INTRODUCTION

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The family Acanthaceae derives its name from the type genus, *Acanthus*, the Greek term 'Acanthos' means a spine (Bailey, 1933). This taxon was first recognized by A.L. De Jussieu (1789) in his "Genera Plantarum". Since then this family has attracted the attention of botanists for various reasons.

The family shows great diversity of habit from herbaceous, less often shrubby, twining to rarely trees. The members of this family, about 250 genera and 2,500 species (Willis, 1973), are distributed mainly in tropical and sub-tropical regions of India, Africa, Central America, Brazil and Indo-Malaysia. About 49 genera and over 500 species (Clarke, 1884-85) are seen in India. More than half of the species belong to 7 genera, *Justicia* (300), *Ruellia* (250), *Barleria* (250), *Strobilanthus* (200), *Thunbergia* (200), *Dicliptera* (180) and *Aphelandra* (150).

The family is distinguished by the opposite leaves with distinct cystoliths, gamopetalous and zygomorphic flowers, didynamous stamens, superior ovary with disc at the base and capsular fruit having explosive dispersal mechanism of seeds which rarely posess the endosperm. The indurated funicle is also a distinctive feature of the family.

The ancestral basic chromosome number of the Acanthaceae is 8, but due to aneuploidy, amphiploidy and polyploidy, many of the members show higher basic numbers often accompanied by differences in chromosome- size due to changes

in nuclear DNA in course of evolution. But there appears no definite trend of either phylogenetic increase or decrease of chromosome-size. (Govindarajan and Subramanian, 1983,1985). However, studies on certain species like *Adhatoda vasica* Nees. from different ecological conditions exhibit some evolutionary trends in their biotypes (Datta and Samanta, 1978).

The members of the family exhibit various types of glandular and non-glandular hairs with ornamentations. Glandular hairs have been classified in to three types i.e. capitate, vesicular and peltate. The non-glandular hairs are divided in to uniseriate and unicellular trichomes (Singh and Jain, 1975). According to Metcalfe and chalk (1950), trichomes show peculiar characteristics to be considered a potential taxonomic character. Salt-secreting glands are present on both the surfaces in *Acanthus ilicifolius* Linn. The Barlerieae have unicellular hairs with thick-walls and narrow-lumen. The Aphelandreae possess long uniseriate hairs with strongly thickened walls (Metcalfe and Chalk,l.c.). The stem and leaves of many members of this family show bundles of acicular fibrils, which resemble large raphides, in some of the cells of the phloem tissue. The nodes are unilacunar with xylem becoming a closed cylinder with narrow rays. The vessels in nodal and internodal regions are typically small (Metcalfe and Chalk, l.c.). Perforations are simple, 1-3 in number, the inclination of perforation plates being median and transverse, lateral or oblique. The intervascular pitting is mostly simple, rarely scalariform, reticulate and bordered pitted. Occasionally, in

nodes, branched vessel elements with the branching at different leaves are found (Chaudhari and Inamadar, 1984b.) which shows the trend of specialization towards vessels mostly round or truncate end-walls, simple perforation plate is showing simple pitted adjacent wall-thickening. Wood-rays are commonly homocellular and rarely heterocellular having a width of 1-6 cells. These wood-rays sometimes are having mixed uniseriate and pluriseriate, paratracheal and scanty wood-parenchyma cells. The internal phloem is also seen occasionally. The leaves are opposite, simple, exstipulate, sometimes spiny and thistle-like with short or long petioles. The morphology of leaf has been studied extensively by various workers. The stomata in the leaves of Acanthaceae are diacytic and paracytic. The overlapping stomata - "contiguous"- were observed by a number of workers (Inamdar and Patel, 1976; Nandu and Shah 1981; Bhatt, 1983). The stomatal index is found to be constant in each taxon. The palisade ratio has been found important in classification at all levels (Simon, 1992). The occurrence of silicified bodies with a cellulose skeleton on the epidermis is another distinctive feature of both stem and leaf. Metcalfe and Chalk (l.c.) had grouped the cystoliths into seven different categories. The variations in shape and size prompted Hoebin (cf. Rangaswamy, 1941) to attempt the classification of the family based on cystoliths (!) but its significance is questioned by a number of workers. (Inamdar and Chaudhari, 1984a; Menon (l.c.); Ahmed K.J.,1974 b,c,d). Petiole, in most of the members, shows an arcuate vascular strand or an arc of discrete bundles. Flowers may be solitary or arranged in cymose,

