ACUTE TOXICITY STUDIES OF CADMIUM CHLORIDE ON BLOOD CLAM *Anadara rhombea*

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***Abstract*:** Heavy metals can accumulate in the tissues of aquatic organisms and cause a range of hazardous effects to all organisms through bio-magnifications. The aim of this study was to investigate the acute toxicity effects of Cadmium chloride on the clam *Anadara rhombea.* Clam samples were exposed to different concentrations (10, 40, 60, 80 and 100mg/L) of Cadmium chloride for 96h and their cumulative mortality was calculated in 12 hours intervals. Results were analyzed by SPSS 20 to obtain number of cumulative mortality and lethal concentrations. LC_{50} of *Anadara rhombea* at 96hr was 27.478mg/L for Cadmium chloride. Mortality rate was increased with the increase in metal concentrations and time.

Keywords: *Anadara rhombea*, LC_{50}, Cadmium Chloride, Acute toxicity, Heavy metal pollution.

I. INTRODUCTION

Metals are substances with high electrical conductivity, malleability and luster that voluntarily lose their electrons to form cations. They found naturally in the earth's crust and their compositions vary among different localities, resulting in spatial variations of metal concentrations. Metal distribution in atmosphere is determined by the properties of the given metal and by various environmental factors (Khlifi and Hamza-Chaffai, 2010). Heavy metals enter the surroundings by natural means and through human activities. The contamination of natural aquatic resources with heavy metals released from industrial, domestic and other anthropogenic activities has become a matter of concern over the past few decades (Waqar *et al.,* 2013). Harmful effects of these heavy metals on aquatic organisms can be detected by performing toxicity tests that allow establishing a dose-response relationship (Akter *et al.,* 2008; Javed, 2013) which help us in predicting acute and chronic effects on aquatic fauna as well as in regulating toxic chemical discharges into the water bodies (APHA, 2005). This work was aimed to find out the acute toxicity of Cadmium chloride on the clam *Anadara rhombea.*

II. MATERIALS AND METHODS

Collection and acclimation of experimental Clam

Anadara rhombea clam collected from Kuduvaiyar estuary is situated in the South east coast, near Nagapattinam, Tamil Nadu, India (Station : Lat 10° 45' N, Long 79o 96' E. The Kuduvaiyar river is a tributary of the major river, 'Cauvery' of South India. The Clams were acclimatized under laboratory conditions for 7 days prior to start of this experiment. Glass aquaria of 10 liter marine water capacity were used in this experiment. Fresh air was supplied to each aquaria through air pump fitted with capillary system.

LC_{50} determination

After acclimation healthy clam of *Anadara rhombea* were chosen for the LC_{50} determination of Cadmium by static renewable bioassay. Clams were not fed during the experimental period. Various concentrations (10, 40, 60, 80 and 100mg/L) of the test solutions were prepared from $HgCl_2$ stock solutions. A group of 10 laboratory acclimatized clam of a particular species having the same weight, size and age were introduced into each test concentration of $HgCl_2$. Triplicates and appropriate controls were maintained for each concentration. LC_{50}

values were calculated as per Speeman-Kerbers methods (1831). Toxicity tests were conducted in accordance with the method recommended by Sprague (1973). Median lethal concentrations of 96 hrs were calculated by Finney's (1974) probit analysis using SPSS Ver.20 Log_{10} Base calculation.

III. RESULTS AND DISCUSSION

To determine the LC_{50} value graphs were plotted between % mortality and log concentrations of toxicant. The concentrations obtained by drawing a perpendicular line against 50% mortality and calculated their antilog value. In the present investigation, LC_{50} of *Anadara rhombea* at 96h was 27.478mg/L for Cadmium chloride. Results of present studies (Table 1-2), clearly indicated that the rate of mortality for any fixed time increased with increase in concentration and for a particular concentration with increase in exposure time and a regular mode of toxicant due to accumulation up to dangerous level leading to death. Table-1 and 2 show the relation between the Cadmium chloride concentration and the mortality rate of *Anadara rhombea*. The results obtained for 96 hour toxicity experiments of Cadmium chloride clams were estimated by Finney's probit analysis method.

The observed percentage of mortality of *Anadara rhombea* for Cadmium chloride for different hours and different concentrations were given in table 1 and 2. Figure 1 showed the probit line graph of the Cadmium chloride toxicity data and probit kill vs log concentrations. The 96-hr LC_{50} study observed that *Anadara rhombea* was significantly more susceptible to Hg toxicity.

Table.1: Toxicity of Cadmium on estuarine blood clam *Anadara rhombea*

Concentration (mg/L)	Log Con. (mg/L)	# of exposed clam	24 hours			48 hours		
			# of mortality	% of mortality	Probit	# of mortality	% of mortality	Probit
20	1.30	10	0	0	0	2	20	4.16
40	1.60	10	1	10	3.72	3	30	4.48
60	1.77	10	3	30	4.48	5	50	5.00
80	1.90	10	5	50	5.00	7	70	5.52
100	2.00	10	7	70	5.52	9	90	6.28
Control	0	10	Nil	Nil	Nil	Nil	Nil	Nil

Table.2: Toxicity of Cadmium on estuarine blood clam *Anadara rhombea*

Concentration (mg/L)	Log Con. (mg/L)	# of exposed clam	72 hours			96 hours		
			# of mortality	% of mortality	Probit	# of mortality	% of mortality	Probit
20	1.30	10	3	30	4.48	4	40	4.75
40	1.60	10	5	50	5.00	6	60	5.25
60	1.77	10	7	70	5.52	8	80	5.84
80	1.90	10	9	90	6.28	10	100	8.09
100	2.00	10	10	100	8.09	10	100	8.09
Control	0	10	Nil	Nil	Nil	Nil	Nil	Nil

