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EVALUTION OF ACUTE AND CHRONIC TOXICITY OF HEAVY METAL MERCURIC CHLORIDE TO A FRESHWATER GASTROPOD SNAILS, *BELLAMYA BENGALENSIS* (LAMARCK)

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ABSTRACT

Acute toxicity testing on freshwater Gastropod Snails, *Bellamya bengalensis* (Lamarck) to $HgCl_2$ was carried out. The Median Lethal Concentration (LC_{50}) of $HgCl_2$ for 24, 48 , 72 and 96 hrs were 3.934,2.390,1.380 and 1.099 ppm respectively.The Lethal concentration (LC_{10}) of $HgCl_2$ for 24,48,72 and 96 hours were 2.959,1.969,0.990 and 0.524ppm respectively. The safe concentration of $HgCl_2$ to fresh water gastropod snails, *B.bengalensis* was 0.2551ppm.Anylysis of results indicates that *B.bengalensis* is highly sensitive to $HgCl_2$.

***KEYWORDS*:** Mercuric Chloride, Acute and chronic Toxicity, Bellamya bengalensis.

INTRODUCTION

Metals are released from both natural sources and manmade activity. The impact of metals on the environment is an increasing problem worldwide. The impact of metals on aquatic ecosystems is still considered to be a major threat to organism's health due to their potential bioaccumulation and toxicity to many aquatic organisms. Metals are nonbiodegradable. Unlike some organic pesticides, metals cannot be broken down into less harmful components. Many compunds released with industrial wastes may be converted by microbial system in aquatic bottom to the highly toxic ones which are taken up by lower organisms living in contaminated wastes.

Generally metals are classfied into non-critcal, very toxic and toxic metals.The murcury, arsenic and lead are very toxic heavy metals. Arsenic is widely distributed in the environment including plant and animal tissues. It forms a variety of inorganic and organic complex compunds having different toxicity to aquatic organisms. Considerable research information has been published on the toxicity of heavy metals in aquatic animals from time to time. Heavy metal toxicity to molluscs has been worked out by Wurtz (1962), Bayden (1973), Brereton et. al. (1973), Several workers have agreed that the uptake of metals from food is the most important route in the environment. (Schulz Baldes, 1974, Cunningham and Tripp,1975). Eister (1977), Catsiki and Arnoux (1987), Krishnakumar *et.al*. (1990), Gupta *et.al*. (1981), Marigomez *et.al*. (1986), Khangarat and Ray (1988) showed the toxic effects of heavy metals on snails and they found considerable changes in their activities.

Elemental mercury it the only liquid metal at 25O^c a third member of the group of IIb triad of the periodic table of elements. Distribution of Hg depends on PH redox potential and nature of concentration of anions which form stable complexes. It can bind with inorganic ligands with chloride, organic ligands eg- amino acids, mercury also binds with suspended particulates. Mercury is discharged into the aquatic environment mainly in the form of elemental mercury Hg (2+), Concentration of dissolved Hg in unpolluted freshwater ranges from (0.02 to 0.1 ug /lit. and in polluted water upto 1000 mg/kg. Sediments the mercurial compunds are highly toxic to aquatic animals in comparison to othger heavy metals (Bryan, 1971). Acute toxicity of Hgcl2 to marine and freshwater invertebrates depends on species (Rehwoldt, et.al; 1973). The toxicity of Hg was studied in some species of fishes by few workers (Akiyama, 1970;Adams and Rowlands,1988; Wobeser, 1975; and Dhanekar, et.al; 1985) were reported in Jintsu and Kumano river of Toyama in Japan in 1970 (More and Ramamoorthy, 1984).

Toxicity is a biological response which, when quantified in terms of concentration of the toxicant can constitute the basis for bioassy procedure 1.2 toxicity tests. It is defined as estimation of the amount of biologically active substance by the level of their effect on test organisms. The view that factors like form of the metal, environmental characteristics, physiological status of the animal, acclimation and accctimatization to the metal etc, can considerable influence the toxicity of a metal (Bryon, 1976)

Toxicity testing is an essential tool for assessing the effect and fate of toxicants in aquatic ecosystems and has been widely used as a tool to identify suitable organisms as a bioindicator and to derive water quality standards for chemicals. There are many different ways in which toxicity can be measured, and most commonly the measure (end point) is death (Walkar et.al,2006).The toxicity of Mercury was observed sequentially from 96 hours acute exposure regime (behavioural endpoints) to chronic durations (haematological and biochemical toxicity end points) in *Bellamya bengalensis*. Time-dependent lethal endpoints for acute toxicity (LC_{50}) of mercury i.e., 24,48,72 and 96 hrs. were estimated as 0.94, 0.88, 0.69 and 0.40 mg/l respectively (Dhara *et al*,2022).

