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Cadmium induced lipid alteration in the bivalve mollusk, *Lamellidens marginalis* during monsoon season

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Abstract
Freshwater bivalves *Lamellidens marginalis* were exposed to acute cadmium chloride for 96 hrs. After 96 hours of acute treatment the different body parts: mantle, gill, gonad, hepatopancreas, siphon, foot, anterior adductor muscle and posterior adductor muscle of the bivalves were separated, dried in the oven and their lipid contents were estimated. The data of the present findings suggest that there was an adverse toxic effect of cadmium chloride on the bivalve *Lamellidens marginalis*. After acute exposure to cadmium chloride, lipid content of mantle, gill, gonad, hepatopancreas, siphon, foot, anterior adductor muscle and posterior adductor muscle was found altered. In acute exposure of cadmium chloride the average lipid content was changed significantly.

Keywords: *Lamellidens marginalis*, cadmium chloride, lipid content, toxicity

Introduction
Bivalves belong to phylum Mollusca, which is second largest phylum (Verma and Prakash, 2020a) [16]. The bivalves are commonly available organisms that are abundant in the fresh water as well as in the marine environment. They have been suggested as ideal contamination indices in aquatic ecosystems because of their wide distribution, extensive population, sedimentary nature and the ability to accumulate contaminants, however, anthropogenic activities, electronic wastes and microplastics in general influence their distribution (Verma and Prakash, 2020b; Prakash and Verma, 2022; Verma and Prakash, 2022) [17, 7, 18] and overall animal biodiversity (Ashok, 2017; Verma, 2017) [3, 15].

Most information about the environmental pollutants on aquatic animals has been obtained from mortality studies. The copper sulphate is used as molluscicide to control terrestrial and aquatic mollusks. The heavy metals are a serious threat to aquatic environment, particularly the invertebrate species because of their toxicity and tendency to accumulate in such delicate organisms, which lead to increased effects due to bio magnification in the food chain (Ali and Naaz, 2013; Ali, 2014; Mahajan *et al.*, 2014 and Sangeetha *et al.*, 2015) [1, 2, 5, 11]. Often very little is known about disturbed physiological and biochemical processes within an organism following exposure to environmental poisons. To better understand potential harmfulness of various pollutants, the biochemical assessment after exposure to pollutants of different nature plays an important role. The lipid metabolite is an important constituent of animal tissue, which plays a prime role in energy metabolism.

Lipids are also important in cellular membranes. Long before, Shigmastus and Takeshita (1959)[12] observed that after glycogen lipids were used as an energy source. Lipids are used as energy reservoir and these are stored and transported in the form of glycerol and esters. Nagabhushnam and Kulkarni (1987) [12] studied the lipid levels in the prawn, Macrobrachium kistnensis when exposed to thiodan and fenthioate. Verma and Tank (1983) [14] studied the effect of pollutants on the tissue of fish *Notopterus notopterus*. Rao *et al.* (1987) [8] studied biochemical composition in respect to pH and fluoride in the bivalve, *Indonaia caeruleus*. Some authors studied the effect of cadmium on some freshwater bivalves including Yasmeen (2019) [20], Yasmeen and Pathan (2021) [21] and Yasmeen *et al.* (2021) [22] on *Lamellidens*. Present work was designed to study the total lipid content from different body parts of *Lamellidens marginalis* after acute exposure to cadmium chloride.

Materials and Methods

On collection of the animals from habitat, they were immediately transported to the laboratory. The fouling and mud on shell valves were removed without disturbing the siphonal regions. The equal sized animals (90-100 mm shell length) were grouped and kept in sufficient quantity of water (animal/liter) in aquaria with aeration for 24 hrs to adjust the animals in laboratory conditions (with renewal of water at interval of 12 to 13 hrs). No food was given during acclimation time and during experiments. After 24 hrs, 05 groups of animals of almost equal size (90-100 mm shell length) were formed and each group with 10 animals including control group and exposed to different test concentrations of cadmium for static bioassay tests. The stock solution of cadmium was prepared by was made dissolving appropriate quantity of cadmium chloride (CdCl2 2½H2O AR Grade CDH Bombay) in double distilled water. The pH of the water is brought between 6.9 and 7.1 by adding 1N HCl (due to insolubility of cadmium in reservoir water having 7.6 to 8.1).

