

SUMMARY AND CONCLUSION

The present *thesis* entitled “**Microbiological Quality of Water of Some Important Lakes of Tourist Importance in Darjeeling Hills**” was conducted for a period of two years (March 2011 to January 2013).

The important findings of this study are as follows:

- Physico-chemical parameters like temperature, DO and pH were measured. Low atmospheric temperatures were recorded in November - January months and high in July- September months during both years of study in all the three lakes. DO concentration did not show consistent result in the investigated lakes. The highest DO values were observed during monsoon (July-September) in Mirik and Jorepokhari Lakes whereas in Nakhapani Lake during post monsoon (November- January) season. The lowest values were recorded during winter in Mirik and Jorepokhari lakes and during summer in Nakhapani Lake.
- Low counts of TBC, TC, FC and FS were observed during post monsoon months (November- January) with sharp increase during Monsoon (July). Mirik Lake showed highest total bacterial counts followed by Jorepokhari Lake and Nakhapani Lake clearly reflecting higher pollutant input and anthropogenic activities in and around the lake in comparison to the other two lakes. High FC/FS ratio in two of the lakes under the study showed very high FC/FS ratio confirming the faecal contamination of human origin. The bacteriological results from this study did not comply with the national (BIS, 2011) or international guidelines for drinking water set by WHO (2004) standard.
- Occurrence of 60% MAR and 93.3% MDR coliform isolates exhibited very high level of faecal pollution of the lake waters. Prevalence of such resistant isolates in the lake waters is an indication of the presence of opportunistic pathogens.
- Extracts of six traditionally used anti-diarrhoeal medicinal plants i.e., *A. rivularis*, *C. speciosus*, *H. javanica*, *H. wallichii*, *P. guajava* and *R. arboreum* showed the potentiality to inhibit the growth of the selected coliforms promising the efficacy of these plants in time of emergency in being cheap and easily available. Methanolic extract of *P guajava* showed the highest anti-microbial potential.
- Native gel electrophoresis of the selected ten isolates showed more than 50% similarity in general probably reflecting variation of their sources.

- Submarine gel electrophoresis of the selected 15 coliform isolates exhibited the presence of plasmid in 13 isolates all of which were resistant to at least 3 different families of antibiotics tested with.

It can be concluded that the tested physico chemical parameters of the lake water samples have marginally crossed the acceptable limits but the bacteriological parameters exceeded the threshold values determined by the National and International agencies. The faecal coliform population was found to be of human origin.

Since quality of water is critical in disease prevalence, the lakes should be protected and regularly monitored for the formulation of action plan to prevent disease epidemics. Occurrence of high population of indicator organisms in the investigated lakes is indicative of improper practices such as poor waste disposal and dumping of wastes and other anthropogenic activities in and around the lakes.

The investigation generated some important baseline data on the pollution status of the lakes. These data would be helpful in planning for future policy decisions on using the lakes as an eco-tourist center and proper management of the surrounding catchment areas around the lakes traditional medicinal plants can be used as immediate control measure in case of epidemics as well as in the places still to be covered by medical facilities.

RECOMMENDATIONS

- This study considered only three lakes in Darjeeling Hills, however a large number of other freshwater resources particularly spring and streams are also used for water consumption. Therefore, it is recommended to replicate such studies in these freshwater resources too.
- Only a few selected physico-chemical parameters were considered, other parameters such as heavy metals and nutrients such as the phosphates and nitrates should also be determined.
- Only indicator organisms were studied, therefore, prevalence of pathogenic bacterial strains transmitted through water consumption should also be studied.

- Only six medicinal plants were used in this study. More locally found plants may also have the anti-microbial potential against the entero-pathogens, therefore the potentiality of other plants should also be explored.
- Possibility of vertical as well as horizontal transfer of antibiotic resistance property among the intestinal pathogen population calls for an urgent attention to realize the health risks and likely epidemic in the population using the lake waters for drinking and other purposes.
- Further awareness and educational programmes at community, regional and national levels is needed for the prevention as well as control of pollution of water bodies.