Chapter 9

General Discussion on chemotaxonomy of Myrtales

The distribution of the various phytochemicals in the nine families screened is presented in the Table 9. Flavonols were omnipresent and flavones were seen in six families. Gossypetin, a characteristic flavonol of rare occurrence, was identified from five families. Quinones also were fairly commonly seen in all the eight families except Rhizophoraceae. Alkaloids were located in four families. Tannins were located in five families.

If we consider **gossypetin** and its derivatives as valid taxonomic markers, the Rhizophoraceae, Alangiaceae, Onagraceae and Lythraceae stand apart from the rest of the families in not possessing these compounds. The Rhizophoraceae are also peculiar in the absence of quinones which are widely distributed in all the other families. These features in combination with the other characters, which distinguish this family from the Myrtales, like the absence of internal phloem and presence of large interpetiolar stipules, seeds with well-developed endosperm and scalariform vessels indicate that the **Rhizophoraceae** are not at home in the order Myrtales. The absence of the isoquinoline alkaloids of the Cornales and iridoids keeps this family away from the Cornales also. The Rhizophoraceae are similar to the members of Rosales in having flavonols as the dominant pigments. But the absence of sorbitol (a characteristic compound of Rosales), apocarpous pistil and numerous stamens do not favour the inclusion of this family in the Rosales either. The shifting of this family to the Geraniales, as practised by Thorne (2000), does not get any chemical support because tannins are unheard in any of the member families of the Geraniales. Most of the plants in the Geraniales are herbs characterized by lignans (Linaceae), volatile oils (Geraniaceae) or saponins (Zygophyllaceae) and all these compounds are not synthesized by any member of the Rhizophoraceae. The presence of flavones along with flavonols in *Carallia* brings this family closer to the Combretaceae and other families of the Myrtales. Therefore the phenolic profile favours the **treatment of Rhizophoraceae in a unifamilial order Rhizophorales** closer to the Myrtales.

Table 7: Comparative account of phytochemicals in the families studied

Sr. No.	Family	Flavones	Flavonols	Gossypetin	Tannins	Quinones	Alkaloids
1.	Myrtaceae	16 %	100 %	39 %	100 %	56 %	6 %
2.	Combretaceae	30 %	100 %	46 %	100 %	38 %	—
3.	Lythraceae	42 %	57 %	Absent	100 %	100 %	28 %
4.	Punicaceae	100 %	100 %	100 %	100 %	100 %	100 %
5.	Onagraceae	—	100 %	—	—	100 %	—
6.	Lecythidaceae	—	100 %	66 %	—	66 %	—
7.	Alangiaceae	—	100 %	—	—	100 %	100 %
8.	Melastomataceae	22 %	88 %	11 %	—	66 %	—
9.	Rhizophoraceae	33 %	100 %	—	100 %	—	—

The Alangiaceae also with their distinct characters such as presence of latex, isoquinoline alkaloids of emetine type and unitegmic crassinucellar ovules are distinct from the other families included in the Myrtales. Therefore, shifting of this family to the Cornales as practised by all recent taxonomists is upheld.

The fact that only one member has been screened in the Onagraceae, that too aquatic (where the incidence of flavonols are too low) out of the total 17 genera of this family, prevents me from drawing any valid taxonomical conclusion on this family. Otherwise the Onagraceae is very much at home in Myrtales with their internal phloem, the typical character of the order. But it is somewhat isolated in this order due to its 4-nucleated embryo sac (unique in this order) and diploid endosperm which is initially nuclear. Data on other members of this family are to be procured for drawing any taxonomic conclusions here.

The Lythraceae also stand apart in their failure to synthesize gossypetin and its derivatives. But this family also is very similar to the other families of the Myrtales in having internal phloem, quinones and flavonols. Therefore this family may be treated in a separate suborder Lythrineae as recommended and practised by Thorne (2000).

The family Lecythidaceae also is distinct from the remaining families in the absence of tannins, flavones and alkaloids. It differs from the characteristic members of the Myrtales, however, in their alternate leaves, bitegmic tenuicellular ovules, lack of internal phloem and a series of embryological features that have been elucidated by Mauritzon (1939). Cronquist (1981) considered these differences too formidable to ignore and since no other order could accommodate the Lecythidaceae with undue strain, he recognized an order Lecythidales. Once removed from the Myrtales, the placement of Lecythidales was a problem and the Rosidae and Dilleniidae were the two subclasses which could accommodate this order.

According to Cronquist (1981), the Lecythidales were found to be much more at home in the Dilleniidae than in the Rosidae. The bitegmic, tenuicellular ovules of this order are seen in orders like Theales, Primulales and Ebenales, but are rare and scattered elsewhere. Although centrifugal stamens have been demonstrated in the Myrtales, this kind of androecium is much more common in the Dilleniidae. Stratified phloem of the Lecythidales is especially common in the Malvales and to a lesser extent in the Theales.