In present work toxicity of heavy metal mercury is to be carried out on the experimental animal *Bellamya bengaleusis*. It is therefore necessary to decide the acute and chronic doses of $HgCl_2$. heavy metal salts.

MATERIAL AND METHOD

The gastropads snails, Bellamya (Viviparus) bengalensis were collected from the Suki dam at Garbardi Tal-Raver, Dist-Jalgaon (M.S.). The gastropods were acclimatized to laboratory condition for 2-3 days, before setting the experiments. Water was changed after every 12 hours. Healthy active animals of approximately same size (25 to 30 mm.) and weight were chosen.

Lethal toxicity tests were conducted over 96 hours. The experimental troughs contaning 5 litres dechlorinated water were used to keep the animals. Stock solutions of the toxicant, $HgCl_2$ was prepared in double glass distilled water and added to the test medium to get the desired concentration. Ten animals were exposed to each concentrations containing five liter toxicant along with control maintained in aged tap water. Three replicates were run for each concentration. Static bioassays were carried out for a period of 96 hours as per standard methods of APHA (1981).

The experimental concentrations were renewed after every 24 hours using aged tap water as diluent medium. During bio-testing, feeding was discontinued. Mortality was recorded after every 24 hrs and data was analyzed so as to compute 24, 48, 72 and 96 hrs LC_{50} values for three heavy metals by probit analysis (Finney, 1971).Then calculated of fudicial limit, lethal dose and safe concentration.

OBSERVATION AND RESULTS

Bellamya bengalensis was exposed for acute toxicity tests in the laboratory condition until 96 hours duration for three heavy metal toxicants, mercuric chloride ($HgCl_2$) .Toxicity tests were conducted for 24, 48, 72 and 96 hours by the method described by Finney (1951). The regression equations were obtained for heavy metal.

The results obtained after toxicity evaluation of heavy metal to *Bellamya bengalensis* are cited in table 1.1 and 1.2. The LC_{10} and LC_{50} values for heavy metal salts are summarised in table-1.2. The LC_{10} values for 24, 48, 72 and 96 hours exposure to $HgCl_2$ are 2.959, 1.969, 0.990 and 0.524 PPM respectively.

The occuracies calculated for log LC_{50} values are cited in table 1.2 and the variance "V". The accuracy of standard error or variance for 24, 48,72 and 96 hours for log LC_{50} for $HgCl_2$ were 0.001798, 0.002542. 0.004345 and 0.006959 respectively.

Chi-square values are summarised in table 1.1 under the column X^2. The calculated values are less than tabulated values. The null hypothesis is accepted. There seems to be good correspondence between the calculated and observed values.

Table 1.1: Regression equations of probit mortality (y) against x, the logarithm of the metal concentrations, LC_{50} and LC_{10} values for *B.bengalensis*(Lamarck) exposed to $HgCl_2$.

Sr. No.	Name of Heavy metal salt	Time of exposure in hr's	Regression Equation Y = y + b (x –x)	LC_{50} value ppm	variance 'V'	X^2 value	Fiducial Limits (ppm)		Lethal Dose (ppm)	Safe Conc. (ppm) 'C'
							M_1	M_2		
1	$HgCl_2$	24	21.49522x – 6.40932	3.93	0.001798226	0.03049	0.4475852	0.61371477	94.32	0.2551
		48	15.215654x – 0.7584847	2.39	0.0025424200	0.01878	0.27957206	0.4772279	114.72	
		72	8.895097331x – 5.14137789	1.38	0.0043456181	1.07009	0.01089424	0.26930575	99.36	
		96	5.353098024x – 0.133197234	1.09	0.006959384	0.93796	-0.01224089	0.20460892	104.64	

Table 1.2: Safe concentration, LC_{10} and LC_{50} values of heavy metal salts $HgCl_2$ for *B.bengalensis.*

Sr. No	Name of Heavy metal salt	Safe Conc. 'C' (ppm)	LC_{10} value in ppm				LC_{50} value in ppm			
			24 hrs	48 hrs	72 hrs	96 hrs	24 hrs	48 hrs	72 hrs	96 hrs
1	$HgCl_2$	0.2551	2.959	1.969	0.990	0.524	3.394	2.390	1.380	1.099

Fiducial limits are summarised in table 14. Fiducial limits for Hgcl2 for 24,48,72 and 96 hours exposure were 0.4475 to 0.6138, 0.2795 to 0.4772, 0.0108 to 0.2693 and -0.0122 to 0.2046 PPM respectively.

