African Journal of Basic & Applied Sciences 3 (5): 243-247, 2011
ISSN 2079-2034

Cadmium Levels in Freshwater Bivalve *Lamellidens marginalis* from Kutluq Lake, Daultabad, near Aurangabad District (M.S.) India

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Abstract: The present study was conducted to determine heavy metal, cadmium concentrations in whole body and different body parts viz. mantle, gill, gonad, hepatopancreas, siphon foot, anterior adductor muscle and posterior adductor muscle of freshwater bivalve. *Lamellidens marginalis* in respective groups i.e. control, Lc_0 and Lc_{50} groups. In control group the content was high from gill (1.7674±1.1503). In Lc_0 group when compared to control group the content was high from adductor muscle (522.66% < 0.001). In Lc_{50} group content was high from whole body (670.09% < 0.001) when it was compared to control group. In Lc_{50} group when compared to Lc_0 group show significantly high from anterior adductor muscle (45.38% < 0.001).

Key words: *Lamellidens marginalis* · Cadmium · Kutluq lake

INTRODUCTION

The bivalve molluscs appear to have particularly high capability for concentrating metals in body along with other foreign materials found in their environment when they filter food particles during feeding. Because of the ability of many metals to form complexes with organic substances there is tendency for them to be fixed in the different tissues and what to be exerted so they have a large biological half life, therefore one of the major problem that metal possess with respect to their effect on aquatic organisms [1].

Pollution an undesirable changes in the physical, chemical and biological characteristic of air, water and soil, which is harmful to living organisms. Whatever may be the mode of contamination polluted environment is what suitable for existing life forms.

The bivalve molluscs are known to be used as indicators of contamination [2-5]. It is becoming important to have a broad understanding of metal levels in a large number of bivalve molluscs from different habitats to establish a base one for comparison with possible future contamination in marine, estuarine and freshwater ecosystems [6, 7].

An accumulation of metal occurs at all levels in the food chain including phytoplankton [8-11]. The bivalve molluscs are normally subjected to considerable fluctuation to man-made environmental perturbations, such as exposure to industrial and domestic sewage waste effluent. These animals are suspension feeders on the primary stages of food chains and influence the organization and functioning of the ecosystem. Heavy metal pollution is known to be a major problem aquatic environment because of their toxicity, their persistence, their tendency to accumulate in organisms and in underlying food chain amplification [12]. Sedentary organisms like molluscs which one not subjected to rapid migration can be affected badly if the water column is contaminated by toxic chemicals, [13].

The present study was planned to investigate toxicity of the cadmium with particular reference to bivalve molluscs. Bioaccumulation patterns of these metals in whole body and different body parts were also investigated.

Metals are non-biodegradable and are considered as major environmental pollutants causing cytotoxic, mutagenic and carcinogenic effects in animals [14]. Aquatic organisms have the ability to accumulate heavy metals from various sources including sediments, soil erosion and runoff, air, depositions of dust and aerosol and discharges of waste water [15, 16]. Therefore, accumulation of heavy metals in aquatic organisms can pose a long lasting effect on biogeochemical cycling in the ecosphere.

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MATERIALS AND METHODS

The freshwater bivalves *Lamellidens marginalis* (90 – 100mm in shell length) were collected from Kutlaq lake, Daultabad near Aurangabad (Maharashtra State) India. After bringing to the laboratory, the fouling biomass and mud on shell valves were removed without disturbing the siphonal regions. The equal sized animals were grouped and kept in sufficient quantity of water (animal / litre) in aquaria with aeration for 24 hours to adjust the animals to laboratory conditions with renewal of water at interval of 12 to 13 hours. No food was given during this time and during experiments. After 24 hours animals of equal size (90 – 100mm shell length) were grouped in 10 and exposed to different test concentrations of cadmium.

The stock solution of cadmium was prepared by dissolving appropriate quantity of cadmium chloride ($CdCl_2$ – 2 ½ H_2O AR Grade CDH Bombay in India) in double distilled water. The pH of the water is brought between 6.9 to 7.1 by adding 1NHCl (due to the insolubility of cadmium in reservoir water having pH 7.6 to 8.1).

Appropriate test concentrations were then prepared and animals were exposed. The experiments were conducted in natural day-night rhythm. The animals from control, Lc_0 and Lc_{50} groups were subjected for the determination of cadmium level from the whole body and different body parts. The cadmium estimation was done an atomic absorption spectrophotometer (GBC 932 AAS). Five animals were shucked and blotted on blotting papers and dried in an oven at 92^0C to obtain constant weight, the material was powdered and 500g was then digested in Nitric acid. Perchloric acid (4:1) at 95^0C and diluted with deionized water upto 25ml. All the tissues were digested to overnight and samples were taken for cadmium estimations.

RESULTS

The cadmium levels based on dry weight basis are shown in Table and Figures. The cadmium levels were recorded for whole body and different body parts viz. mantle, gill, gonad, hepatopancreas, siphon, foot, anterior adductor muscle and posterior adductor muscle.

