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SHORT COMMUNICATION

ACUTE TOXICITY OF CADMIUM AGAINST CATFISH, *HETEROPNEUSTES FOSSILIS* (SILURIFORMES: HETEROPNEUSTIDAE) IN STATIC RENEWAL BIOASSAYS

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ABSTRACT: Static renewal evaluation of the acute toxicity of Cadmium Chloride against the freshwater fish *Heteropneustes fossilis* was conducted in the laboratory. The 96h LC_{50} was in the low mg/l range (by international protocols). Probit-log analysis was used to determine the LC_{50} values at different exposure periods. The upper and lower confidence limits and slope functions were calculated. The LC_{50} values for Cadmium Chloride at 24, 48, 72 and 96 h are 620.34, 414.59, 384.88 and 360.50 mg/l, respectively. The upper confidence limits were 645.59, 433.27, 394.72 and 380.32 mg/l for 24, 48, 72 and 96 h and lower confidence limits were 595.33, 395.87, 374.34 and 337.55 mg/l, respectively.

Key words/phrases: Bioassay, Cadmium, Catfish, Heavy metal, Toxicity

INTRODUCTION

The pollution of aquatic ecosystems by heavy metals has received world-wide attention ever since the discovery of mercury as the cause of Minamata disease in Japan which caused neurological disorders and heavy mortality. As regards their harmful effects, the heavy metals are unique. There is an increasing awareness of heavy metal toxicity and scientists are working all over the world over in this field (Prato *et al*., 2006; Pratap and Wendelaar Bonga, 2007; Benaduce *et al.,* 2008; Oner *et al.*, 2008).

Heavy metals are discharged into water bodies through industries such as steel and mining, textile dyes, paints and varnishes, fertilizers, feed additives and ceramics. Cadmium is a highly toxic metal with the ability to easily form complexes with other metals and elements. It has an extremely long biological half-life and is widely used in industry for metal-coating, pigments and paints, batteries, in solder alloys, etc. Its absorption is enhanced by dietary deficiencies of calcium and iron. It is transported in the blood by red blood cells and large protein molecules. After reaching into an animal's physiological system, cadmium can accumulate in various tissues

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(Bervoets *et al.*, 2001; Pillai *et al.*, 2002) and cause serious damage to tissue and organs (Rangsayatorn *et al.* 2004; Wangsongsak *et al*., 2007).

Kasherwani *et al.* (2009) investigated cadmium toxicity to freshwater catfish, *Heteropneustes fossilis* in static bioassay tests. The purpose of the present investigation was to evaluate the acute toxicity of cadmium for the catfish, *H. fossils* in static renewal bioassay.

MATERIALS AND METHODS

Live specimens of adult *H. fossilis* (weight 41 ± 5 gm and length 18 ± 4 cm) were procured locally from water bodies (having no known pollution sources nearby). The fish were inspected for external signs of injury and diseases. Those which showed such symptoms were discarded and only the healthy ones were selected for experiments. These fish were acclimatized to the laboratory conditions (under natural photoperiod 11.58-12.38; temperature 27.2±1.4 C; pH 7.21 ± 0.06; dissolved oxygen 7.78 ± 0.30 mg/l; Hardness 167.32 ± 5.81 mg/l as $CaCO_3$) for 15 days in plastic pools. Each pool contained 500 L of dechlorinated tap water (keeping the water for at least 48 h before use). During acclimatization, the fish were fed daily with wheat flour pellets and ground dried shrimps, 2-3 times per day. Water was renewed daily after cleaning the fecal matter and leftover food. All care was taken to avoid giving stress to the fish. The fish were not fed 24 hour before and during the experimental period so that excretory substances may not influence the toxicity of test solutions. The mortality rate during acclimatization was less than 4%.

For the determination of LC_{50} values for cadmium, four-day static renewal acute toxicity test (APHA *et al*., 1985) was used. Six replicates each containing ten fish (kept in glass aquarium containing 30 l of the test solution) were subjected to each concentration of Cadmium Chloride (250, 300, 350, 400, 450, 500, 550, 600, 650, 700 and 750 mg/l) for the test (range finding). Cadmium Chloride (Thomas Baker Chemicals Ltd., India) was first dissolved in distilled water (stock solution) and then the desired volume of the solution was mixed in dechlorinated tap water to obtain the above mentioned toxicant concentration. A control group with six replicate (each containing 10 fish) kept in 30 l dechlorinated tap water was also run. The solutions of all the aquaria (control and experimental) were renewed daily. Precautions were taken to remove the dead fish. Death in fish was confirmed when the movement of the operculum stopped and the fish failed to respond when gently prodded at the caudal peduncle. Assays were terminated and results discarded if control mortality exceeds 10% at any time.