Wedge-shaped phloem is likewise more common in the Malvales and Theales. *Barringtonia* in the Lecythidaceae produces 3-sambubiosides, similar to those of *Hibiscus*. In addition, the Lecythidales resemble characteristic members of the Malvales in their valvate calyx, connate filaments and mucilage (*Lecythis*), but differ in the absence of stellate pubescence and cyclopropenoid fatty acids. The Lecythidales resemble several families of the Theales in their bitegmic, tenuicellular ovules and they resemble the Ochnaceae in having cortical vascular bundles. The pollen structure also is readily comparable with that of the Theales and Malvales. With all these reasons Cronquist (1981) derived Lecythidales and Malvales as cases of parallel evolution with divergent specializations from a common ancestry in the Theales. Thorne (2000) also supported this contention.

But this treatment does not get any support from the present investigation. Many of the members do elaborate gossypetin and related compounds typical of the Myrtales. The stratified phloem and the centrifugal stamens, the characters on the strength of which the affinity with Malvales is sought, are seen in Myrtaceae too. The quinones common in Lecythidaceae are rare in Theales and Malvales. But the absence of internal phloem is a valid taxonomic difference with Myrtales. Taking into consideration all these characters, it appears logical to keep the Lecythidaceae separate in a unifamilial order Lecythidales which is to be kept just near Myrtales in Rosidae itself.

The remaining four families appear to be a closely knit group within which some taxa produced their own characteristic chemical feature/s. Thus the Combretaceae developed combretastatins, Punicaceae elaborated pyridine alkaloids and Myrtaceae developed volatile oils. The Myrtaceae appear to be the most primitive family here with a profusion of flavonols and tannins. The Melastomataceae abandoned tannins and thus are at a higher level of evolution. The Punicaceae with their flavones are the most advanced group here. The putative phytogenetic relationships are presented in Fig. 1

The presence of gossypetin, first located in a few members of the Malvaceae brings Myrtales closer to this taxon. But the Malvales being too specialized to be an ancestor to the Myrtales and the production of gossypetin may be due to parallel evolution or due to a common ancestry. This concept brings the Theales into the picture as the possible ancestor of Myrtales. But the Myrtales are traditionally believed to have