or rarely racemose inflorescences. They are perfect, gamopetalous and zygomorphic having distinct bracts and bracteoles which are often showy or petaloid. The calyx is synsepalous, more or less deeply (4)5 (-16-) lobed having imbricate or valvate arrangement or sometimes reduced. The corolla is sympetalous formed by essentially regular to more often irregular petals which are commonly bilabiate and 5- lobed with imbricate or convolute arrangement. Sometimes it is seen that the upper lip of the corolla is reduced. The stamens are four in number, inserted in the corolla-tube in didynamous conditions. *Pentastamonacanthus* is the only sp. with five fully developed stamens. The anthers typical of the family are tetrasporangiate and dithecal opening by longitudinal slits. pollen-sacs may be parallel and juxtaposed, widely separated on a modified connective or sometimes reduced or suppressed. Pollen-grains are binucleate or trinucleate, tricolporate (most common) but diverse in architecture including triporate, diporate, pentoporate and inaperturate types. An annular nectary-disc is commonly present around the base of the ovary. This disc surrounds a gynoecium of two median carpels united to form a compound, superior and generally bilocular ovary. The style is slender and terminal with a dry funnel-shaped or more often two-lobed stigma. Sometimes upper stigma-lobe is reduced or suppressed. Generally, the ovules are two in each locule when they are superimposed or sometimes collateral and rarely up to ten (*Ruellia*) or numerous in each locule (Nelsonioideae). The ovules also are varied **i.e.** anatropous to amphitropous or campylotropous, and tenuuinucellar. The integumentary tapetum

occurs rarely. The embryo is large, dicotyledonous, straight, spathulate and more or less curved or bent. The development of embryo-sac is *Polygonum* type which shows the elongation of micropylar-end at 4- nucleate stage, its penetration in to the placenta and a peculiar mode of endosperm-formation. The endosperm when present (in Nelsoniodeae) is cellular or partly or wholly nuclear with terminal haustoria in its development. Sometimes only the partly micropylar haustorium is developed (Johri and Singh, 1959). The funiculus here is modified into a hook-shaped jaculator which is functioning in flinging out the seed. The fruit, a loculicidal capsule, is having on explosive type of dehiscence. The flattened seeds is another distinguishing character of the family Acanthaceae. (Bremekamp, 1955,b).

1.1 TAXONOMY :

The family Acanthaceae appears to be a heterogeneous taxon and therefore classified differently by various taxonomists. Bentham and Hooker (1876) place the family in order Personales whereas in Engler's system (1887 - 1915,1931) it is included in the Tubiflorae. Hutchinson (1973) has considered it as the most advanced taxon of his Personales while Thorne (1976), Dahlgren (1980), Takhtajan (1980) and Cronquist (1981) have lodged this family in Scrophulariales. The affinities of the family with Scrophulariaceae, Bignoniaceae and Pedaliaceae are described by Chaubal and Deodikar (1966 -'67), Sreemadhavan (1977) and Kumar and Paliwal (1982).

The history of infrafamilial classification of Acanthaceae is as ancient as the time of Sir A.L.De Jussieu

(l.c.) when he subdivided the family on the basis of the number of stamens. Since then the family had been classified variously by many authors such as Nees (1832,1847), Anderson (1864,1867), Bentham and Hooker (1876), Clarke (Hooker,1884-85), Lindau (1895)
and Bremekamp (1953,1965).

Nees Von Essenbeck (1847) divided the Acanthaceae in to two subfamilies : Anechmatacantheae (without retinacula) and Echmatacantheae (with retinacula), the former being comprised of two tribes (Thunbergieae and Nelsonieae) and the latter of nine (Hygrophileae, Ruellieae, Barlerieae, Acantheae, Aphelandreae, Gendarusseae, Eranthemeae, Dicliptereae and Andrographideae). Anderson (1864-1867) splitted the family in to 3 suborders Thunbergideae (with Thunbergia Linn.), Ruellideae (with all the genera having contorted corolla - lobes in bud) and Acanthideae (genera with imbricate corolla - lobes). The last two subfamilies were subdivided to tribes and subtribes. The system is distinguished by its treatment of Nelsonieae as a tribe of Ruellideae, transfer of *Asystasia* Bl. to its own tribe within Acanthideae and inclusion of the tribes Gendarusseae and Dicliptereae as subtribes within the tribe Justicieae. The classification given by Bentham and Hooker (1876) was similar to that of Anderson, where the family is divided in to five tribes keeping Ruellieae, Nelsonieae and Acantheae of Nees(l.c) almost unchanged in comparison with tribe Justicieae which had been expanded by including plants of the tribes Barlerieae, Andrographideae and Asystasieae to the subtribal level. Clarke (in Hooker,1884-85) had also classified the family in to five

