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Research Article

BIOACCUMULATION OF TOXIC HEAVY METALS IN THE EXPERIMENTAL GASTROPODS MODEL, *BELLAMYA (VIVIPARUS) BENGALENSIS* (LAMARCK)

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ABSTRACT
The present study was carried out to determine the level of bioaccumulation of some heavy metals namely Mercury (Hg), and Copper (Cu) in freshwater gastropods snail's *Bellamya bengalensis.*The bioaccumulation of heavy metal salts in snail's was studied under three groups. Group A was maintained as control, group B snail's were exposed to chronic $LC_{50/10}$ dose of mercuric chloride (0.109 ppm) and group C snail's were exposed to chronic $LC_{50/10}$ dose of copper suphate(2..233ppm) for 21 days.Bioaccumulation level in whole body tissues of *Bellamya bengalensis*' from all groups were estimated after 7, 14 and 21 days. It was found that the freshwater snail, *Bellamya bengalensis* showed the highest concentration of copper as compared to mercury and control. The bioaccumulation studies also indicate the ability of the snail to regulate and excrete excess level of heavy metal salts from its body.

Keywords: *Bioaccumulation, Mercury, Copper, Bellamya Bengalensis*

INTRODUCTION
Heavy metals occur in aquatic systems from natural sources and anthropogenic activities. The pollution of aquatic environment by heavy metals affects aquatic biota posse's considerable environmental risks and concerns (Amisah *et al.*, 2009). Compared with other types of aquatic pollution, heavy metal pollutants less visible but its effects on the ecosystem and humans are intensive and very extensive due to their toxicity and their ability to accumulate in the biota (Shanmugam *et al.*, 2007; Edem *et al.*, 2008).
Wood (1974) classified metals into non-critical, very toxic and toxic metals. He classified arsenic, lead & mercury as very toxic heavy metals.
These heavy metals enter into the body of animals including man through the non vegetarian and vegetarian diet, drinking water and air and accumulate in the tissues, usually react with proteins and interfer the physiological activities and thus increase the risk of life in various ways. They are difficult to remove from the body. Cu is classified as a heavy metal and has many physical properties that make it useful for various industrial applications. Its high electrical and thermal conductivity as well as its resistance to corrosion makes it an important element in the use of combustion sources (i.e. municipal incinerators and combustion of coal, gasoline, diesel and lubricating oils), tires and brakes of vehicles (WHO, 1998; Rice *et al.*, 2002).
However, once it enters aquatic environments, it is only slightly soluble in freshwater, saline waters or mildly acidic solutions, but carbonate, which can be found in copious amounts in freshwater, can more readily dissolve Cu (WHO, 1998). The biotic ligand model (BLM) is a good model that estimates dissolved metal toxicity, including Cu, based on natural occurring ions in the environment (Cruz and Delos, 2010). The BLM was first derived to look at the effects of metal toxicity to fish gills, but has recently been extended to other aquatic organisms, such as algae and crustaceans (Cruz and Delos, 2010, Vijver *et al.,* 2004). Mercury is one of the most hazardous environmental pollutants. Mercury tends to concentrate in various organisms including fish due to reduced biodegradation of its derivatives. Consequently, gastropod snails are widely used as biomarkers for assessing heavy metal contamination level of aquatic environment and the health state of aquatic ecosystems.Considering all these things, the main objectives of this research were to determine the contamination levels of heavy metals in water as well bioaccumulation in aquatic organisms like *Bellamya bengalensis.*

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MATERIALS AND METHODS

The snails,*Bellamya bengalensis* were acclimatized to laboratory condition for 2-3 days and healthy active snails of approximately medium size and weight were chosen. These snails were divided into three groups, such as group A, B and C. The snails of group A were maintained as control. The snails from group B were exposed to chronic concentration (LC 50 value of 96 hr/10) of heavy metal salt, mercuric chloride (0.109 ppm) upto 21 days, while snails from group C were exposed to chronic concentraction of copper sulphate (2.233ppm) upto 21 days. During experimentation snails were fed on fresh water algae. The whole body mass of snails from all groups were collected after every seven days and were dried at 80 c in an oven till constant weight was obtained. The 500 mg sample was taken for digestion. The tissue was digested in 10 ml of acid mixture ($HCL:HNO_3$ in (3:1) ratio) on hot plate till dryness. The digested mixtures were kept in water bath for 6-7 hours until the samples were cooled. Cool digested samples were filtered (Whatman grade 541). The total volume was diluted to 50 ml by double glass distilled water in volumetric flask.The sample were analysed on the instrument atomic absorption sepctrophotometer (Chemito).The concentration of Hg andCu accumulation in the tissue of each exposure period was recorded and the results are given in the tables.

