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Toxicity evaluation of cadmium chloride in fresh water fish *Ophiocephalus striatus*

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Abstract
Heavy metals are very adverse effect on aquatic community particularly fresh water fishes whose habitat is very limited area. The current rate of use of heavy metals greatly increased by the humans for various purposes. Industrial wastes are the main cause of pollution in fresh water bodies. Heavy metals like cadmium present in industrial waste create serious water pollution problem.

Keywords: lethal concentration, fishes, median lethal, glass aquaria, control, experimental

Introduction

The aquatic environment is an extremely diverse and highly variable system, crucial for the continued survival of life on planet earth. The physical and chemical properties for natural waters differ inherently between areas. This is mainly due to differences in the area's climate, geomorphology, geology, and type of soil (Davis *et al*. 1998). Most importantly the mining of metals produced contaminated drainage water, resulting in increased heavy metal concentrations in flowing and standing waters (Llyod 1992) [12]. Metal concentration in aquatic organisms appear to be of several magnitudes higher than concentration present in the ecosystem (Laws 2000) [11]. This is attributed to bioaccumulation where by metal ions are taken up from the environment by the organism and accumulated in various organs and tissues. Metals also become increasingly concentrated at higher trophic levels, possibly due to food chain magnification (Martin and Kanuer 1973) [19] one such metal is cadmium which has been shown to accumulate in the various tissues of fish at higher concentration than appears in the environment.

Cadmium as toxicants

Cadmium is a non-essential element, with no known biological function (Viarengo, 1985; Allen, 1994; Martinez *et al.*, 1999) [13], naturally found at low concentrations in natural waters (Eaton, 1974; Allen, 1994; Bennet-Chambers *et al.*, 1999) [4, 22, 10]. It can have severe toxic effects on aquatic organisms when present in excessive amounts (Hollis *et al.*, 1999), or even if present in extremely low concentrations (Witeska *et al.*, 1995). Cadmium Pollution sources are diverse, but it is commonly accepted that electroplating plants are mainly responsible (Cuthbert *et al.*, 1976) [24]. The metal is widely distributed in natural waters due to industrial discharge (Pratrap and Wendelaar Bonga, 1993), but it also occurs naturally in the earth's crust and is released with the natural weathering of rocks (DWAF, 1996) [3]. Cadmium is used primarily in nickel cadmium batteries in coating and plating operation in plastic, synthetic products and alloys industries. Cadmium is widely distributed as a mineral deposit and is found in shale and igneous (volcanic) rocks, coal, sandstones, limestones lake, marine sediments soils etc. Localised and naturally high cadmium concentration can be found in zinc ores where it forms isomorphic imurities in zic sulphide. A few rare cadmium minerals are known such as greenokite (Cds), cadminoseite (Cdss) (John 1998) [9]. Cadmium is naturally released to the environment from volcanic sources (some of 60% of total natural emission) and along with rain water it reaches up to the water bodies. (Boyland 1998) [2]. Small amount of cadmium minerals are also associated with lead minerals. Cadmium occurs in earth crust along with zinc, lead-zinc compounds, lead zinc-copper ores. It is usually found as cadmium sulphide.

The average concentration in earth curst is about 0.2 ppm cadmium compounds such as cadmium oxides, carbonates, sulphide and hydroxide are insoluble in water but cadmium flurides, bromide, chlorides, iodide, nitrate, and sulphate are particularly water soluble. Cadmium is used for electroplanting of metals (Butterworth 1995).

Martial and Methods

Live and healthy *Ophiocephalus (Channa) striatus* fishes were collected from their breeding places. Fishes were checked for injury and diseases and them washed in 1% $KMno_4$ solution for 5 Min. Acclimatize that is fishes were swim freely and feeding well of two weeks in glass aquaria whose capacity was 300 liter water. After two week acclimatization 60 adult, healthy, disease free fishes were selected for the experiment. The average length and weight of fishes was 20-25 ± cm and 100 ± gm respectively. Each 10 groups of fishes were kept in six different glass aquaria whose capacity is 300 liter filled with 40 liter Water to each aquaria. One aquarium is used as a control and other five is used as an experimental. Fishes were dose not feed during experimental period. Before conducting experiment physico-chemical analysis of water was to be done by standard methods published in A.P.H.A. (1992) which is given below:

