4. Discussion

Toxicological investigations have become unavoidable due to the hasty progression of industrialization and modern technical development, which in due course cause pollution. Heavy metals are being released into the water bodies from various industries as effluents and waste water and initiate deleterious effects on aquatic organisms. Research on toxicity is very indispensable to evaluate the quality of water which is consumed by community. When the accumulation in the animal body surpasses definite level, this also reveals the influence of these pollutants on various systems of the body. If the toxicants are not detected and removed from the water bodies, it will definitely affect the aquatic communities

#### References

- Adami, G.M., P. Barbieri, M. Fabiani, S. Piselli, S. Predonzani, E. Reisenhofer, (2002). Levels of cadmium and zinc in hepatopancreas of reared *Mytilus galloprovincialis* from the Gulf of Trieste (Italy). *Chemosphere*, 48(7): 671-677.
- Agrawal SS, Paridhavi M. Herbal drug technology. Universities press, India. 2007:607-614.
- Bat. L., Bilgin. S., Gundogdu. A., Akbulut. M., and Culha M., (2001), Individual and combined effects of copper and lead on the marine shrimp *Palaemon adspersus* Rathke, 1837 (*Decapoda: Palaemonidae*), *Turkish journal of marine sciences*, 7, pp 103-117.

triggering various alarming effects on biochemical and enzymatic pathways, when they enter into the body of the organism. There are many studies concern with the toxicity of cadmium and lead on vertebrates and invertebrates (Rasmussen et al., 2000, Adami et al, 2002 and Filipovic et al., 2003)

Metals are essential for human life and physiological functions. Some metals are essential elements required by humans, and most metals are used in electrical and electric equipment, cars and catalysts (Herincs et al., 2013; Wu et al., 2013; Singh and Rajaraman, 2014). The metal which has a relatively high density and toxic at low quantity is referred as 'heavy metal', e.g., arsenic (As), lead (Pb), mercury (Hg), cadmium (Cd), chromium (Cr), thallium (Tl), etc. Acute toxicity studies should be conducted to measure the impact of any toxicant on aquatic life with in a short period, (96 hours)  $\text{LC}_{50}$  value is a statistical estimate of the concentration of the toxic materials in water that kills 50% of the test animals under experimental condition at specific time intervals (Sprague, 1973). This value is ideally suited for toxicity studies as it gives a more acceptable and reproducible concentration required to affect 50% of the organisms than any other value (Pickering and Henderson, 1966). Acute toxicity study was done to find out the impact of cadmium and lead in *M. casta* within a short period. In the present study, the 96-hours  $\text{LC}_{50}$  values of cadmium and lead were found to be  $6.5 \text{ mg}^{-1}$ ,  $18 \text{ mg}^{-1}$  respectively. Calabrese *et al.*, (1973) observed the 48 hours  $\text{LC}_{50}$  value of cadmium and lead in the oyster larvae. It was observed to be  $3.8 \text{ mg}^{-1}$  and  $1.6 \text{ mg}^{-1}$  respectively. It is said that larvae are more sensitive than their adult. In *Chasmagnathus granulata* 96 hours  $\text{LC}_{50}$  value of cadmium is higher than that of lead (Ferrer, et.al., 1999). In the present investigation  $\text{LC}_{50}$  value of cadmium is higher than that of lead. It is suggested that the toxicity response may vary from species to species.

#### 5. Conclusion

The bioconcentration of cadmium and lead in the soft tissues in mantle, gill, digestive gland and foot muscles showed an distinct pattern of distribution. The order of metal accumulating ability of the organs were digestive gland > gill > mantle > foot muscle. In all these tissues the concentration of lead was higher than that of cadmium. 96 hours  $\text{LC}_{50}$  value of cadmium and lead were determined to undergo metal toxicity experiments at sublethal concentrations.  $\text{LC}_{50}$  value of cadmium at 96 hours was  $6.5 \text{ mg l}^{-1}$  and that of lead was  $18 \text{ mg l}^{-1}$ .