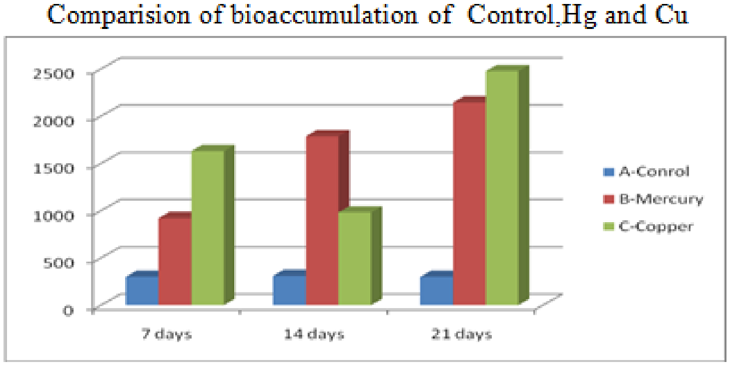
RESULTS AND DISCUSSION

Concentrations of mercury and copper in whole body tissues of gastropods snils were presented in Table. The study of heavy metal concentrations in snails was important with respect to water pollution and biomagnifications of heavy metal salts. In the present study, the concentration of heavy metals in fishes was as: Cu > Hg

The biaccumulation data from table, indicates that the amount of Hg in tissues on exposure to $HgCl_2$ (0.109ppm) increased with increase in exposure period as compared to control. The mercury contents are expressed in µgm/Kg dry weight. The control group of animals showed minute quantity of mercury as compared to the experimental groups. The control group of animal showed 300.0 µgm/Kg mercury in whole body tissue while the amount of accumulation was of Hg in presence of $HgCl_2$ (0.109ppm) for 7 days was 920.0 µgm/Kg . The concentration in the tissues was raised after 14 days which was 1786.0µgm/Kg. While after 21 days the rate of accumulation was 2144.0 µgm/Kg. There was minute change in the accumulation in control animals.

The concentration of bioaccumulation copper in presence of $CuSO_4$ (2.233ppm) increased with increse in exposure period as compared to control. The copper content is expressed in µgm/Kg. dry weight. The control group of animals showed minute quantity of copper as compared to the experimental groups. The control group of animal showed 300.0 µgm/Kg ,Copper in whole body tissue while the bioaccumulated copper in presence of $CuSO_4$ (2.233ppm) after 7 days exposure was 1630.0µgm/Kg. The concentration in the tissues was raised after 14 days to 1980.0 µgm/Kg, while after 21 days increases to 2676.0 µgm/Kg. There was minute change in the bioaccumulation of Cu in control animals.

Comparision of bioaccumulation of Control,Hg and Cu



Exposure period

Table 1: Mercury and Copper content (µgm/Kg dry weight) in whole body tissues of *Bellamya bengalensis* (Lamarck) after chronic treatment of Hg and Cu

Treatment	Sr No.	Body Tissue	Hg and Cu content (µgm/kg dry weight) 7 Days	14 Days	21 Days
(A) Control	I	W.B.	300.00	310.00	300.00
(B) 0.109 ppm $HgCl_2$	Ii	W.B.	920.00 + 67.391•	1786.00 + 82.642•	2144.00 + 86.007•
(C) 2.233ppm $CuSO_4$	Iii	W.B	1630.00 +81.595•	980.00 + 84.343•	2676.00 + 88.789•

• *-Compared with respective A, W.B.- Whole Body*

The accumulation of metal in different species is the function of their respective membrane permeability and enzyme system. The ratio between bioaccumulation and exposure concentration with periods of exposure has been shown by various investigators. The accumulation of several metals is due to the low capacity of these mollusks for discriminating among metals, which are similar in some characteristics such as ionic radius (Mitra *et al.*, 2000; Pragatheeswaran, 1987; Sayer *et al.*, 1989; Barber and Sharma, 1998; Senthiloathan *et al.*, 1998; Jeffree *et al.*, 1993; Metcalfe, 1994). Heavy or toxic metals are metals with a density at least five times that of water. They are stable elements (meaning they cannot be metabolished by the body) and bio-accumulative are (passed up the food chain to humans). These include : mercury, lead, nickel, arsenic, cadmium, aluminium, platinum and copper.Heavy metals besides micronutrients have no fuction in the body and can be highly toxic. Studies confirm that heavy metals can directly influence behaviour of living organism including man. Two obvious methods exist for expressing the heavy metal component of living organisms. Absolute may be assessed by considering the organisms, metal contens i.e. body burden and the metal component may be expressed as a fuction of the weight of individual organism. Passow *et al.,* (1961) reported that lead can induce synthesis of specific proteins which selectively bind them. Inhibition of enzyme activities by heavy metals is either due to the direct binding with enzyme protein or due to damage of cell organelles or by toxic effect produced. The specific amoebocytes and or digestive vesicles within the cell may engulf metals outside the cell membrance (i.e. in the human digestive tract), then move back into the tissue carying their particulate burden (Owne *et al.*, 1966). The pond snail (*Lymnaea stagnalis* L.), which is one of the most common snails of freshwater habitats in central Europe, have a good indicator potential, since more information about the features of heavy metal accumulation, toxic pollution tolerance and impact of metals on the physiology of the genus *Lymnaea* are known (Królak, 1998; Bogatov and Bogatova, 2009). The accumulation of metals in invertebrates is also dependent on functional feeding group and scrapers that feed on periphyton, such as snails, accumulated the largest concentrations of metals (Farag *et al.*, 1998).