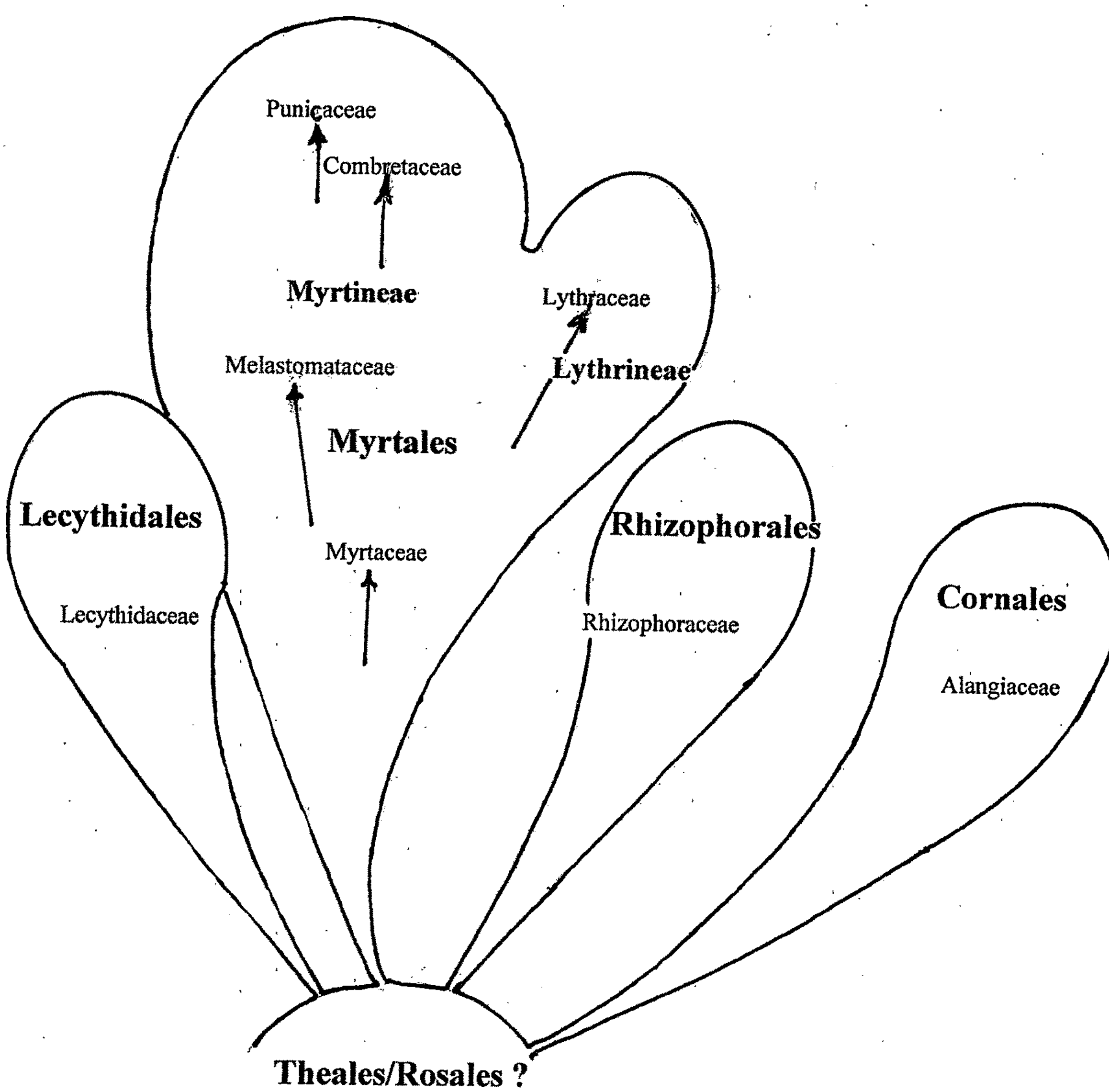

Fig. 1. Putative phylogenetic relationships of the families included in Myrtales and related taxa

originated from Rosales. More work in these lines are needed to decide on this issue of the ancestral group of Myrtales whether Theales or Rosales.

Regarding the **Bioprospecting** aspect of the present study three new sources of combretastatins and 47 new sources of bioflavonoids were discovered. The new sources of combretastatins are the following:-

1. *Combretum coccineum*
2. *Combretum extensum*
3. *Combretum ovalifolium*

The order Myrtales and allied taxa are a rich store house of **bioflavonoids.** The plants which can be used as sources of bioflavonoids are the following:-

Myrtaceae

1. *Syzygium malaccense* (leaves)
2. *Eugenia uniflora* (leaves and stem)
3. *Syzygium cumini* (leaves)
4. *S. jambos* (leaves)
5. *S. zeylanica* (leaves and stem)
6. *Psidium guajava* (leaves)
7. *P. cattleyanum* (leaves and stem)
8. *Callistemon lanceolatus* (leaves and stem)
9. *Eucalyptus globulus* (leaves and stem)
10. *Pimenta dioica* (leaves)
11. *Melaleuca cajupute* (leaves and stem)
12. *M. leucadendron* (leaves and stem)
13. *Leptospermum scoparium* (leaves and stem)
14. *L. flavescens* (leaves and stem)
15. *Syzygium aromaticum* (leaves and stem)

Combretaceae

16. *Terminalia bellirica* (leaves)

17. *T. arjuna* (leaves and stem)
18. *T. catappa* (leaves)
19. *T. crenulata* (leaves)
20. *T. paniculata* (leaves)
21. *Combretum extensum* (leaves and stem)
22. *C. ovalifolium* (leaves and stem)
23. *C. coccineum* (leaves)
24. *Quisqualis indica* (leaves and stem)
25. *Q. malabaricum* (leaves)
26. *Anogeissus latifolia* (leaves)
27. *Calycopteris floribunda* (leaves and stem)

Lythraceae

28. *Ammania baccifera* (leaves and stem)
29. *Lagerstroemia flos-reginae* (leaves)
30. *L. indica* (leaves)
31. *L. parviflora* (leaves and stem)
32. *Lawsonia inermis* (leaves and stem)
33. *Woodfordia floribunda* (leaves)

Melastomataceae

34. *Melastoma malabathricum* (leaves and stem)
35. *Osbeckia grandiflora* (leaves and stem)
36. *Memecylon edule* (leaves)
37. *Medinilla rubicunda* (leaves and stem)
38. *Dissotis rotundifolia* (leaves and stem)
39. *Tibouchina semidecandra* (leaves)

Rhizophoraceae

40. *Rhizophora mucronata* (leaves and stem)
41. *Bruguiera gymnorhiza* (leaves and stem)

42. *Carallia integerrima* (leaves and stem)

Punicaceae

43. *Punica granatum* (leaves and stem)

Lecythidaceae

44. *Couropita guianensis* (leaves and stem)
45. *Careya arborea* (leaves)
46. *Barringtonia acutangula* (leaves and stem)
47. *Alangium salvifolium* (leaves)