4. Calabrese, A. 1973. How some pollutants affects embryos and larvae of American oyster and hardshell clam. *Mar. Fish. Rev.* 34: 66-77.
5. Cunny H, Hodgson E. Toxicity testing. In: Hodgson E, (ed). A test book on modern toxicology. 3rd edition. A John Wiley & Sons. Inc. Publication. 353- 384.
6. Ferrer, L., Asteasuain, R., Marcovecchio, J. 1999. Heavy metals distribution in estuarine sediments. A possible trapper role of organic matter, 4<sup>th</sup> Open Sci. Meeting-Land Ocean Interact. *Coast. Zone (LOICZ-IGBP), LOICZ, Bahia Blanca*, 113pp.
7. Filho. O.E.C. Lopes. R.M., and Paumgartten F.J.R., (2004), Comparative study on the susceptibility of freshwater species to copperbased pesticides, *Chemosphere*, 56, pp 369-374
8. Filipovic, V. and Raspor, B. (2003). Metallothionein and metal levels in cystol of liver, kidney and brain in relation to growth parameters of *Mullus surmuletus* and *Liza aurata*. From the Eastern Adriatic Sea. *Water Research*. 37: 3253-3262.
9. Finney, D. J. 1971. Probit Analysis, 3<sup>rd</sup> (Ed). *Cambridge University Press*, 333pp.
10. Herincs E, Puschenreiter M, Wenzel W, Limbeck A. 2013. A novel flowinjection method for simultaneous measurement of platinum (Pt), palladium (Pd) and rhodium (Rh) in aqueous soil extracts of contaminated soil by ICP-OES. *J. Anal. At. Spectrom.* 28: 354–363.
11. Honda. R.T, De-Castilho. F.M., and Val A.L., (2008), Cadmium induced disruption of environmental exploration and chemical communication in *matrinxa*, *Brycon amazonicus*. *Aquatic Toxicology*, 89, pp 204-206.
12. Kalpaxis. D.L., Theos, C., Zaplanteri, M.A., Dinos, G.P., Catsiki, A.V., and Leotsinidis M., (2004), Biomonitoring of Gulf of Patras, N. Peloponnesus, Greece. Application of a biomarker suite including Ch.4 Acute Toxicity Studies 130 evaluation of translation efficiency in *Mytilus galloprovincialis* cells, *Environmental research*, 94, pp 211-220.
13. Shaw. B.J., and Handy R.D., (2006), Dietary copper exposure and recovery in Nile tilapia, *Oreochromis niloticus*, *Aquatic Toxicology*, 76, pp 111-121.
14. Khallaf. E.A., Galal. M., and Authman M., (2003), The biology of *Oreochromis niloticus* in a polluted canal, *Ecotoxicology*, 12, pp 405-416.
15. Klaschka U., (2008). The info-chemical effect-a new chapter in ecotoxicology, *Environmental science and pollution research*, 15, pp 452-462. 20.
16. Litchfield J T & Wilcoxon F A. 1949. A simplified method of evaluating dose-effect experiments. *J. Pharmacol. Exp. Ther.* 96:99-113.
17. Pickering, Q.H., Henderson, C and Lemke, A.E. 1966. The toxicity of organophosphorous insecticides to different species of warm water fishes. *TRANS. AMMER. FISH.SOC.* 91: 175-184.
18. Rasmussen, A.D., O. Anderson, (2000). Effects on cadmium exposure on volume regulation in the lugworm, *Arenicola marina*. *Aquat. Toxicol.* 48: 151-164.
19. Singh SK, Rajaraman G. 2014. Can anisotropic exchange be reliably calculated using density functional methods? A case study on trinuclear MnIII-MIII-MnIII (M = Fe, Ru, and Os) cyanometalate single-molecule magnets. *Chemistry* 20: 113–123.
20. Sprague, J. B. 1973. The ABC's of pollutant bioassays using fish. In: *Biological methods for the Assessment of water quality*. American Society for testing and materials. *ASTM STP 528*: 6-30.
21. Wu R, Xue Y, Qian X, Liu H, Zhou K, Chan SH, Tey JN, Wei J, Zhu B, Huang Y. 2013. Pt nanodendrites anchored on bamboo-shaped carbon nanofiber arrays as highly efficient electrocatalyst for oxygen reduction reaction. *Int. J. Hydrogen Energ.* 38: 16677–16684