Result and discussion

Table 1: Changes in the lipid content from different body parts of *Lamellidens marginalis* after exposure to acute toxicity tests of cadmium in Monsoon season

Biochemical constituents	Control	Lc0	Lc50
Mantle	4.883±0.049	5.245±0.049 (7.42%) ***	5.064±0.049 (3.70%)* (3.45%)°
Gill	5.848±0.049	3.979±0.049 (31.96%) ***	6.271±0.049 (7.23%) *** (57.60%)ooo
Gonad	4.401±0.049	2.713±0.049 (38.36)***	7.536±0.049 (71.23%) *** (177.78%) ooo
Hepatopancreas	5.305±0.049	5.546±0.049 (4.55%) **	7.053±0.049 (32.96%) *** (27.18%) ooo
Siphon	5.426±0.049	3.919±0.049 (27.78%) ***	6.148±0.048 (13.30%) *** (56088%) ooo
Foot	6.168±0.327	6.933±0.049 (12.40%)*	8.258±0.049 (33.88%) *** (19.12%) ooo
Anterior Adductor muscle	4.461±0.049	2.593±0.049 (41.88%) ***	6.872±0.049 (54.06%) *** (165.03%)ooo
Posterior Adductor muscle	5.185±0.049	3.375±0.049 (34.89%) ***	5.124±0.049 (1.17%) (57.81%) ooo

(Bracket values shows percentage difference) (*, o, $p<0.05$, **, oo $p<0.01$, ***, ooo $p<0.001$, *, compared to control group, 0- compared to Lc50 group)

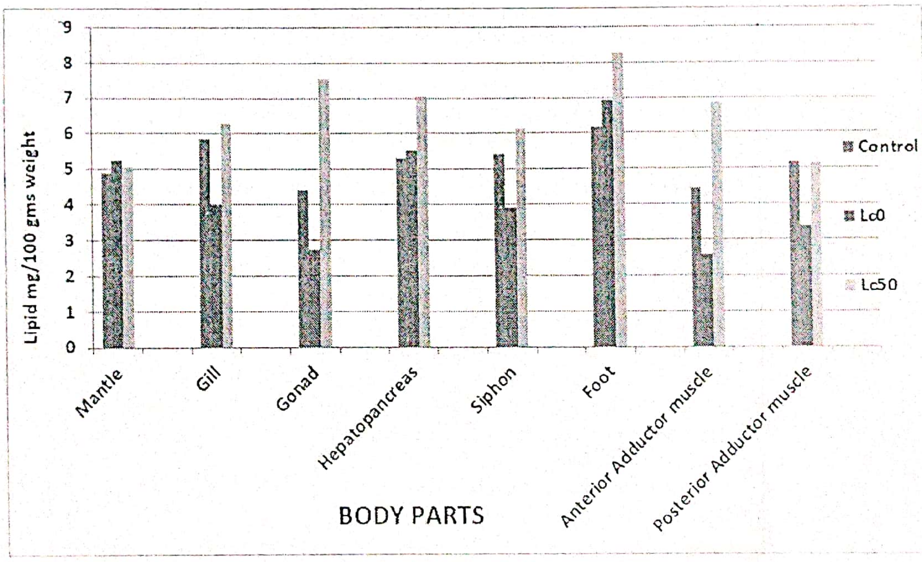

Fig 1: Changes in the lipid content from different body parts of Lammelidens marginalis after exposure to acute toxicity tests of cadmium in mansoon season

