Indian J. Fish., *44(4)* : *405-408, Oct.-Dec., 1997*

NOTE

Acute toxicity of Zn, Pb and Cd in the freshwater catfish *Mystus vittatus* (Bloch)

L.M. RAO AND R. MANJULA SREE PATNAIK

Department of Zoology, Andhra University,
Visakhapatnam - 530 003, India

ABSTRACT

Acute toxicity tests of 96, 72, 48 and 24 hrs for the heavy metals Zn, Pb and Cd in the fresh water catfish *Mystus vittatus* were conducted. It was observed that increase in the concentration of metal reduced the duration to kill 50 % of test organisms. The toxicity ranking for the three heavy metals was Cd>Pb>Zn. Behavioural changes were also observed in the test organisms exposed to metals.

Studies on the concentration of heavy metals in the polluted environment indicating the potential heavy metal concentration in different strata of aquatic ecosystem have been reported earlier (Badsha and Goldspink, 1982; Jaffar and Ashraf, 1988; Ashraf *et al.*, 1991). Besides, many laboratory bioassays have been conducted to assess the toxicity of heavy metals on different test organisms (Crandall and Goodnight, 1963; Pickering and Gast, 1972; Ronald and Gardener, 1973; Singh and Singh, 1982). In the present study, the effect of median lethal concentrations of three selected heavy metals (Zn, Pb and Cd) on the catfish *Mystus vittatus* have been investigated.

Stock solutions: AR grade $ZnCl_2$, $PbCl_2$, $CdCl_2$, in distilled water constituted the stock solutions for all studies. Aliquots from each stock were premixed in distilled water to bring it to desired concentration prior to addition and subsequent dilution by test medium.

Test fish: The test fish (*Mystus vittatus*) were collected from relatively clean Mehadrigedda reservoir during the forenoon of early summer months (March-April). Their size ranged between 10 and 15 cm in length and all were in mature condition. They were acclimatised for one week at room temperature in the laboratory. These fishes were fed with commercial fish feed during acclimatisation period. To avoid any possible effect of faecal matter, the water in acclimatisation tanks was replenished every alternate day. There were no deaths during acclimatisation or afterwards in the untreated groups.

Bioassy procedures: Static bioassay method with renewable water medium was adopted. A set of range finding experiments were conducted to find out

the tolerance level of these animals to the tested heavy metal and to decide the porbable range of concentration. All exposures were conducted at room temperature of 25 ± 2°C in glass troughs of 10 l capacity. The test medium was tap water with pH 7.2 ± 0.2 and dissolved oxygen 6±2 ml / l. The dissolved oxygen content was maintained at 90 % saturation by using aerators. Ten starved animal for each concentration with duplicates were taken for the bioassay, running the control specimens simultaneously. Mortality was recorded every 6 hrs and dead animals were removed. Death was ascertained by lack of opercular activity and loss of any movements when touched by a glass rod.

The exposure tests were conducted for 24, 48, 72 and 96 hrs for three different heavy metals. The median lethal concentration for each metal for each exposure time was calculated by the method of probit analysis (Finney, 1971) and expressed in ppm.

The median lethal concentrations and mortality rates for *M. vittatus* after 24, 48, 72 and 96 hrs of exposures to different concentrations of $ZnCl_2$, $PbCl_2$, $CdCl_2$ are presented in Table 1. From the Table it may be found that an increase in the heavy metal concentration decreased the exposure time required to bring about 50 % mortality of fish. Thus in the case of zinc the median lethal concentration was high at 24 hr exposure (162.61) and low at 96 hr exposure (131.5). Similarly in the case of Pb and Cd it was higher at 24 hr exposure (49.64; 24.06 respectively) and low at 96 hr exposure (43.21; 17.94 respectively).

Among the three metals Zn, Pb and Cd tested for the toxicity it was found that cadmium was more toxic than lead and zinc (Fig. 1). A curve with a steeper slope indicates higher toxicity than a curve with shallow slope.

From these metal exposure tests consistent trends were observed showing a rise in mortality rate with increasing concentration revealing that bioconcentrations of heavy metal increase with additions of metal concentrations (Eaton, 1974). The 96 hrs LC for zinc was 131.5 ppm whereas for 24 hrs, it was 162.61 ppm. Hence these bioassay tests of 96, 72, 48 and 24 hrs show an inverse relationship between median lethal concentration and exposure time as it is observed that increase in the concentration of metal reduces the duration to kill 50 % of the test organisms (Table 1).

While comparing the median lethal concentrations of zinc, lead and cadmium, it was found that high doses of zinc was required to kill 50 % of specimens indicating its low toxic nature. At the same time it was evident from the Cd bioassay that cadmium, at potentially low levels, was able to kill 50 % of specimens specifying its high toxic nature. The concentration of lead required to kill 50 % of the specimens ranged in between these two metal (Zn & Cd) levels. Cadmium is generally regarded as more toxic than zinc (Hale, 1977; Anderson *et al.*, 1980; Andros and Gorton, 1980). The overall trend of heavy metal toxicity was Cd>Pb>Zn. The same is evident from Fig. 1, where the toxicity curve of Cd is steeper compared to those of Pb and Zn.