tribes, Thunbergieae, Nelsonieae, Ruellieae, Acantheae and Justicieae. Lindau (1895) had presented the monograph of the Acanthaceae by extending the Radlkofer's (1883) work on pollen morphology. He (l.c.) had subdivided the family in to four subfamilies on the basis of fruits, number of ovules and presence or absence of retinacula and their shapes, viz. Nelsonioideae (ovules many, retinacula papilliform), Mendoncioideae (ovules four, fruits drupaceous, retinacula absent), Thunbergioideae (ovules four, fruit beaked capsule) and Acanthoideae (ovules two to many, retinacula hook-like). The subfamily Acanthoideae is grouped in two series (Leonard, 1951) comprising of sixteen and five subtribes respectively. This classification has been well-accepted and used even today (Melchior, 1964 ; Wasshaussen, 1966 ; Heine, 1962,1966 ; Hutchinson, 1973 ; Gibson, 1974 ; Takhtajan, 1980 ; Thorne, 1983). With some modifications, the system is also used in recent works (Barker, 1986 ; Valsaladevi, 1987 ; Balkwill and Norris, 1988 ; Scotland, 1992).

Van Tieghem (1908), for the first time, raised the Thunbergiaceae as a separate family including the Mendoncioideae, Nelsonioideae and Thunbergioideae of Lindau (l.c.) within, leaving the Acanthoideae to form the family Acanthaceae. Wettstein (1935) assigned the subfamilial status to Thunbergiaceae and Acanthaceae (Van Tieghem, l.c.) and Anechmatacantheae and Echmatacantheae of Nees (l.c.) respectively to form Thunbergioideae and Acanthoideae within the Acanthaceae. Wettstein's (l.c.) Thunbergioideae included first three subtribes of Lindau while his Acanthoideae was analogous

to that of Lindau (l.c.).

Bremekamp (1953,1965) is another author known for his extensive work on the infrafamilial classification of the Acanthaceae. In his opinion, Lindau's Mendoncioideae and Thunbergioideae show great resemblance to Bignoniaceae and Pedaliaceae than to his Acanthoideae and should be raised to separate families; Thunbergiaceae was recognized on the basis of rostrate capsule with one or two seeds in each of the two cells, semiglobose seeds with a large excavation at its ventral side, an epicalyx formed by the two very large bracteoles, truncate, dentate or shortly lobed calyx and bristles at the base of the anthers whereas Mendonciaceae had drupaceous and usually unilocular fruits either with one or two seeds and by pollen - grains with their very short colpi and very thick nexine. He also suggests the placement of Nelsonioideae of Lindau (l.c.) near to the Rhinacantheae in the family Scrophulariaceae based upon the characters such as well - developed endosperm, parietal placentation, albuminous seeds, loculicidal capsule etc. He has recognized two subfamilies viz., Acanthoideae and Ruellioideae, the former with five tribes,i.e.(Haselhoffieae, Rhombochlamydeae, Stenandriopsideae, Aphelandreae and Acantheae) and latter with seven tribes(Trichanthereae, Whitfieldieae, Louteridieae, Ruellieae, Lepidagathideae, Andrographideae and Justicieae). Among recent taxonomists, Airy Shaw (1973), Gibson (l.c.), Dahlgren (l.c.) and Cronquist (l.c.) are commendatory to this system whereas Hutchinson (l.c.), Takhtajan (1980,1987) and Thorne (1976) have followed Lindau's treatment.

CONTORTAE

Contortae, the first series of the Acanthoideae, consist of seven tribes, i.e. Trichanthereae, Louteridieae, Hygrophileae, Petalidieae, Strobilantheae, Ruellieae and Barlerieae. Bremekamp's subfamily Ruellioideae is similar to the Contorate in possessing the tribes Trichanthereae and Louterideae alongwith Andrographideae, Justicieae, Whitfieldeae, Lepidagathideae and Ruellieae of which the tribe consist of the rest of the tribes of Contortae, i.e. Hygrophileae, Petalideae, Strobilantheae and Barlerieae as subtribes.