In control group the content (mg/g dry weight) was high from gill (1.7674±1.1503) followed by mantle (1.3657±0.1503), siphon (0.9078±0.0465), gonad (0.7833±0.0492) hepatopancreas (0.6226±0.0150), anterior adductor muscle (0.562±0.1239), foot (0.5142±0.0298), posterior adductor muscle (0.4419±0.1137) and whole body (0.2029±0.0730). Foot and anterior adductor muscle showed almost equal amount of content.

Lc_0 group showed highest value (mg/g dry weight) from gill (8.9175±0.6516) followed by mantle (6.9489±0.7515), siphon (4.8803±0.984), gonad (4.0268±0.2935), hepatopancreas (3.2937±0.0752), posterior adductor muscle (2.7515±0.2525), foot (2.6912±0.1239), whole body (1.1408±0.4250) and anterior adductor muscle (0.0285±0.1157). Gonad, siphon, foot, anterior adductor muscle and posterior adductor muscle showed almost equal amount of content.

In Lc_{50} group the content showed highest values (mg/g dry weight) from mantle (8.8568±0.3013) followed by gill (8.1338±0.9827), gonad (5.1170±0.3392), siphon (4.9010±0.4560), hepatopancreas (4.4788±0.6715), posterior adductor muscle (3.3138±0.4920), foot (3.133±0.2993), anterior adductor muscle (2.9489±0.4733) and whole body (1.5625±0.6505).

In Lc_0 group when compared to control group the content was increased from posterior adductor muscle (522.66% < 0.001) followed by whole body (462.25% < 0.005), siphon (437.60% < 0.001), hepatopancreas (429.03% < 0.001), foot (423.38% < 0.001), gonad (414.09% < 0.001), mantle (408.82% < 0.001), gill (404.56% < 0.001) and anterior adductor muscle (304.09% < 0.001). In Lc_{50} group the content significantly increased from whole body (670.09% < 0.001) followed by posterior adductor muscle (649.90% < 0.001), hepatopancreas (619.37% < 0.001), gonad (553.27% < 0.001), mantle (548.52% < 0.001), foot (509.30% < 0.001), anterior adductor muscle (487.44% < 0.001), siphon (439.88% < 0.001) and gill (360.22% < 0.001). When it is compared to control group in Lc_{50} group when compared to Lc_0 group showed significantly high from anterior adductor muscle (45.38% < 0.001) followed by hepatopancreas (35.98% < 0.001), mantle (27.46% < 0.001) and gonad (27.08% < 0.001). The decreased value showed from gill (8.79% not-significant) whole body (36.97%), posterior adductor muscle (20.44%), foot (16.42%) and siphon (0.42%) all values showed not significantly.

DISCUSSION

The ability of bivalve molluscs, partially those of the genus Mythlus to concentrate trace metal in their tissues is well known. Bivalves are filter feeding organisms characterized by low biotransformation capacities. They accumulate the bio-available fraction of the contaminants present in water column and the metal content of their

Table 1: Cadmium content (mg/g dry weight) from different body parts of *Lamellidens marginalis* from Kutluq lake

	Summer		
Tissue	Control	Lc_0	Lc_{50}
Whole Body	0.2029±0.0730	1.1408±0.4250 (462.25%)*	1.5625±0.06505 (670.09%) * (36.97%)
Mantle	1.3657±0.1503	6.9489±0.7515 (408.82%)***	8.8568±0.3013 (548.52%)*** (27.46%)o
Gill	1.7674±0.1503	8.9175±0.6515 (404.56%)***	8.1338±0.9827 (360.22%)*** (8.79%)
Gonad	0.7833±0.0492	4.0268±0.2935 (414.09%)	5.1170±0.3392 (553.27%)*** (27.08%)o
Hepatopancreas	0.6226±0.0150	3.2937±0.0752 (429.03%)***	4.4788±0.6715 (619.37%)*** (35.98%)o
Siphon	0.9078±0.0465	4.8803±0.984 (437.60%)***	4.9010±0.4560 (439.88%)*** (0.42%)
Foot	0.5142±0.0298	2.6912±0.1239 (423.38%)***	3.133±0.2993 (509.30%)*** (16.42%)
Anterior Adductor Muscle	0.5620±0.1239	0.0285±0.1137 (304.09%)***	2.9489±0.4733 (487.44%)** (45.38%)o
Posterior Adductor Muscle	0.4419±0.1137	2.7515±0.2525 (522.66%)***	3.3138±0.4920 (649.90%)*** (20.44%)

(Bracket values shows percentage differences) (*, o-1< 0.05; **, oop<0.01; ***, ooo-p<0.001; * compared to control group and cadmium exposed groups; o-compared to Lc_0 and Lc_{50} groups)

