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Bioaccumulation of Some Trace Metals (Mg, Fe, Zn, Cu) from Begger's Bowl *Cymbium melo* (Solander, 1786) (A Marine Neogastropod)

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Abstract: Heavy metals in the aquatic environment have to date come mainly from naturally occurring geochemical materials. However, this has been enhanced by human activities such as boat activity, industrial effluents, domestic sewage etc. An attempt was made to determine the level of trace metals such as Mg, Fe, Zn and Cu in foot, mantle, body tissues, shell of *Cymbium melo* and sediment (habitat) using optical emission spectrophotometer technique. The highest concentration of these elements was recorded in the body tissues and lowest concentration, in mantle. In this study among the four metals, magnesium (151.3±1.9 ppm on DWB)) was reported to be maximum and copper (0.644±0.01 ppm on DWB) was reported to be minimum. The Mg was found to be varying from 151.3±1.9 (body tissues on DWB) to 71.48±1.2 ppm (mantle on DWB). The Fe content was higher in body tissues (31.1±0.5 ppm on DWB) and lower in mantle (6.748±0.08 ppm on DWB); whereas the Zn content was more in body tissues (2.197±0.02 ppm on DWB) and less in foot (1.47±0.03 on DWB). The Cu concentration was ranging from 1.361±0.01 (body tissues on DWB) to 0.644±0.01 ppm (mantle on DWB) in *C. melo*. In general, the shell reported only low concentrations Mg: 19.49±0.3 ppm, Fe: 3.467±0.035 ppm, Zn: 0.71±0.005 ppm and Cu: 0.16±0.003 ppm. But at the same time, in sediment, Mg recorded the maximum value of 290.58±5.12 ppm and Cu, the minimum value of 4.52±0.33 ppm.

Key words: Trace metals, sediment, different body parts, *Cymbium melo*, cuddalore

INTRODUCTION

From an environmental point of view, the coastal zone can be considered as the geographic space of interaction between terrestrial and marine ecosystems that is of great importance for the survival of a large variety of plants, animals and marine species (Castro *et al*., 1999). Metal pollution of the coastal environment continues to attract the attention of environmental researchers (Shulkin *et al*., 2003). The coastal zone receives a large amount of metal pollution from coastal towns, industrial dumps and rivers. Pollution by heavy metals is a serious problem due to their toxicity and their ability to accumulate in the biota (Islam and Tanaka, 2004). One of the most successful examples of their use in biomonitoring is called the Mussel watch program (Cantillo, 1998).

The use of molluscs to measure heavy metal pollution in estuarine environments is also well-established (Phillips and Rainbow, 1993; Langston and Spence, 1995; Langston *et al*., 1998). Although used less intensively for biomonitoring than bivalves, many gastropods have the required attributes to be effective biomonitors (Phillips, 1977; Phillips and Rainbow, 1993; Langston and Spence, 1995). The heavy metals directly or indirectly affect the food chain and consumption of

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contaminated food from this environment is hazardous to man. So, in the present study, an attempt has been made to determine Mg, Fe, Cu, Zn and Cu concentration in different body parts and shell of *C. melo* apart from sediment of its habitat.

MATERIALS AND METHODS

Animal Tissues

The animals were collected from the Cuddalore landing centre (in east coast of India, Lat.11°43'N: Long 79°49'E) during the month of October, 2006. The begger's bowl *C. melo* specimens of marketable size group of 170 mm were chosen for the present study. They were brought to the laboratory and were dissected out for various body parts such as foot, mantle and body tissues and kept in hot air oven for complete drying. The dried tissues and the shell were ground in to powder and used for further analyses. One gram of the powdered sample was digested with Conc. HNO_3 and $HClO_4$ (4:1) and analysed for Mg, Fe, Zn and Cu using optical emission spectrophotometer (Optima 2100DV). (Topping, 1973).

Sediment

Metal concentration in sediment was determined by following the method of Chester and Hughes (1967).