The safe concentration of heavy metal salts $HgCl_2$ was calculated and are expressed in table 1.2. The safe concentrations for $HgCl_2$ was 0.2551PPM.

DISCUSSION

The mortality of aquatic organism due to pollutant increases with increase in time of exposure period and lethal concentration value decreases with increase in exposure time. These obseervations are in agreement with the findings of Nimmo and Behner (1976). Bayne and Thomson (1971) studied the toxicities of metals, pesticides and PCB's singly and in combination to shrimp. They observed that cadmium but not methoxychlor was accumulated by shrimp and methowychlor appeared to influence the process of accumalation or loss of cadmium from tissue of shrimp.

The toxicity of all the studued metals in dependent on water parameters like hardness, PH, dissolved oxygen, temperature. Also majority of heavy metals show high affinity towards protein and form metllothionin which in turn acts as a detoxificant. Many workers studied mercurial compounds toxicity to aquatic animals (Rehowldt, *et. al*. 1973, Wobser; 1975 and). Eldon *et. al*. (1981) studied the effect of low concentration of heavy metals on the bivalve, *Macoma balthica* and observed that mortality was high on in animals exposed to Hg and Cd. Gupta *et. al*. (1981) also reported that toxicity of copper sulphate increased with increse in temperature in the snail, *Bellomya bengalensis*. Uptake and incorporation of Hg into Hg binding protein of gifts of mytilus edulis as a fuction of time was determined by Roesijadi. (1982). Rana and Rekha (1982) observed mercurial toxicity in the liver of a freshwater teleost, *Channa punctatus*. Greater accumulation of Hg in liver after a longer treatment and the respective change in enzyme activity showed a close response releationship. Effect of Cd on Hg uptake by mussel's mytilus edulis was reported by Breittmayer *et.al.* (1984). they found that cadmium at high level decreases mercury toxicity, reduce bioaccumulation in gills and viscera and seem to easy elimination towards shell and intervalve water. Rise in the level of mercury and other heavy metals in marine as well as in inland water of Hussain Sagar Lake were reported by Prahalad (1987). Balogh V. *et. al*. (1988) made an extensive study on heavy metal concentrations of Lymnaea stagnalis in the environs of Lake Balaton. The concentration of toxic metals (Cr, Cd, Hg, Pb) showed linear decreasing tendency while that of Zn, Cu, Mn. It was found to significantly increase with the increase in body weight. Nagabhushanum *et.al.* (1990) have got similiar kind of results on crab, *Scylla serrata*. The LC_{50} values noted for $HgCl_2$, $CuSo_4$ and Znso4 were 5.88, 346.7 and 398.1 ppm respectively. Seth *et.al*. (1990) studied the toxicity of 2-methoxethyl mercuric chloride, $CuSo_4$ and $HgCl_2$ to freshwater snail, *Viviparus bengalensis*. The bioassay reveated variations showing $HgCl_2$ to be more toxic while $CuSo_4$ to be least toxic. Masarrat sultana (1995) reported the impact of different heavy metals lime Cuso4, $HgCl_2$ and $CdCl_2$ on the freshwater bivalve, *L. marginalis* Patil P.B and Mahajan A.Y,(2012) concluded that the toxicity of tested heavy metals to *L. corrianus* affect respiratory and nervous system of the animal resulting into death. The present investigations also confirm a high sensitivity of mollusk to Copper Chloride as compared to Copper Sulphate.

It was observed that Hgcl2 was found to be more toxic as compared to Cuso4 and ZnSo4. Bargmann *et.al*. (1993) noted the accumulation and toxicity of Cu, Zn, Hg and Pb accumulation in the amphipod increased with increasing exposure to metals. Jagadeesan *et.al*. (1999) studied alternations in the behaviour pattern in Labeo rohita (Ham). Fingerlings induced mercury and he observed that, absense of locomotary activity, increased operculum movement and stationary station following 96 hours treatment. Palil (1998) studied the toxicity of heavy metals like $CuSo_4$, $HgCl_2$ and $ZnSo_4$ to the freshwater bivalve, *Lamellidens Corrianus.* It was found that Hgcl2 was more toxic as compared to $CuSo_4$ and $ZnSo_4$.

CONCLUSION

The present studies it can be concluded that the toxicity of tested heavy metal Mercuric chloride to *B.bengalensis is* confirm a high sensitivity.

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