During thses exposure tests the impact of toxins was observed in the form of changes in the behavioural pattern of the fish. The fishes were under stress condition for the entire

TABLE 1. *Results of Zn, Pb and Cd bioassay*

Period of Exposure	Zinc		Lead		Cadmium	
	LC_{50} (ppm) (95% confidence limit)	Regression equation	LC_{50} (ppm) (95 % confidence limit)	Regression equation	LC_{50} (ppm) (95 % confidence limit)	Regression equation
24 hrs	162.61	Y=-248.78+60.26X	49.64	Y=-208.11+57.67X	24.06	Y=-121.9069+37.5307X
48 hrs	154.8	Y=-268.83+69.65X	47.80	Y=-154.46+43.33X	21.96	Y=-98.9431+31.1067X
72 hrs	148.5	Y=-298.17+72.68X	45.50	Y=-174.05+48.94X	19.93	Y=-87.3480+27.9883X
96 hrs	131.5	Y=-135.56+34.12X	43.21	Y=-207.23+58.37X	17.94	Y=-77.7125+25.4196X

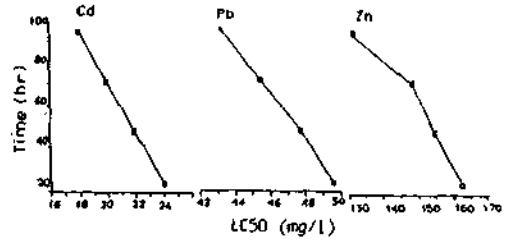

Fig. 1. Toxicity curve for cadmium, lead and zinc.

biossay period and showed erratic, unbalanced swimming movements and tended to surface more frequently than the fish in control medium . Similar observations were made earlier by Clearey, 1971; Eaton, 1974; Abbasi and Soni, 1984. Haemorrhagic spots near anal fin region were also observed in 96 hrs cadmium exposed fish.

Acknowledgements

The authors are thankful to the University for the facilities provided. The second author is grateful to the UGC for awarding a Junior Rsearch Fellowship.

References

Abbasi, S.A and R. Soni 1984. Toxicity of lower than permissible levels of chromium (VI) to freshwater teleost *Nuris denricus*. *Environ. Pollut., Ser. A*, **36**: 75-82.

Anderson, R.L., C.T. Walbridge and J.J. Fiandt 1980. Survival and growth of *Tanytarsus dissimilis* (Chironomidae) exposed to copper, cadmium, zinc and lead. *Arch. Environ. Contam. Toxicol.*, **9** : 329-335.

Andros, J.D. and B.R. Gorton 1980. Acute lethality of copper, cadmium and zinc to northern squa fish. *Trans. Ame. Fish. Soc.*, **109** : 235.

Ashraf, M. Jaleel Tariq and M. Jaffer 1991. Contents of trace metals in fish,

sediment and water from three fresh water reservoirs in the Indus river, Pakistan. *Fish. Res.*, **12** (4).

Badsha, K.S and C.R. Goldspink 1982. Preliminary observations on the heavy metal content of four species of fresh water fish in NW England. *J. Fish. Biol.*, **21** : 251-267.

Clearey, J.E., 1971. Toxicity and bioconcentration of cadmium, chromium and silver in *Micropterus salmoides* and *Lepomis macrochirus*.. *Ph.D. Thesis*, Univ., Oklahama, Oklahama City, OK, USA, 76pp.

Crandall, C.A. and C.J. Goodnight. 1963. The effects of sublethal concentrations of several toxicants to the common guppy, *Lebistes reticulatus. Trans. Ame. Microsc. Soc.*, **82** : 59-73.

Eaton, J.G. 1974. Chronic toxicity to the blue gill *Lepomid macrochirus* Rafinesque. *Trans. Ame. Fish. Soc.*, **103** : 729-735.

Finney, D.J. 1971. *Probit Analysis.* 3rd Edn. Cambridge University Press, London.

Hale, J.G. 1977. Toxicity of metal mining wastes, *Bull. Environ. Contam. Toxicol.*, **17** : 66.

Jaffar, M. and M. Ashraf 1988. Selected trace metal concentration in different tissues of fish from coastal waters of Pakistan (Arabian Sea). *Ind. J. Mar. Sci.*, **17** : 231-234.

Pickering, G.H. and M.H. Gast 1972. Acute and chronic toxicity of Cd to the fathead minnow, *Pimpephales promeles. J. Fish. Res. Bd. Canada*, **29** : 1099-1104.

Ronald Eisler and R. George Gardener 1973. Acute toxicants to an estuarine teleost of mixtures of cadmium, copper and zinc salts. *J. Fish. Biol.*, **5** : 143-145.

Singh, S.R. and B.R. Singh 1982. Effects of copper and zinc sulphate on the blood parameters of *Mystus vittatus. Matsya*, **8** : 1-6.