SUMMARY AND CONCLUSION

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Heavy metals added to an aquatic ecosystem by natural and manmade sources during their transport are distributed between different compartments of aquatic ecosystem, such as water, sediments and biota. The metallic load then undergoes different chemical changes, whereby a high degree of variation in metal concentration occurs. Metal least soluble gets accumulated on the bottom sediments acting as sink, these metals are affected by mineralogical and chemical compositions of suspended material, anthropological influence and in situ processes such as deposition, sorption and enrichment in organism. The nonessential metal lead (Pb) occurs in the environment as a consequence of both natural and anthropogenic processes, with mining and smelting, coal burning, cement manufacturing and use in gasoline are contributing most to Pb contamination of aquatic organisms and environment (WHO, 1995). Lead chronic toxicity is a major health problem in modern society, but is also a potentially preventable problem. Use of biomonitinoring species are increased incredibly in heavy metals toxicity study and thus some of the species of fresh water and marine water Crabs and Bivalves are used for the purpose. Bivalves being tolerant species, its use in various heavy metal researches is remarkable in the world. Thus toxicity of heavy metals being base of the present investigation, the remedial study was also done on bivalves using Calcium, which is known for its metal removing capacity and chelating properties.

The main objective of study was to see if calcium could be used for elimination of lead from animals. Chelation therapy involves the use of chemical compounds injected into the blood stream, muscle or taken by mouth to bind metals that are present in toxic concentrations so they can be excreted.

Therefore, the study emphasized effect of heavy metal lead (Pb) on the Hepatopancreas and Gonads of freshwater mussel, *Lamellidens marginalis*. The investigations also reveal the fact that calcium can be used as chelating agent for toxicity removal. The results obtained are advantageous and can

prove supportive for using biological remedy for heavy metal toxicity. Following are some conclusions drawn from the study:

1. The Physico - chemical study of water involved in study were temperature, pH, Dissolved Oxygen, hardness, BOD, COD, nitrates, calcium and lead. It was observed after the analysis that almost all the parameters were found to be within limit at the animal collection site water and experiment water sample. Therefore, there will be additional stress from water on the test animals.
2. In acute toxicity study, organisms were exposed to the toxicants for the short period i.e. 96 hrs. The experimental animals, freshwater mussel, *Lamellidens marginalis* show a LC_{50} value as 280 ppm and LC_0 as 60 ppm of lead.
3. These animals when exposed to chronic toxicity of $1/10^{th}$ of LC_{50} i.e. 28 ppm for 8 days and 16 days. It was observed that animals show rapid and immediate toxic effect.
4. The results showed that the accumulation of heavy metal lead was more in hepatopancreas as compared to that of gonads of the fresh water bivalve, *Lamellidens marginalis.*
5. In hepatopancreas lead was deposited after it was absorbed by gills. Since hepatopancreas act as sink for all pollutant in molluscan and also involved in detoxification mechanism.
6. Hepatopancreas initiate immobilization of metallothionien thus gonads are less effected by heavy metals compared to hepatopancreas.
7. The Biochemical changes as a consequence of lead toxicity were manifested in reduction in glycogen in the tissue, which was observed more in 16 days exposure as compared to 8 days
8. Which might be due to longer exposure period which result in stressful environment results in mobilization of glycogen to meet energy needs warranted by toxic chemicals.
9. The decrease in the glycogen level might be due to breakdown of glycogen in digestive gland subjected to glycogenolytic activity.
10. Hepatopancrease showed maximum decrease in glycogen which proves organs involvement in detoxification and thus energy expenditure,

whereas the glycogen content was less altered in remedial group, which suggest that the calcium was acting as chelating agent thus stops the Pb ions to bind to cell membrane and alter their function.

11. The protein content also showed remarkable significant decrease on 16 days exposure compared to 8 days, which shows its immediate metabolism in 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.
12. 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 sulfhydryl groups and also reduce cell respiration and oxidative phosphorylation.
13. The calcium treated groups showed very minor changes in protein contents and may be due to no change in membrane permeability caused by lead in treated groups.
14. The enzymes Acid phosphatase and Alkaline phosphatase show a significant increase in the organs studied, like hepatopancreas and gonads. 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.
15. The enhanced level of ACP activity is partially responsible for destruction of protein content of tissue thereby resulting in impairment of RNA and protein synthesis. This will further result in depletion of protein content culminating in necrotic condition of the hepatopancreas.
16. The biochemical changes observed in the tissue can be confirmed by light microscopy. The hepatopancreas showed shrinking of tubules in some areas while enlargement in few areas. The connective tissue was disintegrated and tubules were irregular in shape.
17. The structural changes in hepatopancreas leads to inefficiency of hepatopancreas to synthesize vitellogenin protein.

18. The gonads of lead treated animals also showed histological deformation on exposure. The ovarian and testicular follicles show shrunken nature due to stress. Due to reduction in protein synthesis the hormonal cascade was disturbed which result into reproductive disturbance.
19. The gametes show abnormal development due to lack of vitellogenin essential for oocyte maturation thus slow down the reproductive process. The ruptured structures of gonad makes it clear that the germ cell lines are disturbed.
20. On the other hand in the groups treated with remedial dose the alteration were minor and shows curative effect which again proves calcium can be used in curing lead toxified animals to some extent.
21. Considering the experimental data support the premise of a potential for calcium supplementation in the amelioration of Pb poisoning as Calcium binding proteins have high affinity for Pb.

From the foregoing study it can be concluded that lead toxicity is highly dose dependent. The metals act directly or indirectly to release or inhibit some hormones essential for body metabolism and processing. These metals also interact with active sites on cell membrane and initiate metabolic disturbance. Various efforts are taken worldwide to get reed of heavy metal pollution and thus in present investigation attempts are made to produce sustainable and biological remedial method. Thus, using Calcium as media to remove heavy metal can prove effective at field level.