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Research Article

DETERMINATION OF LC50 OF CADMIUM CHLORIDE IN MARINE CATFISH ARIUS ARIUS

R. MANI[1], B. MEENA[2]* AND K. VALIVITTAN[1]

[1]Department of Biotechnology, St.Peter's University, Chennai 600054, India, [2]Department of Zoology, Presidency College, Chennai 600005, India. Email: stptrsbiotech@yahoo.com

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ABSTRACT

Cadmium (Cd) is serious pollutants in the aquatic environment. The present study was to determine the toxicity (LC50) of cadmium chloride in a marine Catfish *Arius arius.* Experimental fishes were collected from Chennai along the Coromandel Coast of Tamil Nadu, India. The fish's average weights were measured (45g ± 5 g). The fishes were acclimatized in a water tank. Eight groups of experimental fish (containing 10 fishes in each group) were exposed to different concentrations of cadmium chloride i.e. 0, 30, 40, 50, 60, 70, 80 and 90 mg/L respectively and for a period of 96 hrs. The test water Cd concentrations were analyzed before treatments using an Atomic Absorption Spectrophotometer. The physic-chemical parameter were analyzed in these test water like dissolved oxygen, pH, temperature, total hardness and alkalinity. As well as mortality rate of the fishes, were monitored daily. The 96 hrs LC50 value of cadmium cloride for *A.arius* was found to be 56.4 mg/L.

Keywords: LC50; *Arius arius*; Cadmium Chloride; Toxicity

INTRODUCTION

Heavy metal toxicity in water is the emerging global concern in developed as well as developing countries. A variety of contaminants including toxic heavy metals such as Cadmium, Copper, Mercury, Arsenic and Zinc are reported to be ubiquitously present in the waste water which are generally released into aquatic ecosystems and are toxic for aquatic organisms [1, 2]. The aquatic environment is contaminated with many types of organic and inorganic pollutants [3], of agricultural and mining industrial origin, industrial, municipal waste [4].

Such pollutants affect the integrity of the ecosystems and physiological functions of animals [3], as well as the human, as consumers [5]. The Cd is ubiquitous heavy metal present in aquatic environments due to natural and anthropogenic sources and is usually present in trace amounts. Fishes have been used as aquatic contamination indicators for many years [6]. Cd accumulates in drinking water and air then eventually accumulates in the body, causing a number of diseases such as hypertension, osteomalacia, gastric dysfunction, central nervous system dysfunction and endocrine disorders in human [6,7].

Toxicity testing has been widely used as a tool to identify suitable organisms as a bio-indicator and to derive water quality standards for chemicals. It is also considered as an essential tool for assessing the effects and fate of toxicants in aquatic ecosystems [8]. Because toxicity studies quantify an organism's response to a biologically active material [9], it is useful in determining the quality of water and is, therefore crucial to restore and resolve metal pollution through environmental monitoring. Fish absorb dissolved or available metals and can, therefore serve as a reliable indication of metal pollution in an aquatic ecosystem [10]. The aim of present study was to determine the toxicity (LC50) of Cd in marine catfish *Arius arius.*

MATERIAL AND METHODS

The experimental (*A. arius*) fishes were collected from Chennai along the Coromandel Coast in the Bay of Bengal, Tamil Nadu, India. The geographical indications were found using GPS (13^{o}00.997: N, 080^{o}16.687 : E). The average length of fishes was measured 16cm ± 4cm and about weight 45g ± 5g. The fishes were acclimatized in the laboratory in a stone tank (100L) at room temperature (30^{0}C ± 2^{0}C) for 7 days. The cadmium chloride (Merck, India) solution was prepared with distilled water for acute toxicity studies. The Cd concentrations were analyzed before treatments using an Atomic Absorption Spectrophotometer (Perkin Elmer Optima-5300 DV). Eight groups of experimental fish were exposed to different concentrations of cadmium chloride i.e. 0, 30, 40, 50, 60, 70, 80 and 90 mg/L respectively and for a period of 24, 48, 72 and 96 hrs. 10 fishes were used per concentration and the experiment was conducted in triplicates, and control group was maintained simultaneously. The control group was kept in experimental water without adding the $CdCl_2$, keeping all other conditions same. All experiments were carried out at equal duration for 96 hrs. Aeration was provided in each tank during acclimatization and experimental exposure. The fishes were fed daily, 1% body weight, with commercial fish pellets. During the experiment, the water in the tank was changed every 24 hr to maintain the appropriate concentration of Cd in the test solutions. Mortality was recorded at 24, 48, 72, and 96 hrs of exposure. The dead fish were removed from the tank as and when noticed.

RESULTS AND DISCUSSIONS

The physic-chemical parameters were analyzed of the test marine water, and the experimentation was monitored and is given in Table 1. These parameters were fairly constant throughout the study.

The experiments were as follow (Table.1): Ambient temperature ranged from 30 to 32 °C, Water temperature ranged from 26 to 28 °C, pH ranged from 7.44 to 7.48, Total hardness ranged from 6594 to 6611 mg/L as $CaCO_3$, Total alkalinity ranged from 150 to 154 as $CaCO_3$. Toxic heavy metals such as Chromium, Cadmium, Copper and Zinc were found to be below deductable limits. The water hardness can have a major influence on toxicity to organisms.

LC50 VALUE

Table.2 the fishes were exposed to different concentrations of cadmium chloride such as 0, 30, 40, 50, 60, 70, 80 and 90 mg/L for a period of 96 hrs. Mortality rate was totally dose and time dependent.

