CONCLUSION

Liverworts are largely neglected in the search for new biologically active compounds. Very few works has been dedicated to study the composition of its secondary metabolites. Till date, research is mainly focused on higher group of plants, mainly angiosperms and no doubt a large numbers of pharmacologically active compounds have been isolated from this group; but as all these plants belong to the same Angiosperm group which contain similar kind of phytochemicals, there’s a need to look for novel natural resources from under-explored area for the discovery of new therapeutic agents. Bryophytes are the plant group which remain untouched in course of drug discovery. Considering this, in the present study, liverworts common in the natural environment of Darjeeling was selected and their pharmacological property as well as phytochemical composition was documented. Taking account of the need for conservation due to increasing human threats to liverworts, the information about the environmental conditions influencing their abundance was also investigated. Problem of adequate sample availability is mainly restricting the functional area of bio-prospection of liverworts, which could be resolved through establishing the techniques of in vitro culture. Comparing the biological activities as well as the phytochemical composition of in vitro grown plants with that of naturally growing individuals, present work recommends using in vitro technique as an alternative for solving the problem of low sample availability as no significant variation in biological activity and phyto-constituents between in vitro cultured and naturally grown liverworts has been recorded. From the result of the present study, following aspects are deserved to be considered important like:

i. Studied liverworts showed significant free radical scavenging activity similar to that of some medical plants belonging to higher group of plants. More in vitro and in vivo studies alongside detailed phyto-constituent analysis are suggested in this field for use of liverworts in disease preventing therapies.

ii. It was also known from the result that liverworts possess significant anti-diabetic activity too. In vitro bioassay guided purification by column chromatography has resulted in the identification of five phytochemicals namely, 5-hydroxy-2-(4-methoxyphenyl), 4-H-1 Benzopyran-4-one; Pimarin acid; 5 hydroxy-7-methoxy-2-phenyl, 4H-1-Benzoyran-4-one; Palustric acid and 4′,5,7-Trihydroxy isoflavone from liverwort Marchantia paleacea that specifically targets the proteins that are involved in insulin resistance pathway. Network pharmacology technique identified the phytochemicals and their protein targets along with
the mechanism of action of these proteins in insulin signalling pathway. By acting either as the agonist or antagonist, these phytochemicals were found to improve the insulin sensitivity in insulin signalling pathway. The result obtained from pharmacological network highlights the potential of liverworts in curing diabetes. Thus, work is needed to understand the series of events leading to interaction of these phytochemicals with their targets.

iii. Outcome of the experiment performed for screening the cytotoxic activity of liverworts provided groundwork to use liverworts as the active source of compounds with cytotoxic activity. Darjeeling, a part of Eastern Himalaya is a home to large number of liverworts but till date, no work related to cytotoxic activity of liverworts of this area has been reported. Thus more focused work in this field is required.

vi. Secondary metabolites present in plants are accountable for the biological activities of the plant. The results of the qualitative and quantitative test for phytochemicals done in this work, showed the presence of variety of phyto-compounds that could be isolated and further studied to understand the detailed mechanism on how they help to inhibit the activity of α-amylase and α-glucosidase enzyme in diabetes, reduce elevated free radicals during oxidative stress and decrease proliferation in cancer cell line.

v. Results showing similar or slightly changed biological activity of in vitro grown plants supported the objective of this work to use tissue cultured plants as a substitute for naturally grown plants to overcome the shortcomings restricting the use of liverworts for analytical purposes.

vi. Study of the effect of physical and biochemical factors on liverworts density found that light, moisture and age of tree exerts major influence on liverwort density. Therefore, forest management should ensure the presence of large, old trees as well as care should also be taken to maintain the forest canopy cover as abrupt exposure to light causes increased radiation leading to the changes in the microclimate resulting in habitat destruction of liverworts.