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CHEMISTRY IN THE TAXONOMY OF THE SIMAROUBACEAE

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Ten plants belonging to seven genera of the Simaroubaceae are analysed for their leaf phenolics. The family is chemically homogenous in having flavones, glycoflavones and flavonols evenly distributed. Though *Balanites* is similar to the Simaroubaceae in its flavonoid chemistry, its inability to synthesise quassinoids keep it in the Zygophyllaceae. The merger of all the genera of the subfamily Simarouboideae into a single genus is not supported. The family is an advanced taxon among the Sapindales.

Keywords : Simaroubaceae; Chemotaxonomy; Flavonoids; *Balanites*.

Introduction

The Simaroubaceae, a family of tropical/subtropical woody plants, is represented by 7 genera and 13 species in India. The family is characterised by the presence of a prominent disk, mostly unisexual flowers and scales at the base of the filaments. The plants of this family show significant antileukemic properties due to their quassinoids. They exhibit antiviral, antimalarial, amoebicidal, antifeedant and insecticidal properties also.

Engler and Prantl (1931) recognised six subfamilies : Alvaradoideae, Irvingoideae, Kirkioideae, Picramnoideae, Surianoideae and Simarouboideae. Dahlgren (1980) treats the Surianoideae as a separate unigeneric family. The Simaroubaceae inclusive of these subfamilies are very heterogeneous. Nooteboom (1962) proposed the merger of all the genera except *Harrisonia* and *Eurycoma* of the subfamily Simarouboideae into a single genus *Quassia*. The taxonomic position of *Balanites* also remained controversial. Bentham and Hooker (1862) and Cronquist (1981) included this genus in the family Simaroubaceae while Engler and Prantl (1931) placed it in the Zygophyllaceae. Hutchinson (1973) creates a new unigeneric family Balanitaceae, which is accepted by Takhtajan (1980) and Dahlgren (1980). The family Simaro-

ubaceae is considered as a primitive taxon (Nair and Sukumaran, 1960) having woody habit and apocarpous pistil. While Saunders (1939) and Hutchinson (1973) considers the apocarpous nature to be derived from syncarpous ovary and therefore places the family at a higher level of evolution.

Due to their excellent pharmacological properties, the quassinoids attracted the attention of the chemists (Polonsky et al., 1980). Most of the plants also contain alkaloids principally of indoles belonging to canthin-6 ones and β-carbolines and their derivatives. Very few reports on the phenolics of the family are available (Nooteboom, 1966). The family is a rich source of hydrolysable tannins. A detailed chemistry of the Simaroubaceae is available elsewhere (Waterman and Grundon, 1983). In the present work ten plants belonging to seven genera of the subfamily Simarouboideae are screened for the leaf phenolics.

Materials and Methods

Ailanthus excelsa, *Balanites aegyptiaca* and *Quassia* are collected from Baroda; *A. altissima* from Kashmir; *A. triphysa*, *Samadera* and *Brucea* from TBGRI, Trivandrum; *Picrasma* from Dehradun and *Simarouba* from Amaravathi. The isolation and identification of various compuonds are done by following standard methods (Harborne, 1984; Mabry *et al*, 1970; Markham, 1982).

Results and Discussion

The results obtained from the chemical analysis of the leaves are presented in Table-1. All the plants screened contained flavonoids in their leaves. The flavones, glycoflavones and flavonols are widespread in the subfamily. The various flavones encountered are apigenin, luteolin and their methoxylated derivatives. Of these luteolin and its derivatives are more frequent. Kaempferol, quercetin and 3',4'-diOMe quercetin are the flavonols identified. Kaempferol is found in only one plant, *Ailanthus triphysa*, while the latter two flavonols showed 75% incidence of occurrence. Coumarins identified are scopoletin and 7-OMe scopoletin. Proanthocyanidins, though occur in about 50% of plants, are present in very low concentrations. Hydrolysable tannis are located in five plants. Out of seven phenolic acids identified, vanillic, syringic and ferulic acids are present in all the plants screened. Gallic/ellagic acids are frequent (6/10). All the ten plants analysed contained alkaloids and sapogenins.

