GENERAL SUMMARY AND CONCLUSION

*Rasbora daniconius* is found in rivers, ponds and lakes. The fish locally known as ‘Kanheri’ comes under the order physostomy and belongs to family Cyprinidae. Rasbora restricted to Indian and African regions which is distributed in India, Burma, Pakistan, Ceylon and in a rivers of East coast of Africa.

The study of effects of pollutants like heavy metals is important in aquaculture. Environmental parameters play a very important role in controlling physiological activities of the aquatic animals especially fish. Moreover, changes in the environment due to increasing urbanization include the obsolescence of the infrastructure, the pollution of city atmosphere and water pollution due to municipal waste and industrial effluent, which result in health hazards. Hence, it was thought that such study would reveal how the fishes behaviorally and physiologically cope with the altered environment. Therefore, the present probe was undertaken, to study effects of heavy pollutants on the Toxicity and Physiology of *R. daniconius*. The freshwater fish *R. daniconius* inhabits the freshwater stream and pond though out the year. It was therefore thought proper to select this fish as bioindicator of heavy metal pollution of freshwater aquatic ecosystem.
Several attempts have been made to develop biological markers or bioindicators of heavy metal contamination of aquatic ecosystems. Fish have been used for many years to indicate whether water is clean or polluted. Fish are excellent bioindicators of heavy metal contamination. The freshwater fish *R. daniconius* has been used as the bioindicator of heavy metal pollution in order to investigate acute toxicity of zinc, lead, nickel, singly and in combination. The proposed investigation on impact of interactions of metals on acute toxicity to *R. daniconius* would reveal the antagonism and synergism of metals in relation to acute toxicity.

In the toxicity studies the toxicity evaluation of heavy metals lead acetate, zinc sulphate, nickel chloride, lead acetate and zinc sulphate, lead acetate and nickel chloride, zinc sulphate and nickel chloride, and lead acetate and zinc sulphate and nickel chloride was conducted on the freshwater fish *R. daniconius* and LC$_{50}$ values were calculated. In present study the LC50 of lead acetate for 24, 48, 72 and 96 were 9.72, 8.43, 6.26 and 4.22 ppm respectively. The LC$_{50}$ of zinc sulphate for 24, 48, 72 and 96 were 14.6, 12.65, 9.38 and 6.26 ppm respectively. And LC$_{50}$ of nickel chloride for 24, 48, 72 and 96 were 82.78, 69.15, 44.86 and 29.22 ppm respectively. When these heavy metals in combination the
LC₅₀ of lead acetate and zinc sulphate 24, 48, 72 and 96 were 7.82, 6.85, 4.57 and 3.68 ppm respectively. The LC₅₀ of lead acetate and nickel chloride for 24, 48, 72 and 96 were 42.92, 32.84, 28.14 and 16.2 ppm respectively. The LC₅₀ of zinc sulphate and nickel chloride 24, 48, 72 and 96 were 59.75, 50.53, 40.02 and 30.13 ppm respectively. When these three metals in combination the LC₅₀ for lead acetate and zinc sulphate and nickel chloride at 24, 48, 72 and 96 were 37.84, 32.48, 28.09 and 25.21 ppm respectively. Heavy metal combination clearly exhibited, antagonism and synergism, lead acetate and zinc sulphate show synergism, as toxicity of combination was more where as the model combination of lead, zinc and nickel showed antagonism, as toxicity was decreased. The nickel had antagonism for both that is lead and zinc.

Lethal doses for heavy metals in order to toxicity were in decreasing manner is lead acetate and zinc sulphate > lead acetate > zinc sulphate > lead acetate and zinc sulphate and nickel chloride > lead acetate and nickel chloride > zinc sulphate and nickel chloride > nickel chloride.

Safe Concentration of heavy metals lead acetate, zinc sulphate, nickel chloride, lead acetate and zinc sulphate, lead
acetate and nickel chloride, zinc sulphate and nickel chloride, and lead acetate and zinc sulphate and nickel chloride are calculated. The safe concentrations are 1.306, 1.182, 1.165, 1.247, 1.54, 1.197 and 1.14 ppm respectively.

Further changes in oxygen consumption have been measured as a response to toxicant that the rate of respiratory movements increased in the presence of hydrogen sulphide showed that the initial reaction of fish might be an increase or decrease in rate of opercular movements depending on the pollutants. Some pollutants could be depressants and some stimulants. It seems logical that internal poisoning could change the respiration rate. Bilinski and Jones, (1973) studies performed on respiratory and metabolic rate of the fishes exposed to the heavy metal pollution have also been documented.

The conclusion of oxygen consumption were after acute treatment as compare to that of control fishes. The rate of oxygen consumption ranged from the oxygen consumed by fish was measured at an interval of 24, 48, 72 and 96 hrs. of interval was found that oxygen uptake significantly decreased. In lead acetate treated animals at the end of 24, 48, 72 and 96 hrs. were 0.1752, 0.1280, 0.1205 and 0.0875 ml/g/h/l respectively the rate of
oxygen consumption at 24, 48, 72 and 96 hrs. of exposure to the acute treatment of zinc sulphate reduced 0.1795, 0.1302, 0.1215 and 0.0922, ml/g/h/l respectively. The acute treatment of nickel chloride reduced the oxygen consumption at the end of 24, 48, 72 and 96 hrs. were 0.1852, 0.1680, 0.1482 and 0.1020 ml/g/h/l respectively. The acute treatment of binary combination of lead acetate and zinc sulphate at 24, 48, 72 and 96 hrs of interval was found that oxygen uptake significantly decreased were 0.1705, 0.1215, 0.1138 and 0.0802 ml/g/h/l respectively. The acute treatment of lead acetate and nickel chloride at 24, 48, 72 and 96 hrs. of interval was found that oxygen uptake significantly decreased were 0.1850, 0.1858, 0.1320 and 0.0955 ml/g/h/l respectively the acute treatment of zinc sulphate and nickel chloride at 24, 48, 72 and 96 hrs. showed oxygen consumption significantly decreased to 0.1845, 0.1650, 0.1420 and 0.958 ml/g/h/l respectively. Tertiary combination of lead acetate and zinc sulphate and nickel chloride, oxygen consumption were observed after 24, 48, 72 and 96 hrs. were 0.1848, 0.1482, 0.1305 and 0.0946 ml/g/h/l respectively. It is quite clear that all the heavy metal treated fishes R. daniconius showed in decreasing manner in oxygen consumption after acute treatment.
The changes in biochemical composition of muscle, liver and kidney of freshwater fish *R. daniconius* exposed to acute treatment of heavy metals were studied along with control animals with respect of percentage of glycogen, protein and lipid in dry tissue.

Results from the present study indicate that the glycogen and lipid content of the tissue like muscle, liver and kidney was found to be satisfactorily decreased after acute treatment when treated with heavy metals lead acetate, zinc sulphate, nickel chloride, lead acetate and zinc sulphate, lead acetate and nickel chloride, zinc sulphate and nickel chloride and lead acetate and zinc sulphate and nickel chloride. Whereas protein content increased in the tissue like muscle ,liver and kidney after treatment with heavy metals.