

BOMBACACEAE

Chapter 4

BOMBACACEAE

The Bombacaceae are the closest ally of the Malvaceae. It is a tropical family consisting of 20-30 genera and about 200 species. The Bombacaceae consist of tall trees with an unusually thick trunk containing a high proportion of parenchymatous water-storage tissue and soft and light wood. The stem is usually armed with deciduous thorns. Leaves simple or compound, alternate, deciduous often with slime cells and beset with stellate hairs or peltate scales (lepidote), stipules caducous. Flowers commonly large and showy, solitary or in axillary or leaf-opposed¹ cymose clusters, actinomorphic, rarely slightly zygomorphic, hypogynous, or slightly perigynous, bracteate often appearing before the leaves. Perianth sometimes subtended by an involucre (epicalyx). Sepals five, distinct or connate at the base, valvate, nectaries consisting of tufts of glandular hairs at the base of sepals. Petals five, distinct or occasionally absent, contorted in bud. Stamens 5-numerous, adnate to the base of the petals, generally connate by their filaments into 5-15 phalanges or into a tube that may divide

into 5-15 phalanges. Some of the stamens are staminodial. Anthers 1-celled, but sometimes irregularly associated on the connate filaments so that some of them may appear to have more than one theca, opening by a longitudinal slit. Pistil one, 2-5 (-8) carpellary, ovary superior, 2-5 loculed, ovule 2 or more in each locule in basal placentation, anatropous, bitegmic, crassinucellar with a zig-zag micropyle. Style one, capitate or lobed. Stigma 1-5. Fruit a loculicidal capsule or seldom berrylike or an indehiscent pod. Seeds often arillate and commonly embedded in a pith like tissue or in a woolly proliferation of the pericarp. Endosperm scanty.

Anatomical features

The anatomical features of this family closely resemble those of the Malvaceae. Stellate and characteristic peltate hairs are often seen. Extrafloral nectaries also are seen in the leaves. Mucilage cells are present in the epidermis and mesophyll of leaves while mucilage cells and cavities are seen in the parenchyma of cortex and pith of stems. Cluster crystals of calcium oxalate occur in parenchyma while silica grains are seen in the xylem cells. Phloem wedge-shaped and usually stratified into fibrous and non-fibrous tangential zones. Vessel segments with simple perforations and imperforate tracheary elements with simple perforations or bordered pits, sometimes septate. Parenchyma abundant and sometimes forming the ground tissue of the wood, apotracheal or in narrow sheets around the vessels (vasicentric). Rays uniseriate or pluriseriate, the latter upto about 10 (4-10) cells wide, mostly heterocellular often including tile cells.

Palynological characters

The pollen of this family shows great variations in size, apertures and ornamentation. A recent study on pollen grains of 29 genera of Bombacaceae revealed 11 pollen types (1) *Bombax*-type, (2) *Ceiba*-type, (3) *Chorisia*-type, (4) *Ochroma*-type, (5) *Kostermansia*-type, (6) *Asterolepis*-type, (7) *Rhodographalopsis*-type, (8) *Durio*-type, (9) *Rhodognaphaton*-type, (10) *Intricata*-type and (11) *Glyranthera*-type. The first 5 pollen types are 3 (-5)-colporate with reticulate, microreticulate, tectate-perforate, rugulose, spinulose, rarely verrucose or smooth exine. The *Rhodographalopsis* and *Durio* types contain both colporate and pororate types. The *Bombax* and *Durio* types are relatively heterogeneous (Nilsson and Robyns, 1986).

Embryological and Cytological characters

The Bombacaceae are very close to the Malvaceae in embryological features. Pollen grains are binucleate at anthesis. Ovules are anatropous, bitegmic crassinucellar with a zig-zag micropyle. Endosperm scanty and development nuclear. The basic chromosome number is large, 28, 36 or 40.

Chemistry

Not much is known on the chemistry of this family. Mucilage is present in a number of plants as also cyanogenic glycosides (Gibbs, 1974). Tannins are reported from *Adansonia*. Fatty acids similar to those of the Malvaceae are isolated from seeds of *Ceiba* (Kaimal and Lakshminarayana, 1970).

Economic importance of the family

Bast fibre is obtained from **Adansonia digitata**. The floss around the seeds which arises from the wall of the fruit of silk cotton trees (belonging to the genera **Bombax** and **Ceiba**) are used for upholstery purposes and in the manufacture of life-saving and other equipment where buoyancy is important. Soft and light woods are obtained from **Ceiba**, **Ochroma** and **Bombax**. **Durio** yields edible fruits. The fruit pulp of **Adansonia** is used as demulcent and astringent in dysentery while the leaves of the same plant are used as diaphoretics and a prophylactic against fevers. The various species of **Adansonia**, **Bombax**, **Chorisia** and **Pachira** are cultivated as ornamentals.