Tribe Trichanthereae :

The six genera, *Bravaisia*, *Trichanthera*, *Macrostegia*, *Sanchezia*, *Androcentrum* and *Gymnacanthus* form Lindau's (l.c.) tribe Trichanthereae to which he had assigned primitive status. Bremekamp (1965) attributed advanced status to the tribe and kept it under his subfamily Ruellioideae specifying that the glabrous seeds of the tribe are also found in advanced taxa like Justicieae (Balkwill **et.al.**, 1986; Immelman, 1992).

Tribe Hygrophileae :

Lindau's (l.c.) Hygrophileae consists of *Synnema*, *Brillantaisia*, *Hygrophila*, *Asteracantha*, *Eremomastax* and *Mellera* as described by Nees (l.c.). Bentham and Hooker (l.c.) treated these plants in a subtribe within the tribe Ruellieae. Bremekamp gives this tribe an advanced status, a concept ably supported by Valsaladevi (1987) on cytological grounds.

Asteracantha longifolia Nees. is a monotypic genus, latter considered as a true *Hygrophila* by Anderson (1860) and named it as *H.spinosa* which has been supported by Clarke (l.c.). Lindau(l.c.) had seperated the genus *Asteracantha* Nees. and *Hygrophila* R.Br. on the basis of the axillary spines in the former which is supported by Santapau (l.c.) but Heine (1962) and Crammer (1989) opposed this seperation which is based on a single character.

Tribe Petalidieae :

Containing *Blechum*, *Micranthus*, *Zygoruellia*, *Petalidium* and *Pseudobarleria*, this tribe is recognised by many, though Bentham and Hooker (l.c.) have considered the taxon as subtribe, including two more genera *Daedalacanthus* and *Phaulopsis* Willd. within their tribe Ruellieae. Balkwill and Norris (l.c.) have supported the placement of these genera near *Petalidium* Nees. Bremekamp (1965) also assigns a subtribal status to the Petalidieae. Karlstrom (1978) is of opinion that there is considerable difference in the epidermal characters of *Petalidium* Nees. and *Phaulopsis* Willd.

Tribe Strobilantheae :

This tribe is composed of thirtreen genera including *Hemigraphis* Nees. Nees (l.c.) had merged this tribe in to his Ruellieae. Bentham and Hooker had treated the Strobilantheae as a subtribe in their Ruellieae. This is supported by Bremekamp (1965) who suggested the taxon to the slightly advanced over Ruellieae. Clarke (l.c.) had placed *Hemigraphis* Nees. in subtribe polyspermeae along with *Ruellia* Linn and *Strobilanthus*

in Tetraspermeae in the tribe Ruellieae.

Cytopalynological evidences (Valsaladevi, 1987) suggested that the genus *Strobilanthes* Blume. is highly heterogenus. According to Bremekamp (1944), *Strobilanthus* Bl., in a restricted sense, does not occur in India. He also has splitted this genus in to about two dozen genera which has been striken out by Ahmed (1974) who did not observe any prominent dissimilarities in the epidermal characters of the concerned taxa. Vishnu Mittre and Gupta (1966) have doubted the delimitation of the genera *Pteracanthus* and *Nilgirianthus* sensu Bremekamp (l.c.) on the basis of unreliable(!) pollen characters and the nature status attributed to *Strobilanthus* Bl. by Bremekamp (l.c.).

Tribe Ruellieae :

Lindau's (l.c.) tribe Ruellieae consists of *Ruellia* Linn., *Dipteracanthus* Nees. and *Eranthemum* Nees. Bremekamp's Ruellieae is the largest tribe of the Acanthaceae subdivided into six subtribes (Blechinae, Ruelliinae, Barleriinae, Petalidinae, Strobilanthidinae and Hygrophilinae) exibiting primitive placement of Ruelliinae over Petalidinae, Strobilanthidinae and Hygrophilinae. Bremekamp's (l.c.) subtribe Ruelliinae is different from B.& H'.s (l.c.) subtribe Euruellieae in laking *Dyschoriste* Nees. which has been transferred to subtribe Petalidinae by Bremekamp (l.c.).

