CHAPTER 5

CONCLUSION
5.1 CONCLUSION

This is not surprising that medicinal plants have been a part of the tradition and culture of the Asian people from a very long time especially in India. Survey of pharma sector shows that, interest of pharma industry in medicinal plants is increasing day by day. The topic “Chemical study of Andrographis paniculata for pharmaceutical potential” was taken into study so that it turns to be helpful for the pharmaceutical industries and in the long run can eventually benefit the human race. In order to achieve the objectives of the study, various tests were performed, by the help of which potential and medicinal qualities of the plant Andrographis paniculata were enormously highlighted.

Results of physico-chemical study reveals that ash value of whole plant material (drug) was maximum when the crop was fully matured and LOD of drug was also found to be higher than that of leaves of Andrographis paniculata. In all the extractive values tested, alcohol soluble extractive value was maximum. The results were helpful to achieve main objective i.e. pharmaceutical potential of drug. Study of physiological variation show higher percentage of chlorophyll in young stage and with decrease in chlorophyll content anthocyanin content was increasing. Presence of increased percentage of Andrographolide in young plant may be due to the presence of chlorophyll or not, is still an area of research that still has to be explored. The finding of phytochemical analysis shows the presence of polyphenols and indicates that leaves and whole plant material of Andrographis paniculata have antioxidant qualities. Methanolic extract of Andrographis paniculata has highest phenol and flavonoid content followed by ethanolic extract. Medicinal value of leaves of the plant Andrographis paniculata due to presence of polyphenols content was better than Tinospora cordifolia.

The methanolic extracts of leaves of Andrographis paniculata showed promising anti-oxidant activity. Results also suggest that there is a direct co-relation between the total polyphenols extracted and anti-oxidant activity. Reducing power of the methanolic extracts of the leaves of Andrographis paniculata was compatible with synthetic anti-oxidant. The methanol extract of the leaves of Andrographis paniculata exhibited appreciable activity as compared to the aqueous and ethanol extracts. These results showed that leaves of Andrographis paniculata in drug form can replace synthetic anti-oxidants. Anti -microbial study evaluated the activities of extracts of whole plant material (drug), different parts of plant with geographic variation against the test organisms.
The results implied that these extract samples contain compound with therapeutic potential when compared to the anti-biotic against tested pathogens. All the extracts tested showed varying degree of anti-microbial activities. Results clearly indicate that leaves and whole plant material of *Andrographis paniculata* can be used as natural anti-microbial agent. Crude extract of *Andrographis paniculata* before flowering in chloroform can be used for further purification and preparation of new anti-microbial for the more resistant type of micro-organisms. Further anti-microbial study is required so that *Andrographis paniculata* can replaced synthetic antibiotics.

Andrographolide was purified from *Andrographis paniculata*, preliminary and confirmatory tests were conducted to make sure the plant sample contained active diterpene lactones and Andrographolide was present in *Andrographis paniculata*. The purified Andrographolide was further confirmed by melting point, ph value, color test, UV $\lambda$ max and was compared with standard bio-marker of Andrographolide. HPTLC and HPLC of different stages of life cycle of plant, different parts of plant and from different locations reveals that Andrographolide content decreases after the plant crosses 110 days mark and advances in its life cycle to eventually become fully mature. Leaves were the most enriched part of the plant than the others in terms of Andrographolide content. Results of chemistry and bioactivity of *Andrographis paniculata* in different phyto-geographical sites are helpful in accordance with pharmaceutical potential. When the plant was studied for the full one year cycle by HPLC, it was noticed that Andrographolide content varied significantly during one year time. It was observed that Andrographolide content in the leaves and whole plant material (drug) was maximum in October and minimum in June. Results of study of seasonal variation of main active constituents Andrographolide is helpful in harvesting of plants at perfect time to obtained highest yield percentage. Another result of HPLC which was obtained by the chemical study of *Andrographis paniculata* was that, Andrographolide content was far higher in the green leaves in comparison to dry leaves, proving that use of green leaves by the pharmaceutical industries will be helpful in the manufacturing of most efficient products of *Andrographis paniculata*.

Results of the study indicate that cultivated plants without adding any specific manure have high content of Andrographolide than the naturally grown ones. Study reveals that the plant continued to grow even after one year which was earlier doubtful and it was surprisingly observed that Andrographolide content was not only restored to its initial percentage but later on it was also found to be even more than fully matured crop. A result of fresh and six month old extracts of the
leaves and drug indicates the shelf value of the extracts of *Andrographis paniculata*. For the best medicinal value, extracts must be used within one month of extraction in ideal conditions. These results may be helpful for pharma industries. All results of the study will be helpful in findings of pharmaceutical potential of *Andrographis paniculata*. A large numbers of natural medicines of *Andrographis paniculata* are available in the market. Results of identification and yield determination of the main active constituent Andrographolide may be helpful in increasing the effectiveness of these medicines. Findings of this study may be helpful in harvesting of plants at the perfect time so that optimum parts of drug for high medicinal potential can be utilized by drug manufacturers.

All results of the study are helpful in generating the data useful for resourceful application in pharmaceutical industries. Variation in Andrographolide content of *Andrographis paniculata* in different geographical sites concluded, that in Dehradun, cultivation of *Andrographis paniculata* can be easily carried out with minimum use of natural resources available. Results of the study will not only be helpful in development of the local pharmaceutical industries but also in blooming of the financial condition of the farmers in Dehradun. This study explored the quality and value of the medicinal plant *Andrographis paniculata* for pharmaceutical industries.

**5.2 Scope for further work**

All results are very encouraging and are very helpful in future investigation of *Andrographis paniculata* plant medicinal values. The above findings recommend the further investigation of *Andrographis paniculata* leaves to evaluate their chemical potential. The developed HPLC method can be utilized for the quantitative determination of Andrographolide in *Andrographis paniculata* herb samples. The method developed is simple, sensitive and statistically validated. Use of leaves of *Andrographis paniculata* as a natural anti oxidant for the replacement of synthetic anti oxidants, demands further detailed study. Recently, some new phytochemical have been isolated from the plant *Andrographis paniculata*. Detailed chemical study of these contents has not been done till date. In future their detailed study may be possible after the investigation of standard bio markers. The results of the research may be helpful in advance study of the plant in India and abroad for the benefit of mankind. Extensive work has been done on this plant, but still it requires more R and D work for drug development.