Taxonomy

Schumann (1895) divided the Bombacaceae into three tribes Adansonieae, Matisieae and Durioneae and this classification is generally followed. The affinities of the Bombacaceae with the Malvaceae and the resultant controversies are already described in the previous chapter.

In the present work three members of the Bombacaceae i.e. **Adansonia digitata**, **Bombax ceiba** and **Ceiba pentandra** are subjected to a chemotaxonomic analysis.

Materials and Methods

Both **Bombax** and **Ceiba** were procured from Baroda. **Adansonia** was collected from Victoria gardens, Bombay. Standard procedures described in chapter 2 are followed for

the extraction, separation and characterisation of various compounds.

Results

The results of screening leaves of the three members of the Bombacaceae are presented in Table 4. All the three plants contained flavonoids. *Adansonia* contained only flavonols while *Ceiba* and *Bombax* possessed flavones. The flavonols in *Adansonia* were the relatively unspecialised kaempferol and quercetin. No Methylated flavonols were seen in this plant. The flavones in *Bombax* were 7-OMe apigenin and 7,4'-diOMe apigenin while *Ceiba* contained only the former compound. Proanthocyanidins were seen only in *Ceiba pentandra*. Among the phenolic acids, vanillic, syringic, and melilotic acids were present in all the three plants. Ferulic acid is identified in *Bombax* and *Ceiba*. None of the plants produced glycoflavones. Both alkaloids and tannins were present in *Ceiba* while the former group of compounds are located in *Adansonia* also. Tannins in *Ceiba* were in trace amounts.

Discussion

In containing flavones, flavonols and proanthocyanidins, the Bombacaceae are almost identical with the Malvaceae. In both the families flavones present are of the apigenin derivatives. Of course these compounds form the dominant flavonoids in the Bombacaceae while they come second to flavonols in the Malvaceae. The reverse trend is seen in the distribution of flavonols. These compounds are present in a majority of plants in the Malvaceae whereas in Bombacaceae they are obtained from *Adansonia* only. Proanthocyanidins and tannins are rare in both these families. Similarly both the families contain saponins in

Table 4 : The distribution of flavonoids, phenolic acids and other phytochemicals in members of the Bombacaceae

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|----------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|
| (1) <u>Tribe Adansonieae</u> | | | | | | | | | | | | |
| 1. <i>Adansonia digitata</i> L. | . | . | + | + | . | + | + | + | . | . | . | + |
| 2. <i>Bombax ceiba</i> L. | + | + | . | . | . | + | + | + | + | . | . | . |
| 3. <i>Ceiba pentandra</i> Gaertn | + | . | . | . | + | + | + | + | + | + | . | + |

(1) 7-OMe Apigenin, (2) 7,4'-DiOMe Apigenin, (3) Kaempferol, (4) Quercetin (5) Proanthocyanidins (6) Vanillic acid, (7) Syringic acid, (8) Melilotic acid, (9) Ferulic acid (10) Alkaloids (11) Saponins, (12) Tannins.

many plants. All these features corroborate the close affinities existing between the Bombacaceae and the Malvaceae.

The Bombacaceae are different from the Malvaceae in their inability to synthesise glycoflavones, a group of compounds present in a number of members of the latter family. In the Malvaceae, the tribe Hibisceae, appears to be the closest ally of the Bombacaceae because it is the group containing flavones in good amounts. It is noteworthy that this tribe has capsular fruits (as Bombacaceae) while the rest of the Malvaceae produce schizocarpic fruits. In vascular structure also the shrubby genus **Hibiscus** (Hibisceae), with its solitary cylindrical vascular strands is exactly comparable with the least complex type to be found in the Bombacaceae (Metcalf and Chalk, 1950). However the shifting of the Hibisceae to the Bombacaceae as suggested by Edlin (1935) cannot be supported because the Hibisceae are distinctly different from the Bombacaceae in elaborating glycoflavones and methoxylating their flavonols. Therefore the Hibisceae should be treated as a constituent tribe of the Malvaceae rather than of Bombacaceae.

Within the Bombacaceae, **Bombax** and **Ceiba** are chemically very close in possessing similar flavones. **Adansonia** is distinctly different from these two genera in producing flavonols instead of flavones. Since the number of plants screened is quite small, only after acquiring data from many more plants of these taxa, any taxonomic conclusion can be arrived at.

The interrelationships of the Bombacaceae with other families of the Malvaceae are discussed in Chapter 8.