Nees (l.c.) had classified the species of *Eranthemum* in two groups (1) **Grandibracteata** (with conspicuous bracts) and (2)

Parribracteata (with inconspicuous bracts). Anderson (1860) had transferred E. monatatus (native ceylon) to a new genus, *Daedalacanthus*, and latter added 14 more Indian species to place them in his Ruellieae. He kept *Eranthemum* in Asystasieae. Bentham and Hooker (**l.c.**) placed *Daedalacanthus* in Ruellieae and *Eranthemum* in Justicieae.

The delimitation of the genus *Ruellia* Linn. has been a matter of controversy. Four from the total of eight species (Linnaeus,1737) were placed under a new genus *Dipteracanthus* Nees (1832) and the remaining species were kept in a number of small genera by Nees (**l.c.**) and Oersted (1854). The Linnean genus was revived by Anderson (1864, 1867). Gray (1878) and Clarke (l.c.) shared the view that the 18 genera which were sunk under *Ruellia* by Bentham and Hooker (1862-1883) were congruent and were connected by intermediate forms. Lindau (**l.c.**) divided the genus in to nine sections 1.**Leptosiphonium** F.v. Muell 2. **Euruellia** 3. **Fabria** E.Mayer 4. **Dipteracanthos** Nees. 5. **Physiruellia** Lindau 6. **Ploutoruellia** Baill. 7. **Schizothecium** Baill. 8. **Chromatoruellia** Baill. and 9. **Microruellia** Baill. This treatment has been followed by Melchior (1964). According to Long (1973), *Ruellia* is not a natural, phyletic group.

Dipteracanthus patulus which was previously included in the genus *Ruellia* has been separated by Santapau (1951) on the basis of its inflorescence. This was supported by Mohan Ram (1960) on the morphological and embryological grounds.

Tribe Barlerieae :

The tribe comprises of *Barleria* Linn., *Lepidagathis*

Willd. and *Neuracanthus* Nees. Bentham and Hooker (l.c.) had included these plants in separate subtribes Barlerieae and Eujusticieae under the tribe Justicieae which is supported by Clarke (l.c.) while Bremekamp (l.c.) has rearranged this subtribe by keeping *Crossandra* Salisb. in the tribe Acantheae and *Lepidagathis* Willd. in a separate subtribe Lepidagathineae under the tribe Lepidagathideae. Chaubal (l.c.) believes that the removal of *Lepidagathis* from Lindau's Barlerieae to a seperate tribe is justified on the basis of pollen morphology.

IMBRICATAE :

The second series of the Acanthoideae, **Imbricatae,** consists of 9 tribes **i.e. Acantheae, Aphelandreae, Andrographideae, Asystasieae, Graptophylleae, Pseuderanthemeae, Odontonemeae, Isoglosseae** and **Justicieae.**

Tribe Acantheae :

Sclerochiton, Trichacanthus, Blepharis, Acanthus, Pseudoblepharis and *Crossandra* form Lindau's (l.c.) tribe Acantheae. Bremekamp (1965) keeps this tribe primitive to Trichanthereae. The placement of *Crossandra* in this tribe, as earlier done by Nees (l.c.), is supported by Bremekamp (l.c.) also. Balkwill and Norris (1988), based on floral morphology and palynology, suggest the placement of *Crossandra* Salisb. under a seperate subtribe within the Acantheae.

Tribe Aphelandreae :

Lindau's (l.c.) Aphelandreae include nine genera of

which some species of *Aphelandra* R.Br. are known to be cultivated in India. In Bremekamp's (l.c.) opinion, the tribe is primitive over Acantheae.

Tribe Andrographideae :

The tribe is constituted by the genera *phlogacanthus*, *Andrographis*, *Diotacanthus*, *Cryptophragmium*, *Cystacanthus* and *Haplanthus*. Nees (l.c.) and Bremekamp (1948,1965) have agreed to the tribal status of this taxon but Bentham and Hooker (l.c.) and Clarke (l.c.) had treated it as a subtribe to their tribe Justicieae.

Tribe Asystasieae :

Lindau's tribe, Asystasieae include *Thomandersia*, *Parasystasia*, *Isochoriste*, *Asystasia*, *Spathacanthus*, *Asystasiella*, *Solenoruellia* and *Chamaeranthemum* on the basis of distinctive pollen and redused number of seeds per capsule. Bremekamp (1965) assigns these genera in subtribe Odontoneminae of Justicieae. Earlier Nees (l.c.) had kept *Asystasia* in Ruellieae. Bentham and Hooker (l.c.) have considered it as subtribe Asystasieae under the tribe Justicieae.

