SUMMARY AND HIGHLIGHTS

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Detailed study of the family using chemical characters and a re-evaluation of past research involving various botanical discipline has been done for a logical treatment of the family. The thesis incorporates chemical studies on hundred and two plants belonging to the families Scrophulariaceae (72), Pedaliaceae (2), Orobanchaceae (2), Gesneriaceae (1), Lentibulariaceae (3), and Solanaceae (22). The members have been screened for various chemical markers such as leaf flavonoids, phenolic acids, proanthocyanidins, quinones, saponins, iridoids, alkaloids and tannins. This survey revealed a number of new sources of secondary metabolites. The new chemical reports include flavones from 64 plants, glycoflavones from 11 plants, flavonols from 18 plants and iridoids from 22 plants. The chemical data obtained have been used to assess the intrafamilial classification and interrelationships among various taxa at all levels of hierarchy. The answers to all the querries raised in the introductory chapter of this thesis have been sought out and the position and status of a number of controversial taxa have been confirmed. The highlights of the present investigation are summarized below.

The high incidence of saponins and benzoic acids as also the rarity of glycoflavones, proanthocyanidins, quinones,

alkaloids and tannins are features which bind together members of the family. A classification based on a priori weighting on chemical characters has been attempted in the family. This, however, is not very much in conformity with the existing systems of classification.

Within the Scrophulariaceae, only the subfamily Rhinanthoideae exhibits a separate chemical identity. The subfamilies Pseudosolaneae and Antirrhinoideae are similar in containing 6-oxygenated flavones, glycoflavones, proanthocyanidins, alkaloids and cinnamic acids as also by the rarity of iridoids. These chemical features justify the merger of the two subfamilies, thereby recognising only two subfamilies, viz. Antirrhinoideae and Rhinanthoideae as proposed by Pennell (1935). The advanced chemical and morphological characters of the subfamily Rhinanthoideae keep it as the climax group of the family Scrophulariaceae.

The different tribes within the subfamilies and genera within the tribes are characterized by various assortments of chemical characters.

The primitive nature of the tribe Gratioleae (Subfamily Antirrhinoideae) expressed in morphological characters is reflected in their chemical nature too. The infrequent presence of iridoids as well as 6-oxygenated flavones and the presence of C-glycosides, proanthocyanidins and quinones keep the tribe

Gratioleae as the primitive tribe within the subfamily Antirrhinoideae. The tribe Antirrhineae is warranted as the most evolved because of the frequent presence of 6-oxygenated flavones and iridoids.

The tribe Digitaleae, in having, 6-oxygenated flavones, glycoflavones, proanthocyanidins and quinones added by the rarity of iridoids is dissimilar to other members of the subfamily Rhinanthoideae and thus is shifted from Rhinanthoideae to Antirrhinoideae as once proposed by Schmid (1906) and Bellini (1907).

The creation of the monogeneric tribe Russelieae (Thieret, 1967) is justified chemically. The genus Russelia is distinct within cheloneae in having quinones, iridoids and caffeic acid.

Chemical characters do not warrant the subtribal segregation of the tribe Gratioleae. The various genera within the tribe are divided on chemical ground and the groups formed are not in accordance with the subtribal divisions of Bentham and Hooker (1876). However, the subtribes within the Digitaleae show distinct chemical traits, thereby can be raised to the tribal status as practiced in recent systems (Pennell, 1935).

The generic distinction of Lindernia and Torenia on the basis of flavone alone (Diaz, 1977) is not acceptable. Nevertheless, the presence of proanthocyanidins in Torenia can distinguish it from Lindernia. The differences between Kickxia and Linaria in morphological, cytological and seed characters

are complemented by chemical characters. Their generic segregation is thus, justified. The genus Antirrhinum in possessing C-glycosides and quinones is distinct from Linaria. The magnitude of differences between the two genera, warrants a subtribal segregation of the two genera, within the tribe Antirrhineae.

The proposed affinity between the genus Scrophularia and Verbascum (Thieret, 1967) does not gain any chemical support. Verbascum, in contrast to Scrophularia is devoid of 6-oxygenated flavones and show the presence of glycoflavones and iridoids.

The lucid chemical affinity between Scoparia and the members of Gratioleae justifies the shifting of Scoparia from the tribe Digitaleae to the Gratioleae (Pennell, 1935). This holds true for the genus Sutera too, which has been shifted from the tribe Manuleae to the Gratioleae. The placement of Lindenbergia within the tribe Gratioleae is supported on chemical characters, for the plant shows the characteristic combination of 6-deoxy, 6-oxy and glycoflavones as noticed in other members of the tribe.

Pedaliaceae, Orobanchaceae, Gesneriaceae, and Lentibulariaceae are the satelite families analysed for their chemical similarity with the Scrophulariaceae. The Pedaliaceae, show a marked chemical affinity with the Scrophulariaceae in having 6-oxygenated flavones and iridoids. Martynia is distinct from Pedalium in having glycoflavones, saponins and phenolic acids such as p-OH benzoic acid and ferulic acid. Thus, the separation of Martynia along with few other genera into a distinct family

Martyniaceae (Engler and Prantl, 1897) is supported.

The family Orobanchaceae is distinct in possessing proanthocyanidins and tannins. A possible origin of the family through the parasitic members of the Scrophulariaceae (tribes Gerardieae and Euphrasieae) can be traced out. Both these taxa are characterized by 6-deoxyflavones and tannins.

The iridoids, aurones and chalcones characteristic of the Scrophulariaceae are noticed in the Gesneriaceae too. The elimination of flavonoid system in Lentibulariaceae, a feature observed in the aquatic members of the Scrophulariaceae, indicates possible evolution of the family through the Scrophulariaceae.

The Solanaceae, in contrast to other families, are rich in flavonols as well as alkaloids and are devoid of flavones and iridoids. The tribe Salpiglossideae, is similar to the rest of the Solanaceous members in chemical characters and hence cannot be elevated to a separate family or treated as the connecting link between the Scrophulariaceae and Solanaceae.

Chemical data on the Buddlejaceae, Oleaceae, Acanthaceae, Bignoniaceae and Myoporaceae are critically evaluated to trace their possible relationship with the Scrophulariaceae. The inclusion of Buddlejaceae in Scrophulariales is justified chemically because the family is reported to contain iridoids, 6-oxygenated flavones and the characteristic water soluble

yellow carotenoid gentiobioside and crocin. The Oleaceae, for being rich in flavonols and wanting iridoids, is considered as a connecting link between the Gentianales and Scrophulariales.

The morphological similarity between Acanthaceae and Scrophulariaceae is reflected in their chemical nature too. Both the families are rich in 6-oxygenated flavones and iridoids. The subfamily Nelsonioideae is treated as the connecting link between the two families. The elevation of Thunbergioideae to a distinct family Thunbergiaceae is approved chemically. The high frequency of flavonols and low incidence of iridoids keeps the family Bignoniaceae at a lower evolutionary level. Tribe Tecomeae containing Paulownia is treated as connecting link between the Scrophulariaceae and Bignoniaceae.

Finally, the evolutionary relationship of various genera within the family Scrophulariaceae and various families within the Scrophulariales is shown graphically by constructing cladograms.