At 24h exposure periods, the mortality of the fish was subjected to Probit analysis with the POLO-PC software (LeOra Software) to calculate the LC_{50} and 95% confidence interval.

RESULTS AND DISCUSSION

The percent mortality of *H. fossilis* after exposure to various concentrations of Cadmium Chloride for 24, 48, 72 and 96 h is shown in Figs. 1, 2, 3 and 4. The LC_{50} values (Table 1) for Cadmium Chloride at 24, 48, 72 and 96 h are 620.34, 414.59, 384.88 and 360.50 mg/l, respectively. Table 1 also depicts the upper and lower confidence limits for *H. fossilis.*

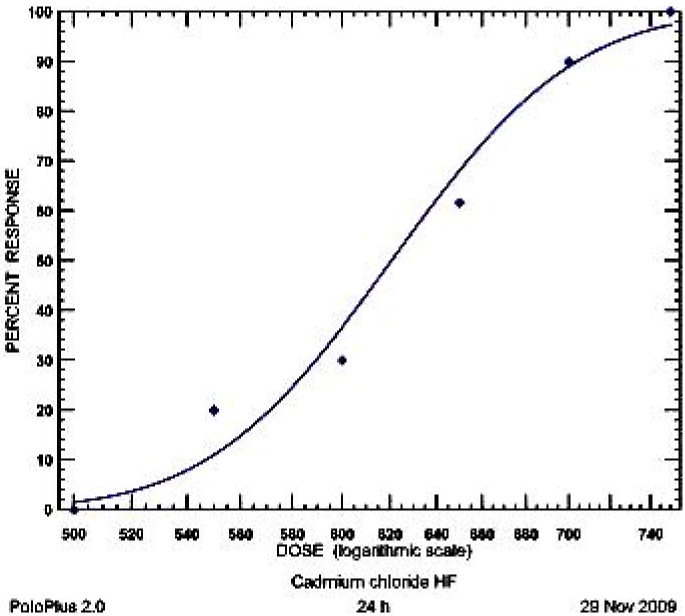

Fig. 1 Percent mortality of the fish *Heteropneustes fossilis* after 24 h exposure to different concentrations of Cadmium Chloride.

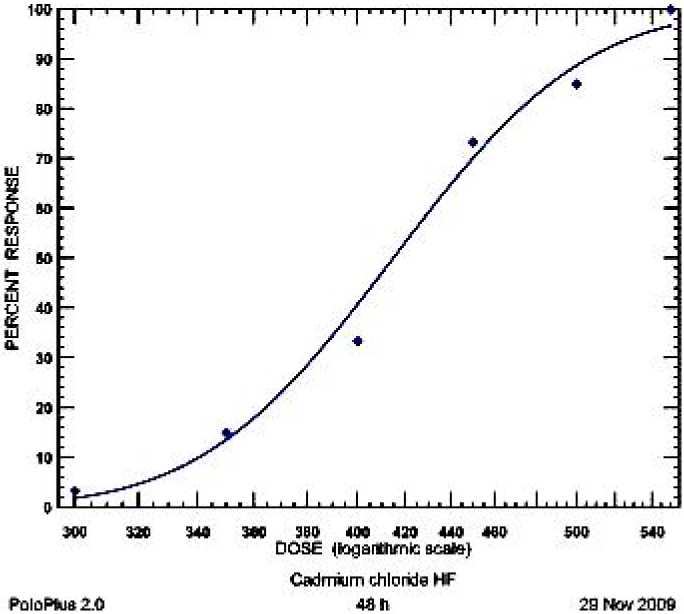

Fig. 2 Percent mortality of the fish *Heteropneustes fossilis* after 48 h exposure to different concentrations of Cadmium Chloride.