Tribe Graptophylleae :

Only Lindau had accorded a tribal status to this taxon. Nees (l.c.) had merged the tribe in his tribe Gendarusseae keeping *Graptophyllum* Nees. and *Pachystachyus* Nees. along with *Adhatoda* Nees., *Jacobinia* Moric. and *Beloperone* Nees. Bentham and Hooker (l.c.) had accomodated them in his subtribe

Eujusticieae with *Lepidagathis* willd. and *Rhinacanthus* Nees. whereas Bremekamp has considered this group as a subtribe Odontoneminae excluding *Adhatoda* Nees. and including *Asystasia* Bl. and *Peristrophe* Nees.

Tribe Psuederanthemeae :

Lindau's (**l.c.**) tribe Pseuderanthemeae is very small taxon consisting of only three genera, viz. *Dodonacanthus* Nees., *Pseuderanthemum* Radalkf. and *Ptyssiglotis* T.Anders. Bremekamp (**l.c.**) has merged the tribe in to his Justicieae while Bentham and Hooker (**l.c.**) had kept it under Eujusticieae.

Tribe Odontonemeae :

This tribe is subdivided into three subtribes, named **Diclipterinae, Odontoneminae** and **Monothecinae.**

Subtribe Diclipterinae :

Peristrophe, Tetramerium, Rungia, Dicliptera, Hypoestes Periestes and *Lasiocladus* form the subtribe. Diclipterinae of Lindau (**l.c.**). Nees (**l.c.**) had treated this taxon as a tribe and kept between Eranthemeae and Andrographideae while Bentham and Hooker had attributed it a subtribal status by putting it under the tribe Justicieae. Bremekamp (**l.c.**) has splitted Lindau's subtribe by keeping *Rungia* Nees. in Justiciinae and the other genera in Odontoneminae.

Subtribe Odontoneminae :

This is one of the largest subtribes of Lindau (**l.c.**) consisting of twenty – three genera including important genera

like *Rhinacanthus* Nees. and *Ecbolium* Kurz. Bremekamp (1965) has supported this view, Nees (l.c.) had included this subtribe in to his tribe Eranthemeae whereas Bentham and Hooker (l.c.) had merged it in to the Eujusticieae.

Subtribe Monotheciinae :

The tribe contains only four genera *Ballochia*, *Ruttya*, *Clinacanthus* and *Monothecium*.

Tribe Isoglossineae :

The tribe has been divided in two subtribes **Porhyrocominae** and **Isoglossinae.**

Subtribe Porphyrocominae :

This subtribe possesses six genera including *Fittonia* Coem. This genus has been considered variously, some workers keep it under *Eranthemum* Linn., and others in *Gymnostachyum* Nees. Bremekamp (1965) has kept it in the subtribe Rhytiglossinae while Bentham and Hooker had considered it under his subtribe Eujusticieae.

Subtribe Isoglossinae :

Eleven genera including Stenostephanus, Isoglossa, Populina, etc. form this subtribe Isoglossinae .

Tribe Justicieae :

This is considered as the most evolved tribe by Lindau (l.c.) and contain genera like *Justicia* Linn., *Adhatoda* Nees.,

Dianthera Linn., *Beloperone* Nees. and *Jacobinia* Moric. According to Nees (l.c.), the last three ganera have been more closer to *Gendarussa* and primitive over the former genera. Bentham and Hooker (l.c.) had classified this tribe in to subtribes Barlerieae, Asystasieae, Eranthemeae, Andrographidieae, Eujusticieae and Diclipteреae. Bremekamp (1965) has splitted the tribe in to three subtribes viz. Odontoneminae, Rhytiglossinae and Justiciinae.

Justicia Linn. is the largest and the most complex genus of the family having the number of species varying from 42Ø - 6ØØ (Daniel, 1989). For the past several years, several plants have been added to the *Justicia*, without proper definition, resulting in a highly heterogenous genus. Indian species of *Justicia* has been divided in to six sections by Clarke (l.c.). From these six sections, *Rostelullaria* sensu Clarke has been raised to generic status by Bremekamp (1948). Recently a fairly appreciable attempt of classifying the genus has been made by Graham (1988). Section **Betonica** Clarke is found differing from section **Rostelullaria** in their epidermal characters (Ahmad, 1979), but the differences are not of much taxanomic value since the species concerned themselves show much variations in these characters among themeselves. The generic status and the placement of *Adhatoda* Nees. has been controversial since long. Stearn (1971) is of an opinion of retaining *Adhatoda* as a separate genus away from *Justicia* which has been supported by Graham (l.c.) and Cramer (1992), on the basis of cytological features (Grant, 1955) palynological features (Bhaduri,1944) and epidermal characters (Ahmad,1974b.).