PH	= 7.97
Temperature	= 30.1^0 C
Total dissolve solid	= 250 mg/ lit
Dissolved oxygen	= 6.4 mg/ lit
Hardness	= 75 mg/ lit
CO_2	= 1.02 mg/ lit
Alkalinity	= 165 mg/ lit
Chlorides	= 45 mg/ lit

Commercial grade CdCl2 used for calculating median lethal (LC50) value at 96 hrs. 0.4, 0.5, 0.6, 0.7, 0.8 mg/ lit. CdCl2 is dissolved in five different experimental glass aquaria.During experimental period there is no mortality was observe in control groups of fishes. In experimental groups of fishes each 24 hrs. mortality record is tabulated. (Table**:** 1) The experimental and control experiment were replicates five times. Determine the LC50 at 96 hrs through static bioassay (acute toxicity) by simple graphical method % mortality vs. conc. of toxicant and probit value vs. conc. of toxicant with 95% confidence limit

Table 1: Toxicity evaluation of cadmium chloride.

Conc. of CdCl mg/lit	No. of fishes exposed	Total mortality in fishes				% mortality at 96 hrs	Probit value at 96 hrs
		24 hrs	48 hrs	72 hrs	96 hrs		
Control	10	0	0	0	0	0	0
0.4	10	0	0	1	2	20	4.16
0.5	10	0	1	2	2	20	4.16
0.6	10	1	2	4	5	50	5.00
0.7	10	6	6	7	7	70	5.52
0.8	10	7	8	9	9	90	6.28

(Probit value calculated according to Finny 1971).

Result

LC50 value of *Ophiocephalus (channa) striatus* exposed to cadmium chloride and the mortality of medium sized (±30cm) groups increased progressively up to 96 hrs with respect to concentration and exposure periods. In 0.4 mg/ lit. Concentration of cadmium chloride up to 48 hrs. Mortality was not observed. The LC50 value calculated with the help of static bioassay (non-renewable) method. (Table:-1) Calculated LC50 value at 96 hrs according to % mortality vs. concentration of toxicant (cadmium chloride) is 0.58 mg/lit. Whereas calculated LC50 value at 96 hrs according to probit value vs. concentration of toxicant (cadmium chloride) is 0.63 mg/lit with 95% confidence limit.

Discussion

Syed lal shah (2005) [17] reported toxicity evaluation of mercury, cadmium and lead in Tench *Tinca tinca* at 96 hrs. He also mentioned the LC50 value at 96 hrs. 1.0 ppm of mercury 6.5 cadmium and 6.92 ppm lead. He also stated that the fish with a lower body concentration of a heavy metal has a lower 96 hrs LC50 value of the respective metal and vice versa. He also concluded the concentration of heavy metals in fish is related to several factors such as the feeding habits, foraging behavior of the organism, trophic status, and source of a particular metal, distance of the organism from the contamination source and biomagnifications of a particular metal. He also stated that temperature plays an important role in the value of LC50, increases the temperature of water decreases the LC50 value. In present work increases the room temperature or water temperature decreases the LC50 value. Dissolved oxygen is decreases with increases water temperature. So that temperature plays a vital role in LC50 determination. Jadhav (2003) [7] reported LC50 value at 96 hrs 0.60 ppm of mercuric nitrate in case of male crab *Baryltalphusa guerini.* He also concluded the LC50 value decreases with increases temperature and exposure period. Sobha *et al.*, (2007) [15] reported LC50 value 4.53 mg/lit according to % mortality vs. concentration of toxicant (cadmium chloride) at 96 hrs in case of fresh water fish *Catla catla* through renewable bioassay. They are also stated that LC50 value depends on the size of animal, salinity of water, temperature of water, type of animal, behavior and feeding habit of the animal. Mehmet *et al.*, (2004) [25] reported value of 96 hrs LC50 for *Poecili reticulata* which is 3.04 mg/lit in a static bioassay (renewable) test system. They also mentioned the water hardness and temperature increases decreases LC50 value in case of cadmium chloride toxicity. Vinod *et al.* (2005) [18] mentioned 24 hrs LC50 value 0.0046 ppm of mercury, 0.0325 ppm copper, 0.15 ppm cadmium and 0.69 ppm zinc through static bioassay (non-renewable) in the naupilus larvae of banna shrimp *Penaeus merguiensis.* Suryavanshi and Langekar (2006) [16] stated that observed LC50 at 96 hrs is 9.5 ppm of zinc, and 4.0 ppm of cadmium through renewable static bioassay in case of esturine rock oyester *Crassostrea cattuckensis* in post winter (February) season.

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