At low concentrations, copper is an essential element for organisms, but is toxic at high concentrations, so that its accumulation must be strictly regulated. At low concentrations zinc also plays an important role in physiology that too is toxic at high concentrations, but to a lesser extent than copper. Iron is another essential metal, generally abundant in any environment and has several properties similar to those of manganese; for example, its partitioning between water and sediments is largely controlled by the oxygen concentration in water.

RESULTS AND DISCUSSION

In general, the results obtained from the present study shows variations in the levels of accumulation of trace metals in the three different body parts of *C. melo* and sediment. Among the four metals, the magnesium concentration showed higher value than the other trace metals. The order of accumulation of trace metals in the animal tissues and sediment was as follows Mg>Fe>Zn>Cu (Table 1).

In the present study, the metal concentrations in different soft parts (foot, mantle and body tissues) of *C. melo* showed clear difference among the tissues. In this investigation the maximum metal concentration was observed in body tissues (Table 1) than the other soft body parts studied. It is supporting this in the earlier study Rajan (1987) noticed the metal concentrations in different soft parts (adductor muscle, foot, mantle, gill, gonad and digestive diverticula) of *D. cuneatus* showed clear seasonal variations and differences among the tissues and food availability and weight of the body also influenced the metal concentration. Taylor and Maher (2003) also mentioned the greatest variation in tissue metal concentrations were within sample variation from two species of gastropods *A. constrica* and *B. auratum*.

Table 1: Bioaccumulation of different body parts of the *C. melo* (values in ppm)

Metals	Body tissues	Foot	Mantle	Shell	Sediment
Fe	31.100±0.50	9.767±0.09	6.748±0.080	3.467±0.035	55.130±2.1
Zn	2.197±0.02	1.470±0.03	1.667±0.025	0.710±0.005	5.22±0.51
Cu	1.361±0.01	1.231±0.01	0.644±0.010	0.160±0.003	4.52±0.33
Mg	151.300±1.90	114.600±1.50	71.480±1.200	19.490±0.300	290.58±5.12

The foot and mantle are closely contact with the surrounding medium (water) and also the mantle part was produced more mucus than the other body parts studied that is the reason the accumulation of this two parts was more. The body tissues of *C. melo* it may be secretion and absorption of food, storage and excretion there for the metals taken in by the animals were accumulated more in body tissues.

The soil and sediments are the main sources of this metal. Its co-precipitating power is well known and this property makes it one of most effective substances for abating phosphorus in waste water treatment (Ravera *et al*., 2003). In the earlier study the maximum concentration (6960 μg g^{-1}) of iron in sediment and minimum in (3760 μg g^{-1}). The zinc concentration was recorded maximum in 5620 μg g^{-1} and lowest in 2640 μg g^{-1} and highest concentration of copper 109 μg g^{-1} and lowest concentration in 10 μg g^{-1} (Rajan, 1987). But in the present study sediment showing the maximum concentration was recorded in magnesium (290.58±5.12 ppm) and minimum was reported to be copper (4.52±0.33 ppm).

Black and Mitchel (1952) reported that the usage of zinc block in the fishing vessels would have resulted in enhanced zinc concentration in coastal waters. In Cuddalore coast also hundreds of vessels have been used for the fishing. Nearly all the paints used for boats contain zinc, while antifouling paints contain copper in appreciable level (Goldberg, 1976). In Cuddalore also the release of scrap metals and paint residues from boat is one of the sources for zinc and copper. Source of Mg and Cu might be due to the land drainage and from effluents through irrigation channels and municipal wastes.

Ismail and Safahieh (2005) have been studied the copper concentration in the soft tissues ranged from 49.9 to 60.3 μg g^{-1} in *Telescopium telescopium*. The concentration of Cu in the foot in both male & female animals showed maximum 52 and 56 μg g^{-1} and minimum 21 and 13 μg g^{-1}, respectively from *D. cuneatus* was reported by Rajan (1987). Shanthi (1987) noticed the copper concentrations were found to be 160 μg g^{-1} at station 1 and from 170 to 310 μg g^{-1} at station 2. The copper concentration was found in the present investigation fluctuated from 1.361±0.01 to 0.16±0.003 ppm in three different body parts including shell, it was very low when compare the above mentioned results because changes in salinity of the surrounding medium results in differential rates of trace metal uptake by biota due to gross physiological changes in the linkage of ion fluxes occurring in the body surface of an organisms (Wolfe and Coburn, 1970; Bryan and Hummerstone, 1973). Ikuta (1991) reported that, Cu accumulation is generally higher in the oyster than in the other bivalve species.

