



**CHAPTER- 6**  
**SUMMARY AND**  
**CONCLUSION**

## SUMMARY AND CONCLUSION

Under this work attempts have been made to evaluate roots, leaves and fruits of four medicinally important species viz. *Carissa congesta* Wight, *Carissa carandas* L., *Carissa opaca* Stapf ex Haines and *Carissa spinarum* L. using pharmacognostic tools which covers the experimental studies on botanical, chemical and biological aspects. The aspects studied and results obtained have been summarized as below.

- Detailed pharmacognostic studies have been carried out using parameters of morphology, anatomy and phytochemical studies.
- Powders of different parts have been evaluated microscopically and for qualitative phytochemical tests, fluorescence analysis.
- Extracts of different parts have been studied using TLC profiles and HPTLC parameters.
- Quantitative assessment of proximate contents, secondary metabolites and active constituents has been carried out.
- Based on these studies quick and correct identification keys have been developed for species specific identifications.
- Antioxidant potentials of different parts have been evaluated using DPPH method.
- Antimicrobial activity of root extracts has been evaluated.

These studies revealed following conclusion

- Detail pharmacognosy of *all* the four medicinally important species viz. *Carissa carandas* L., *Carissa congesta* Wight, *Carissa opaca* Stapf ex Haines and *Carissa spinarum* L. has been worked out which helped to resolve ambiguity of species delimitations and proper use values of valued species.
- Studies revealed pharmacognostic characterization for root, leaf and fruit of *Carissa congesta* Wight and *Carissa opaca* Stapf ex Haines as well as leaf and fruit of *Carissa spinarum* L. for the first time.
- The studies bring on record many distinguishing characters for species delimitations based on different aspects, besides morphological features which are sometimes overlapping between the species. Keys, distinguishing the species, have been given.

- The comparative leaf architectural studies showing clear distinguishing pattern between the species have been reported for the first time. Key has been formulated based on leaf architecture. Research paper has been published based on this aspect.
- Fluorescence analysis studies of root stem and leaves have helped for easy and quick identification of the *Carissa* L. species. Keys have been formulated based on fluorescence analysis for the first time.
- Macroscopic and microscopic characterization of *Carissa carandas* L. fruits given in pharmacopoeia (Anonymous, 2005) are comparable to *Carissa congesta* Wight of the present work. This suggest the probability of mistake in nomenclature used in given pharmacopoeia.
- Quantification of marker compounds i.e. Lupeol,  $\beta$ -sitosterol and Naringin in fruits, leaves and roots extracts have been done by HPTLC technique. TLC/ HPTLC studies reveal the presence of marker compound  $\beta$ -Sitosterol in roots and leaves of all the species and fruits of *Carissa congesta* Wight only whereas the presence of Lupeol has been recorded in all the parts of four species. Naringin has been found only in the leaves of *Carissa opaca* Stapf ex Haines.  $\beta$ -Sitosterol is in more quantities in roots ranging between (19.91-30.60 mg/g) and minimum in leaves (3.82- 10.07mg/g). Lupeol content has been found more in roots (ranges between 24.10-36.91 mg/g amongst the species) than in leaves (22.86-25.01 mg/g and almost at par between the species). Amongst fruits, lupeol content is found significant in *Carissa congesta* Wight (24.50 mg/g). Naringin has been recorded only in *Carissa opaca* Stapf ex Haines leaves (7.29 mg/g). The quantitative assessment is useful to define potency of species towards activity of these ingredients.
- The comparative phytochemical studies on four medicinally important *Carissa* species reveal that *Carissa congesta* Wight is the best amongst all if fruit constituents are concerned and match with ayurvedic script –group of cordials (Su 4/10). *Carissa carandas* L. can be the best substitute for *Carissa congesta* Wight having good Vit-C, flavonoids and glycosides in fruits. *Carissa opaca* Stapf ex Haines leaves having naringin content and maximum tannin contents can be stated as the best for therapeutic usage.
- The antioxidant activity has been found in roots in order *Carissa carandas* L. <*Carissa congesta* Wight <*Carissa opaca* Stapf ex Haines <*Carissa spinarum* L. In fruits, on the other hand, minimum activity is found in *Carissa spinarum* L. and maximum *Carissa opaca* Stapf ex Haines.

- Antimicrobial activity of roots has been evaluated against various diseases causing organisms (*Escherichia coli*, *Salmonella typhi*, *Staphylococcus aureus*, *Agrobacterium tumefaciens*, *Erwinia carotovora*, *Enterococcus faecalis*) has shown positive activity against some of the tested extracts. Ethanol and methanol extracts of roots of all the four species have shown very promising activity against *Escherichia coli* and *Enterococcus faecalis*. For ethanol extract the *Carissa carandas* L. has shown the highest activity against *Escherichia coli* and *Carissa congesta* Wight and *Carissa spinarum* L. has shown the highest activity against *Enterococcus faecalis*. In methanol extract *Carissa carandas* L. and *Carissa opaca* Stapf ex Haines have shown very promising activity against *Staphylococcus aureus*.