In control group the content increased from foot (6.168+0.327) followed by gill (5.848±0.094), siphon (5.426±0.491), hepatopancreas (5.305±0.049), posterior adductor muscle (5.185 + 0.049), mantle (4.883±0.049), anterior adductor muscle (4.461±0.049) and gonad (4.401±0.049). Posterior adductor muscle, siphon, hepatopancreas and gill showed almost equal amount of content. Mantle gill and anterior adductor muscle also showed equal amount of content. In LCo group the content highest values from foot (6.933 + 0.049) followed by hepatopancreas (5.546±0.049), mantle (5.245 0.049), gill (3.979±0.049), siphon (3.919±0.049), posterior adductor muscle (3.375±0.049), gonad (2.713±0.049) and anterior adductor muscle (2.593±0.049). Mantle and hepatopancreas, gill, siphon and posterior adductor muscle, and gonad and anterior adductor muscle showed almost equal amount of content. In LCs0 group increased value from foot (8.258±0.049) followed by gonad (7.536±0.049) hepatopancreas (7.053±0.049), anterior adductor muscle (6.872±040), gill (6.271±0.049), Siphon (6.148±0.048), posterior adductor muscles 2+ 0.049) and mantle (5.064 # 0.049). Gonad and hepatopancreas, gill, siphon and anterior adductor muscle, mantle and posterior adductor muscle showed almost equal amount of content.

In LCo group when compared to control the values increased sionificantly from foot (12.40% $p<0.01$) followed by mantle (7.42% $p<0.01$) and hepatopancreas (4.55% $p<0.01$) and decreased significantly from anterior adductor muscle

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(41.88% $p<0.01$) followed by gonad (38.36% $p<0.01$) posterior adductor muscle (38.49% $p<0.01$), gill (3 1.96% $p<0.01$) and siphon (27.78% $p<0.01$).

In LC50 group when compared to control group the content increased significantly from anterior adductor muscle (54.06% $p<0.01$), followed by foot (33.88% $p<0.01$), siphon (13.30% $p<0.01$) and mantle (3.70% $p<0.05$) and decrease significantly from gonad (71.23% $p<0.01$) followed by hepatopancreas (32.96% $p<0.01$), gill (7.23% $p<0.01$) and posterior adductor muscle (1.17% non-significant). On the other hand compared to LC0, L50 group showed increased significantly from anterior adductor muscle (165.03% $p<0.01$) followed by posterior adductor muscle (57.82% P <0.01), siphon (56.88% $p<0.01$) and foot (19.12% $p<0.01$) and decreased value from gonad 177.78% $p<0.01$) followed by gill (57.60% $p<0.01$), hepatoparncreas (27.18% $p<0.01$) and mantle (3.45% $p<0.05$).

Depletion of lipid content in animal tissue after exposure to various pollutants was reported by several investigators. Kamble and Rao (2010) [4], while studying the acute toxicity of Thiodon and Ekalux on the freshwater lamellibranch mollusk, *Lamellidens corrianus*, observed decrease in lipid contents in different body parts. Villalan *et al.* (1990) [19] observed decreasing lipid content due to short term cadmium toxicity in the prawn, Macrobrachium idea. Rao *et al.* (1987b) [9] reported the lipid reduction in different tissues of the bivalve, *Indonaia caeruleus* when exposed temperature and pH stress. A marked fall in the lipid level in all the tissues indicates a rapid initiation of breakdown of lipid. Lipid is a food reservoir, store and transport in the form of di, tri-glycerol's and esters. They are major structural components of the membrane. The liberated energy from the lipid can be used during crisis (Rainbow and White, 1989; Swami *et al.*, 1983) [10, 13]. Decrease in lipid content in adductor muscle of *L. marginalis* was possibly due to stress conditions caused by toxicity of cadmium chloride on lipid metabolism or due to enhanced lipolytic activity as a consequence of increased metabolic demands following exposure to the toxic stress of pesticide.

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