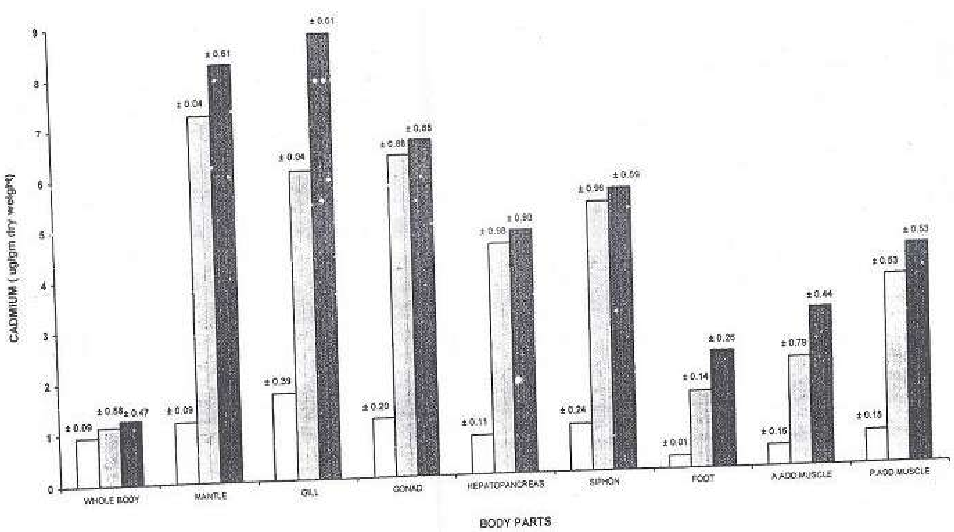

Fig. 1

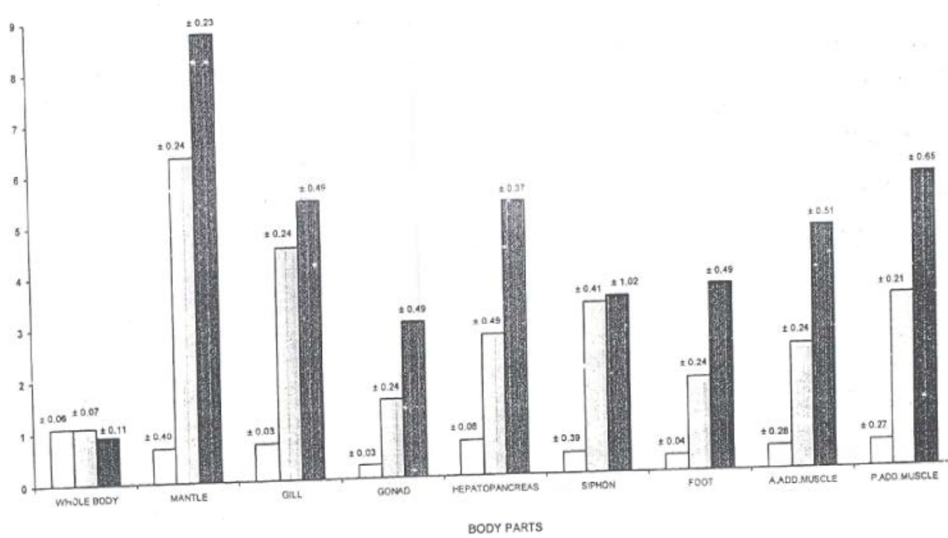

Fig. 2

tissues reflect generally the profile of the pollution they have been exposed to. However, the presence of pollutants like metals in bivalves is not only determined by the concentrations of metal in sediments and waters, but also by physiological and bio-chemical processes within the animal that are species dependent. Heavy metals are not biodegradable and once they enter the environment, the susceptibility of macro-organisms to heavy metals and the bio-accumulation of heavy metals by them are ecologically very significant phenomena [17-19]. *Lamellidens marginalis* is very sensitive in summer.

Many metals including Cd [20] require a preston to mediate transport across cell membranes. Metal uptake then will depend upon the interactions between the metal and the transport protein and free metal ions activity reflect the potential for these interactions. Heavy metals accumulation depends upon the concentration of heavy metal and duration of exposure [3, 21-25]. Metal pollution studies through bivalve molluscs have been made in various monitoring programmers [26].

In present investigation, it was observed that during summer *Lamellidens marginalis* showed cadmium accumulation in different organs was descending order. In control group: - whole body < posterior adductor muscle < foot < anterior adductor muscle < hepatopancreas < gonad < siphon < mantle < gill.

In LCO group:- whole body < anterior adductor muscle < foot < posterior adductor muscle < hepatopancreas < gonad < siphon < mantle < gill.

In Lc_{50} group:- whole body < anterior adductor muscle < foot < posterior adductor muscle < hepatopancreas < siphon < gonad < gill < mantle.

During period of exposure to metals bivalve gill accumulate higher concentration of metals than other tissues. In mantle metal concentration may increase directly from endocytosis or by transportation of metal by amoebocytes, gonad is also having ability to penetrate large amount of heavy metals. Foot consists of large amount of muscles. Heavy metals residues are generally lowest in muscle tissue [27-29].

ACKNOWLEDGEMENT

The authors wish to thank College Principal Dr. Syeda Anees Fatema and Dr. Vidya Pradhan, Head of the Department of Zoology, Dr. Rafiq Zakaria College for Women, Dr. Rafiq Zakaria Campus II, Navkhanda, Jubilee Park, Aurangabad, India for their kind encouragement and their laboratory facilities.

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