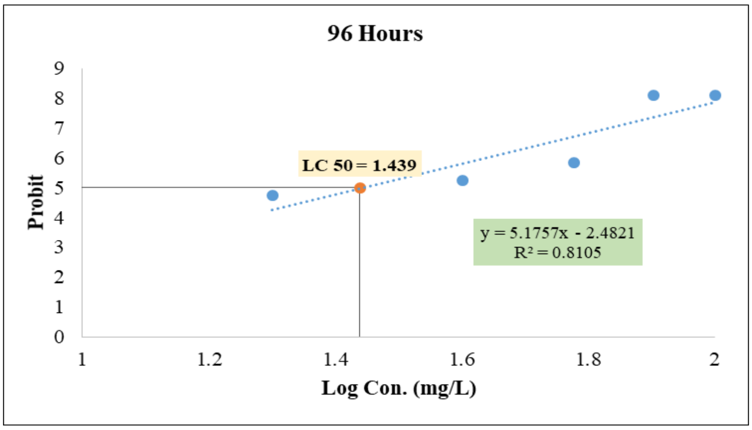

Fig.1: LC_{50} values of Cadmium on estuarine blood clam *Anadara rhombea* (96 Hours)

Table.3: LC_{50} values of Cadmium on estuarine blood clam *Anadara rhombea*

Hours	Lethal Concentration (mg/L)			Regression equation	r^2 value
	LC_{50}	LCM	UCM		
24	78.078	62.630	112.908	y = 7.6846x - 9.4494	0.9327
48	50.278	33.136	71.810	y = 2.8495x + 0.1958	0.8693
72	34.079	20.059	45.626	y = 4.4678x - 1.7967	0.7691
96	27.478	14.312	37.245	y = 5.1757x - 2.4821	0.8105

Data ware analysed by using SPSS ver. 20, regression equation and r^2 value was calculated by log con. (mg/L) vs probit value.
LC: Lethal Concentration, LCM: Lower Confidence Limits, UCM: Upper Confidence Limits, r^2 : R squared

Acute toxicity caused by various toxicants on marine animals can be evaluated by quantitative parameters like survival or mortality of test animals and sensitivity of different clam species to toxicants. Toxicity in clam is the culmination of a series of events involving various physical, chemical and biological processes. Toxicity studies measure a response of an organism to biologically active substances (Spear, 1981) and are useful in determining water quality. The wide variation in sensitivity of different species to different heavy metals depends on various factors like age, sex, weight, physical stage of the animal and presence or absence of enzyme system that can detoxify the pollutants (Nagaratnamma and Ramamurti, 1981). The major cause of mortality might be due respiratory epithelium damage by oxygen accumulation during the formation of a mucus film over the gills of clam (Das and Sahu, 2005).

Cadmium and its compounds have not part take any role in biological functions. The presence of Cadmium in any form in living organisms cause cytochemical and histopathological effects. The organic Cadmium compounds and Cadmium vapour affects central nervous system. Whereas, Cadmium chloride damage liver, digestive tract and kidney (Vahter *et al.,* 2000; Ghosh and Sil, 2008). Clam may absorb Cadmium directly from contaminated water or indirectly from feeding on organisms living in the contaminated water (Javed, 2005; Martins *et al.,* 2004). Although several studies have been conducted to assess the toxicity of heavy metals to algae, the number of studies dealing with the toxic effect of heavy metal on aquatic animals is limited (Harmon *et al.,* 2005).

Modassir (2000) reports the effect of salinity on the toxicity of Cadmium in mangrove clam *Polymesoda erosa*. The toxic effect was found to be influenced by different salinities and mortality increased with an increase in salinity. The 96 hour LC_{50} were 0.58, 0.35 and 0.26 ppm Hg in 10, 20 and 30 ppt salinity, respectively at room temperature. The LC50 values also suggested high mortality with increasing Hg concentration. Accumulation of Hg in the tissue of the clam was greater in the gills than in any other parts. The amount of Hg in the tissues was dependent on the concentration in the medium and length of exposure. This behavior of Hg was related to affinity to certain body organs and changing rate of adsorption after methylation and chemical speciation..

Tzong-Shean and ChinHon (1993) investigated the toxic effects of Cadmium on the hard clam, *Meretrix lusoria*, in various salinities. The 96-hr LC50 values for juvenile hard clams, *Meretrix lusoria*, were 328, 392 and 194 μg/l Hg in 10, 20 and 30 ppt salinities at 25 ± 1°C, respectively; for adult hard clams 341 and 140 μg/l Hg in 20 and 30 ppt salinities, respectively. Acclimatizing the adult clams to low salinity of 10 ppt lessened the toxicity of Cadmium. However, juvenile animals appeared to be more sensitive to Cadmium poisoning after 96 hr exposure in 10 ppt salinity.

IV. CONCLUSION

The present study was an attempt to find the toxicity of Cadmium chloride on clam *Anadara rhombea.* In the acute toxicity test to these toxicants, *Anadara rhombea* exhibited relatively higher toxic response and can be suggested as a candidate species to monitor the toxicity of Cadmium. The toxicity study on clams will be very useful to provide a future understanding of ecological impact.

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