SUMMARY AND CONCLUSION

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Hundreds of different pollutants can be seen in water. The various pollutants and toxic chemicals can enter aquatic environment by several routes. These routes include direct precipitation, surface water, run-off, sewage discharges and industrial wastewater outfalls Heavy metals such as zinc, copper and lead can enter of water bodies from industrial wastewater and domestic wastes. Surface run-off and groundwater seepage carrying heavy metal residues can flow into rivers and lakes from such sites, causing contamination. There are several characteristics of bodies of water that have a significant effect on the toxicity of a given heavy metal. Therefore, many schemes for the protection of the freshwater ecosystem give equal weightage to the results of toxicity tests with macroinvertebrates. Standard methods for the examination of water and wastewater include coverage of the general terminology and procedures for performing bioassays.

The main objective of the study was to see if calcium could be used for elimination of lead from animals. Chelation therapy involves the use of chemical compounds which are injected into the blood stream, muscle or taken orally which forms complex with metal which is present in toxic concentrations so they can be easily removed.

In the present investigation, the fresh water bivalve, *Lamellidens marginalis* showed some changes in physiological processes on exposure with the concentrations of lead and calcium for different exposure periods. The present study on toxicological impact of Pb and detoxification of it by using calcium ions includes different parameters like characteristics of experimental and collection site water, biochemical and enzyme activities accumulation of lead in animal and histopathological changes in the animals tissue exposed to lead and calcium. These results are beneficial for the use in

monitoring of Pb and its detoxification from food chain. Following are some conclusions of the study conducted.

1. The Physico - chemical study of water like temperature, pH, Dissolved Oxygen, hardness, BOD, COD, nitrates, calcium and lead after analysis of collection site water and experiment water samples, all parameters were found within limits of MPCB standards Therefore, there will be no any additional stress from water on the test animals except lead
2. Acute toxicity of lead was studied in bivalve, *Lamelidens marginalis* for 96-hrs exposure period. Animals showed LC_0 and LC_{50} values as 60 ppm and 280 ppm concentration of lead respectively.
3. In the sub - acute toxicity dose concentration used was $1/10^{th}$ of LC_{50} values i.e. 28 ppm respectively.
4. In the behavioral study for acute exposure the bivalve showed highest mortality on higher concentration of lead. As the concentration of toxicant increased, there was increase in the percent mortality. The 100% mortality was occurred at 340 ppm concentration of lead. The behavior of bivalve showed stressed condition.
5. In the behavioral study for chronic exposure the bivalves showsed highest stress at 16 days treatment. The stress condition was increased with exposure time. Due to addition of calcium this stress was released and bivalves behaved normally.
6. The results showed that the accumulation of heavy metal lead was more in gills as compared to that of mantles of the fresh water bivalve, *Lamellidens marginalis.* This accumulation was time dependent and accumulation of lead increases with increases in time.
7. The primary functions of gills are the respiration and collection of food. The particles which enter into the mantle cavity along with the water current by the action of cilia gets spread over the surface of the gills and then get directed to the mouth, that means dissolved material in water or any type of toxicant firstly interact with gill and then with mantle.

8. The protein content also showed significant decrease on 16 days exposure compared to 8 days, in both gills and mantle tissues. The protein is the major content which indicates immediate stress conditions of animals and transaminase activity. Decreased protein content could have been resulted in muscular atrophy and reduced activity at resting stage of muscle will lead to accumulation of glycogen in muscle.
9. Protein synthesis is also reduced by property of lead to inhibit the binding of phenylalanyl and lysyl tRNA to ribosome. Another reason for reduction in protein synthesis may be due to inhibition of the enzymes involved in protein synthesis, as lead inhibits most of the enzymes by binding to functional sulphahydryl groups and also reduce cell respiration and oxidative phosphorylation. The amount of protein content was lowered in the animal with the high lead accumulation thus it appears that the protein and phospholipids in these organs are essential for synthesis of mucoprotein and glycoprotein. Therefore protein content was gradually decreased in the animal, exposed to polluted environment.
10. The mucoprotein and glycoprotein might be utilized for compensation of loss of epithelial cells, tissue deformation, tubular dilation, atrophy, macrophage aggregation, tubular cell necrosis, cell vacuolation and tissue inflammations of the organs like mantle and gill induced by the heavy metal deposition in these organs.
11. The calcium treated groups showed very minor changes in protein contents and may be due to no changes in membrane permeability caused by lead in treated groups.
12. The enzymes acid phosphatase and alkaline phosphatase showed a significant increase in the organs studied, like gills and mantle. These two are important lysosomal enzymes and help in autolysis of the cells after their death. The increase in their activity may be due to a histolytic reaction resulting from the stress. The decrease in protein contents and

increase in acid and alkaline phosphatases results in to changes in histology and cellular damage.

13. The biochemical changes observed in the tissue can be confirmed by light microscopy. The gills showed damage of cilia in gill filamental region. The connective tissue was disintegrated and gill lamellae were irregular in shape. The epithelial cells lose their identity. Basal filament, epithelial cells with accumulation of dark material. In such stress conditions acid and alkaline phosphatase activity is increased.
14. The mantle of lead treated animals also showed histological deformation on exposure. The connective tissue and mucus secreting cells were affected. They showed large acid secretion and stained with basic stain.
15. The collagen of lead treated animals also showed destruction. It is a main component of the connective tissue, due to high acid secretion these collagen fibers were damaged. This damage of collagen leads into the disturbance in all histological architecture of the tissue.
16. The groups treated with calcium dose the alteration was minor and showed curative effect. This proves calcium can be used in curing lead toxified animals to some extent.
17. Calcium treated group showed the normal histology and all structures were normal. There was no accumulation of dark material in gills.
18. The calcium is an important for controlling the cilliary movement of the gills which plays an important role in removal of the toxicants also, by stimulating cilliary movement and by forming chelating complex. Collagens were also proper hence histological architecture was normal.
19. This study suggests that calcium supplementation is an important therapy to remove Pb from organisms and also it can help to remove Pb from the food chain.

From the study it can be concluded that lead toxicity is highly dose and time exposure dependent. The main problem with these heavy metals

is that they are very persistent, especially in biological tissue and hence, once released into the environment they remain in the biota for a prolonged period because heavy metals persist in biological tissue, they are readily transferred and biomagnified in the food chains. Hence, heavy metals are dangerous because of their bioaccumulation and biomagnifications ability. There is a need to remove these metals from food chain and prevent their transfer from lower animals to higher animals. Therefore, the attempt made in this investigation may be a small effort towards detoxification of the pollutant in the environment.