The subfamily Simarouboideae is a homogenous taxon with flavones, glycoflavones and flavonols distributed evenly. However, the two genera *Simarouba* and *Quassia* are distinct in not containing flavonols while the absence of flavones in *A. triphysa*

Table 1 : The distrlbution of Phenolics, Tannis and Saponins among nine members of the Simaroubaceae

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. *Ailanthus altissima* Swingle	+			+				+	+			+	+		+	+	+			+	+	+	+
2. *A. excelsa* Roxb.					+	+		+					+	+	+	÷				+	+	+	+
3. *A. triphysa* Alston						+	+	+						+	+	+	+			+	+	+	+
4. *Balanites aegyptiaca* Delile	+								+					+	+	+				+		+	+
5. *Brucea javanica* Merr.			+	+				+						+	+	+	÷	+		+			+
6. *Picrasma quassioides* Bennet							+	+		+		÷		+	+	+	+	+		+	+		
7. *Samadera indica* Geartn			+			+			+			+			+	+			+	+			
8. *Simarouba glauca* DC.					+						+	+			+	+				+	+	+	+
9. *Quassia amara* L.					÷	+					+	+		+	+	+	+			+	+		+

1. Apigenin 2. Acacetin 3. 7,4–DiOMe Apigenin 4. Luteolin 5. 7–OMe Luteolin 6. 7–OMe Vitexin 7. Kaempferol 8. Quercetin 9. 3',4'–DiOMe Quercetin 10. Myricetin 11. Quinones 12. Coumarins 13. Proanthocyanidins 14. p–Hydroxy benzoic acid 15. Vanillic acid 16. Syringic acid 17. Gallic acid 18. p–Coumaric acid 19. Sinapic acid 20. Ferulic acid 21. Tannins 22. Saponins 23. Alkaloids.

keep this species apart from other members. *Simarouba*, *Balanites* and *Brucea* are closer to each other in containing glycoflavones in their leaves. Among the three species of *Ailanthus*, *A. triphysa* differs from the other two species in containing kaempferol and in the absence of flavones.

The present chemical analysis is not in support of merging all the genera (except *Harrisonia* and *Eurycoma*), of the subfamily Simarouboideae into a single genus *Quassia*, because each genus has a distinct flavonoid profile. *Balanites*, a genus variously placed in Zygophyllaceae and Simaroubaceae, shares a number of chemical characters with both the families (similar type of flavonols and flavones). However this genus does not synthesis the quassinoids which are omnipresent in the Simaroubaceae. The occurrence of diosgenin and their related sapogenins in *Balanites*, a character common to the Zygophyllaceae, is in favour of including this genus in the latter family.

Ailanthus triphysa is the most primitive species of the family containing only hydroxylated flavonols. The flavone-rich *Simarouba amara* is the most advanced plant, which has lost the primitive chemical characters such as flavonols and glycoflavones. The uniform occurrence of canthin and β-carboline type of indole alkaloids and simaroubolides alongwith flavones, glycoflavones and flavonols indicate the subfamily Simarouboideae to be a natural, closely knit group. These advanced chemical features as well as the hydrolysable tannins, reduced amounts of proanthocyanidins and cinnamic acids keep the Simaroubaceae as one the highly evolved families of Sapindales. In addition to the above characters, this family also contains a highly degraded group of triterpenoids, the quassinoids. These advanced chemical characters can be correlated well with morphological advancement the family attained (predominance of unisexuality, winged seeds and the secondary apocarpous conditions). The family would have probably originated from the Burseraceae which exhibit a number of primitive characters such as bisexual flowers, resin ducts, tannins and flavonols and possess the precursors of the quassinoids. The Simaroubaceae are closely related to the Meliaceae and Rutaceae in both morphological and most of the chemical characters, but are definitely advanced over them in certain chemical features.

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