1.2 ECONOMIC IMPORTANCE :

The family Acanthaceae is known for its potentialities as sources of medicines and ornamentals. The two important medicinal plants of the family are *Adhatoda zeylanica* Medic. ('Vasaka') and *Andrographis paniculata* L. *Adhatoda zeylanica* Medic is known for its beneficial effects on bronchitis, other bronchial diseases, asthma and also its effect upon diarrhoea, dysentery, glandular tumor, inflammatory swellings, for improvement of circulation of blood, utricaria and neuralgia. The active principles are a group of quinazoline alkaloids of which the major components are vasicine and vasicinone. The essential oil from the leaves exhibits expectorant, rubifacient and marked antibacterial activities against the strains of *Mycobacterium tuberculosis* Zopf. Whereas the root-extracts are effective against *Micrococcus pyogene* Var. *aureus* and *E. coli*. The resin from the plant is found to be toxic to grain - insects while being non-toxic to man. The extract of bark posses antiviral activity against potato-virus X. Some other uses of this plant are in the preparation of gunpowder, charcoal, fuel for brick-burning and beads and rosaries from the wood, as green manure in rice fields, as aquatic weedicides and insecticides. *Adhatoda beddomei* is considered to be more powerful and active than *Adhatoda zeylanica* Medic.and used medicinally in Kerala. It is used as antiemetic, antibechic and haemostatic particularly in hemorrhages, haemoptysis and menorrhagia. *Andrographis paniculata* L. popularly known as 'Kalmegh' or 'green cheratta' is an accepted and effective drug for relief of gripe and other stomach ailments in infants. It is also used against dysentery,

cholera, diabetes, influenza, bronchitis, swellings, itches, piles, gonorrhea, torpid-liver, jaundice and skin-diseases. The leaves are found to be used in general debility and dyspepsia and along with roots they are used as febrifuge, tonic, stomachache, cholagogue and anthelmintic. The plant is reported to have astringent, anodyne, tonic and alexipharmic properties. *Indonesiella echiodes* Sreem. containing the flavone echiodinin is given in fever. It is said that the plant have properties similar to those of *Andrographis paniculata* L. The other plants known in folk medicine are the following : (1) *Rhinacanthus nasutus* Kurz. used against hepatitis, diabetes and hypertension, cutaneous eruption due to ringworm, eczema, pulmonary tuberculosis and **Neuroherm milaris.** Recently, this plant is reported to be used against cancer in Thailand (c.f. The wealth of India). The roots exhibit antiseptic properties due to the presence of rhinacanthin. (2) *Neuracanthus sphaerostachyus* Dalz., the roots of which are powedered and pasted for curing ring-worms. (3) *Barleria prionitis* Linn., a common hedge-plant, is valued as diuretic, applied for rheumetic pains and itches, fever, catarrh, urinary and paralytic affections and stomachache. The fresh-juice of bark is diaphoretic and expectorant, given in anasarca whereas the roots are used as a febrifuge and as a paste of roots applied over boils and glandular swellings. (4) *Barleria cristata* Linn. exhibits mild-spasmolytic activity; roots are given in anemia and chewed for relief in tooth-ache. (5) *Barleria courtallica* Nees. is credited with mild- antiseptic activity and the root-decoction is prescribed in rheumatism and pneumonia. (6) *Barleria strigosa*