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REFERENCES

Amisah S, Adjei-Boateng D, Obirikorang KA and Quagrainie (2009). Effects of clam size on heavy metal accumulation in whole soft tissues of *Galatea paradoxa* (Born, 1778) from the Volta estuary, Ghana. *International Journal of Fisheries and Aquaculture* **1**(2) 14 -21.

Barber D and Sharma MS (1998). Experimentally induced bioaccumulation and elimination of cadmium in freshwater fishes. *Pollution Research* **17** 99-104.

Bogatov VV and Bogatova LV (2009). Heavy metal accumulation by freshwater hydrobionts in a mining area in the south of the Russian far east. *Russian Journal of Ecology* **40** 187–193.

Cruz LA and Delos C (2010). An introduction to the biotic ligand model. US Environmental Protection Agency, Washington, D.C.

Edem CA, Akpan B and Dosunmu MI (2008). A comparative assessment of heavy metals and hydrocarbon accumulation in Sphyrena afra, *Oreochromis niloticus* and lops lacerta from Anantigha Beach market in Calabar- Nigeria. *African Journal of Environmental Pollution and Health* (6) 61-64.

Farag AM, Woodward DF, Goldstein JN, Brumbaugh W and Meyer JS (1998). Concentrations of metals associated with mining waste in sediments, biofilm, benthic macroinvertebrates, and fish from the Coeur d`Alene Riverbasin, Idaho. *Archives of Environmental Contamination and Toxicology* (34) 119–127

Jeffree RA, Markich SJ and Brown PL (1993). Comparative accumulation of alkaline earth metals by two freshwater mussel species from the Nepean River, Australia: consistencies and a resolved the paradox. *Australian Journal of Marine & Freshwater Research* (44) 609-34.

Królak E (1998). Concentration of heavy metals in the snails *Lymnaea* (*Radix*) *peregra* (O.F. Mull) and *Lymnaea stagnalis* (L) occurring in rivers near Siedlce town. *Polskie Archiwum Hydrobiologii* **45** 553–563

Metcalfe Smith JL (1994). The influence of species and sex on metal residues in freshwater mussels (Family Unionidae) from the St. Lawrence River, with implications for biomonitoring programs. *Environmental Toxicology and Chemistry*.

Mitra A, Mitra S, Hazra S and Chaudhari (200). Heavy metal concentration in India. Coastal Fishes. *Res J Chem Environ* **4** 35.

Owen G (1966). In: *Physiology of Mollusca II,* edited by Wilbur KM and Younge CM (Academic Press) New York 53-88.

Passow H, Rothetein A and Clarkson TW (1961). *Pharmacological Review* **13** 185.

Pragatheeswaran V (1987). Effect of Zinc, Copper and mercury on *Ambassis Commersoni* (Cuvier). Ph.D. Thesis, Annamalai University, India.

Rice KC, Conko KM and Hornberger GH (2002): Anthropogenic sources of arsenic and copper to sediments in a suburban lake, Northern Virginia. *Environmental Science and Technology* **36** 4962-4967.

Sayer MD, Reader JP and Morries R (1989). The effect of cadmium concentration on the toxicity of Copper, Lead, Zinc to Yolk Sac of brown trout, *Salmo trout*. L. In soft and acid water. *Journal of Fishes Biology* **35** 323-32.

Senthiloathan S, Balasubramanian T and Venugopal VK (1998). Metal concentration in mussel *Perna vridis* (Bivalvia) and Oyster *Crassostrea madrasensis* (Bivalvia) from some parts of southeast coast of India. *Indian J Mar Sci* **27** 206-10**.**

Senthiloathan S and Balasubramanian T (1998). Heavy metal concentration in the oyster Crassostrea *madrasensis* (Bivalve) From the Uppanar. Vellar and Kaduviar estuaries of Southeast coast of India. *Indian Journal of Marine Sciences* **27** 211-16.

Shanmugam A, Palpandi C and Kesavan K (2007). Bioaccumulation of some trace
metals (Mg, Fe, Zn, Cu) from Bowl *Cymbium melo* (Solander, 1786). *Research Journal of Environmental Sciences* **1**(4) 191-195.

Vijver MG, Van Gestel CAM, Lanno RP, Can Straalen NM and Peijnenburg WJGM (2004). Internal metal sequestration and its ecotoxicological relevance: A review. *Environmental Science & Technology* **38** 4705-4712.

WHO (1998). Geneva. Environmental Health Criteria 200: Copper.