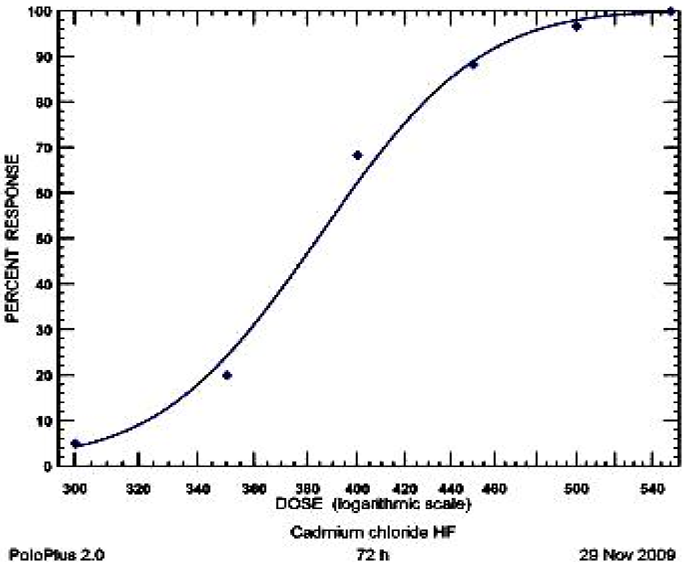

Fig. 3 Percent mortality of the fish *Heteropneustes fossilis* after 72 h exposure to different concentrations of Cadmium Chloride.

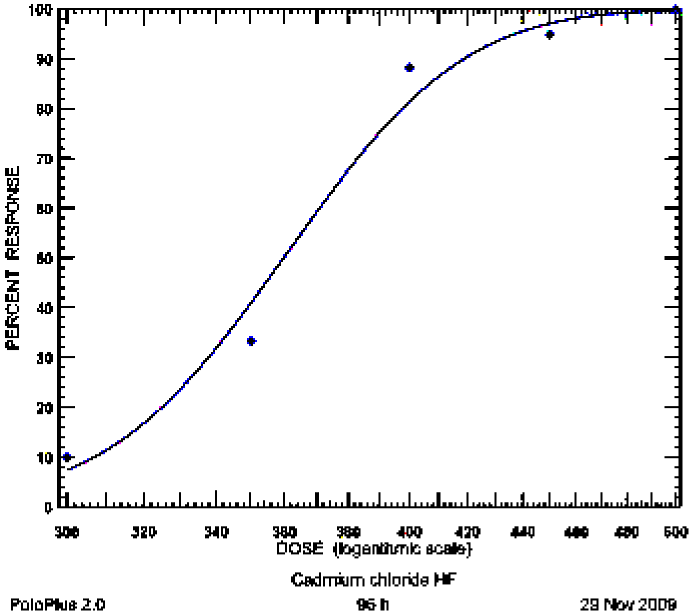

Fig. 4 Percent mortality of the fish *Heteropneustes fossilis* after 96 h exposure to different concentrations of Cadmium Chloride.

Table 1 LC_{50} values and upper and lower confidence limits for 24, 48, 72 and 96 h after exposure of the fish, *H. fossilis* to various concentrations of Cadmium Chloride.

Paramters	24 h	48 h	72 h	96 h
LC_{50} (mg/l)	620.34	414.59	384.88	360.50
Upper confidence limit*	645.59	433.27	394.72	380.32
Lower confidence limit*	595.33	395.87	374.34	337.55

*Upper and lower confidence limits for LC_{50} values calculated at 0.05 level.

In the present study the LC_{50} values of cadmium for *H. fossilis* are 620.34, 414.59, 384.88 and 360.50 mg/l for 24, 48, 72 and 96 h, respectively. LC_{50} value of cadmium for the goldfish *Carassius auratus* has been reported as 46.8 mg/l (McCarty *et al.*, 1978). The 96 h TLm of Cd toxicity for *Pimephales promelas* was recorded to be 0.63 and 73.5 mg/l in soft water and hard water, respectively (Pickering and Henderson, 1966). For *Fundulus heteroclitus* 96 h TLm has been reported to be 50 mg/l at a salinity 24% and temperature 21 ± 1^0C (Eisler, 1971). Exposure of *Notemigonus crysoleucas* to cadmium resulted in a 96 h-LC_{50} value of 3.15 mg Cd/l (Benson *et al.*, 1987). Wide variation was found in individual sensitivity to the toxicity of cadmium applied at concentration of 5-35 mg/l with 96 h exposure time and LC_{50} of 21.07 mg/l (Sovenyi and Szakolezai, 1993). Akram *et al.* (1999) have reported 96 h LC_{50} value for cadmium for cyprinid fish *Barilius vagra* as 6.72 ppm. The 96 h LC_{50} value of cadmium for the fish *Labeo rohita* has been reported as 89.5 mg/l (Dutta and Kaviraj, 2001). It must, however, be pointed out that toxicities of a particular toxicant to different fish species are difficult to compare (Schimmel *et al.*, 1976) because they are influenced by factors such as temperature, pH, hardness and dissolved oxygen content of the test water (Schoettger, 1970). Comparing the 96 h LC_{50} value reported for other fishes, this study indicates that *H. fossilis* is more resistant to cadmium and may be considered as a least sensitive fish.

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