The results indicated different mortality rate of fishes which ranged from 0 to 100 %. When mortality was increased with a corresponding increase of the concentration of Cd. Figure 1. The marine Catfish *A.arius* 50% mortality was showed for Cd at 56.4 mg/L for 96h. Control mortality was zero.

The lethal effects of cadmium chloride on marine Catfish *A. arius* were concentration and duration dependent as mortality increased with increase in its concentration. Mortality in control group was virtually absent and found to be suitable for LC50. In addition, it is an important step to detect the levels of toxicants to be used in the experimental studies of the accumulation and effect of these toxicants to the marine organisms. There are many studies concern with the toxicity of Cd on vertebrates and invertebrates [11, 12]. The early reports also supported to the Cd values of 96 hrs LC50 for *Scorpaena guttata* with 25 mg/L of $CdCl_2$ [13], 43 mg/L of $CdCl_2$ for *Uca rapax* [14], 30.06 mg/L of $CdCl_2$ for *Poecilia reticulate* [15], 5.36

mg/L of $CdCl_2$ for *Mugil seheli* [16], 50.41 mg/L of $CdCl_2$ for *Heteropneustes fossilis* [17], 96.57 mg/L of $CdCl_2$ for *Oreochromis mossambicus* [18], 64.89 mg/L of $CdCl_2$ for *Pangasius hypophthalmus* and 84.8 mg/L of $CdCl_2$ for *Cyprinus carpio* [19].

Table 1: Physico-chemical parameters of Marine water in Coromandel Coast of Tamil Nadu.

Parameters	Units	Range	(Mean ±S.D)
Ambient temperature	^0C	30 - 32	31 ± 0.70
Water temperature	^0C	26 - 28	27 ± 0.83
pH	-	7.44 – 7.48	7.46 ± 0.016
Total hardness	mg/L as $CaCO_3$	6594 - 6611	6603 ± 6.68
Total alkalinity	mg/L as $CaCO_3$	150 - 154	152 ± 0.75
Calcium	mg/L as Ca	624 - 658	644.2 ± 13.06
Iron (as Fe)	mg/L	0.13 – 0.15	0.14 ± 0.007
Chromium	mg/L	BDL	BDL
Zinc (as Zn)	mg/L	BDL	BDL
Cadmium (as Cd)	mg/L	BDL	BDL
Lead (as Pb)	mg/L	BDL	BDL

BDL (Below Deductable Limit) of Cr = 0.007 mg/L, Zn = 0.005 mg/L, Cd = 0.002 mg/L, Pb = 0.042 mg/L

Table 2: Showing correlation between the cadmium chloride ($CdCl_2$) concentration and the mortality rate of *Arius arius*

Concentration of cadmium (mg/L)	Number of exposed fishes	Number of dead fishes	Mortality (%)
0 (Control)	10	0	0
30	10	1	10
40	10	3	30
50	10	4	40
60	10	6	60
70	10	7	70
80	10	8	80
90	10	9	90

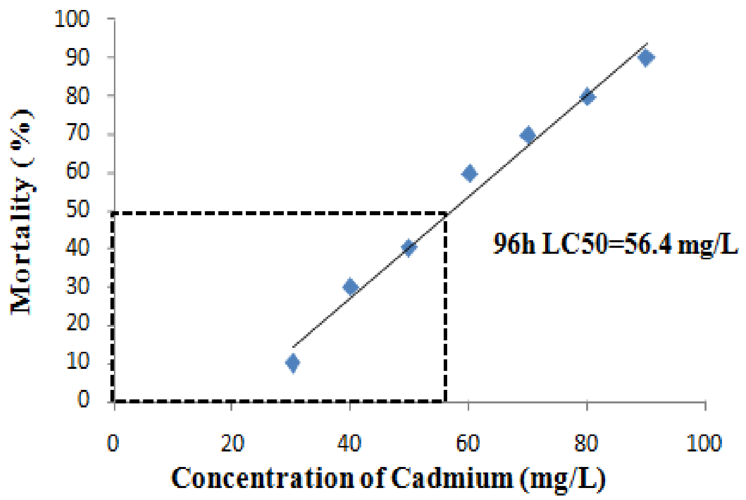

Fig. 1: Depicts the percentage of mortality for different exposure periods at different concentrations of Cd. LC50 value of Cd for the marine Catfish *A. arius* was determined by the simple graphical method.

The effect of the metals on the fish also depends on the size of the animal, hardness of test water, temperature and type of the animals that are exposed. Acute toxicity tests are useful for rapid estimation of the concentration of the toxicants that cause direct irreversible harm to the test organism [20]. The Cd heavy metal is found to be more toxic to the fish and other animal. The Canadian Environmental Protect Act, 1994 has reported the toxicity of Cd in fishes vary from species to species [17]. The toxic effects may include both lethal and sublethal concentration which may change the growth rate, development, reproduction, histopathology, biochemistry, physiology and behavior [21]. Most of the total Cd in continental runoff is either retained in estuaries or deposited in deep-water ocean sediments.

CONCLUSION

Acute effects of Cd have been widely described for different aquatic organisms and exposure routes. The levels of toxicants to be used in the experimental studies of the accumulation and effect of these toxicants to the marine organisms. The results of our studies may provide the LC50 of $CdCl_2$ to *Arius arius*, and can be relied upon for further toxicological studies and will help to fix the quality criteria of effluents from industries which are discharged into the environment.

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