Goksu *et al*. (2005) have been studied the Fe (2.8227±0.24486 μg g^{-1}) has the highest mean for both species, but Cu (0.0355±0.003 μg g^{-1}) for *B. pharaonis* and Cd (0.0605±0.0046 μg g^{-1}) for *P. radiata* have the lowest means. Shanthi (1987) noticed the concentration of iron observed in the tissues of *A. rhombea* ranged from 1310 to 3680 μg g^{-1} at station I and 1630-3700 μg g^{-1} at station 2 and copper concentrations were found to be 160 μg g^{-1} at station I and from 170 to 310 μg g^{-1} at station 2. In the earlier study Ferreira *et al*. (2005) noticed the average concentration was 0.8±0.18, 0.4±0.21, 58±25.6, 249±52.3, 11±1.31, 0.55±0.16, 0.13±0.11 and 1131±321 μg g^{-1} dry weight for Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn, respectively from *Ostrea equestris*. Rajan (1987) has been studied the iron concentration in foot of male and female *D. cuneatus*, the values showed 395 and 409 μg g^{-1}, respectively and also the mantle tissues showed maximum concentrations in 487 and 496 μg g^{-1} and minimum was 192 μg g^{-1} for both male and female *D. cuneatus*. In the present study Fe concentration was ranging from 6.748±0.08 to 31.1±0.5 ppm in three different body parts of the *C. melo*. The maximum concentration was observed in body tissues and minimum was observed in mantle. In the present results when it was compare the previous results it was very low because it may be stated that the environmental parameters like salinity, temperature, dissolved oxygen and pH also have some effect on the accumulation of trace metals. Among the parameters the salinity played major role in the metal accumulation (Rajan, 1987; Shanthi, 1978). The food availability in the environment also some effect on metal concentration in body tissues of bivalves (Bryan, 1973; Frazier, 1975; Phillips, 1977).

Ismail and Safahieh (2005) have been studied Zn concentration was ranged from 36.7 to 58.8 μg g^{-1} in *Telescopium telescopium*. Lau *et al*. (1998) have been studied the Zn concentration was recorded in 185.0±7.071 from *Brotia costula* and also 105.0±10.801 was noticed from *Clithon* sp. (ST1 upstream). However in the present study zinc concentration was ranged from 2.197±0.02 to 0.71±0.005 ppm. In the present results when it was compare the previous results it was very low because the metal content in tissue appears to be dependent on environmental parameters, food availability and reproductive status of the organisms (Rajan, 1987; Shanthi, 1978; Bryan, 1973; Frazier, 1975; Phillips, 1977).

In the present study Mg concentration was more when comparing the other metals. The Mg was found to be varying from 151.3±1.9 to 71.48±1.2 ppm. The maximum concentration was recorded in body tissues and minimum was mantle.

This preliminary study on the bioaccumulation of metals in marine environment by gastropod molluscs had shown that the heavy metal contamination of the study area (Cuddalore coast). In the present study mg concentration was found to be more when compared to the other metals in the following order Mg>Fe>Zn>Cu. In this study three different body parts were studied, among the three parts, the body tissues were showed maximum values and the minimum values were noted in mantle. The order of metal accumulation was body tissues>foot>mantle. From the present study it may be concluded that the *C. melo* cannot be suggested as biomonitoring agent for assessing Mg, Fe, Zn and Cu in the marine environment. Because of the study animal *C. melo* highly carnivorous and also the accumulation rate was very low when compare the sediment. Hence it is necessary to assess the natural level and level of these pollutants which produce undesirable side effects.

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