Willd., roots of which exhibits a mild antiseptic property. (7) The root decoction of *Barleria longifolia* Linn.is effective against dropsy and stone in Kidney. (8) *Blepharis persica* ("Uchchata") is an aphrodisiac drug reported to be useful in wounds, ulcers, nasal hemorrhages, asthma, throat inflammation and disorders of liver and spleen and given as purgative, diuretic, dysmenorrhoea, strangury and conjuctivitis. (9) *Barleria sindica* Wall. is given to increase milk-production. (10) *Acanthus ilicifolius* Linn is valued as diuretic, cordial attenuant, given in drospy, bilious swelling, asthma, paralysis, leucorrhoea and debility. (11) *Peristrophe bicalyculata* Nees., a common plant in India, is reported to be used instead of *A. zeylanica* Medic. The essential oil of this plant is found inhibiting the growth of various strains of *Mycobacterium tuberculosis*. (12) *Peristrophe bivalvis* Merrill. in powder form is used as poultice for skin-diseases. The twigs of this plant yields a dye. (13) *Phlogacanthus thyrsiflorus* Nees. is also put to same medicinal uses as *A. zeylanica* Medic. The flowers of this plant are used as vegetable and leaves and fruits are taken as a specific for fever. (14) *Justicia gendarussa*, a hedge-plant,is used for the treatment of lunacy, debility, snake-bite, amenorrhoea and stomach-disorders in Malaysia (c.f. The wealth of India). The leaves are given internally in cephalalgia, hemiplegia, facial paralysis, internal hemorrhage and as drops for earache and hemicrania.

Certain other plants of the family are known for their uses in folk-medicine. They are *Asystasia gangetica* T. Ander. by the tribes of Begusarai, Bihar (Ghosh, 1987) and *Eranthemum*

roseum by the tribes of Karnala area, Maharashtra (Vartak and Mandavgane, 1981). The Rabha tribe of Jalpuri, W. Bengal, use *Lepidagathis incurva* D.Don. in jaundice, gastric-ulcer and bronchitis and *Nelsonia canescence* (Lamk) Spreng. in hernia, rheumatism etc. (Molla and Roy, 1985). *Daedalacanthus roseus* is used as veterinary medicine in Bihar, Orissa and W.Bengal, India. (Pal, 1980).

In addition to this, many members of the family are also used for their aesthetic value. Almost all the plants of the family are used as ornamentals worldwide. (Table-1), prominent among them are the species of *Barleria* and *Aphelandra*, *Crossandra*, *Thunbergia*, *Pseuderanthemum*, and *Pachystachyus*.

1.3 Previous Chemical Reports :

The family possesses a variety of compounds such as iridoids, quinazoline or quinoline alkaloids, diterpenoids, cyanogenic glycosides, saponins, flavonoids and tannins. Family Acanthaceae was once known for its alkaloids peganin, vasicine, vasicinone and vasicol reported from *Adhatoda zeylanica*. Detailed work showed that vasicinone, reported from this plant is an artifact. (Brain and Bhupendra, 1983). *A.beddomei* Clarke, has been reported to be a good source of vasicine and vasicinone (Jain and Srivastava, 1986). The other quinazoline alkaloids seen in the family are asteracanthin from *Asteracantha* and macrorine, macrorungine and their derivatives from *Macrorungia* (Raffauf,1970). Spermine alkaloids like aphelandrine is seen in *Aphelandra squarrosa* (Daetwylen et.al., 1978) and a methylated derivative of

chaenorpine in *A.tetragona* (Vahl.) Nees. (Tawil, **et.al.**, 1989).

Andrographis paniculata Nees. is another plant which has been under detailed investigation for the past two decades. Diterpenoids like andrographolide and its derivatives such as deoxyandrographolide (Chen and Liang, 1982) and neoandrographolide (Chan, **et.al.**, 1972), are the principal compounds of this plant (Fujita. **et.al.**, 1984). Phlogaranthin-A is another diterpene reported from *Phlogacanthus thyrsiflora* Nees. (Barua, **et.al.**, 1985, '87)

Iridoids have been reported in *Asystasia bella* and *Barleria lupulina*. ~-Sitosterol glycoside, a common sterolin, is found in the seed of *Acanthus mollis* and *A.spinosus* (Loukis and Philianos, 1980), *Rhinacanthus nasutus* (Tian-Shung, **et.al.**, 1988) and *Monechma ciliatum* (Hussein and Maat, 1983) whereas stigmasterol and its derivatives are reported in two plants, **i.e.** *Rhinacanthus nasutus* (Tian-Shung, **et.al.**, **l.c.**) and *Monechma ciliatum* (Hussein, Maat, **et.al.**, **l.c**). The seeds of *Rhinacanthus nasutus* are also found to be containing lupeol (Tian-Shung, **et.al.**, **l.c.**)

The saponins, seen in the Acanthaceae, are Justisiaponin from *Justicia procunbens* Linn. (Tiwari, **et.al.**, 1978) and triterpenoidal saponins from *Acanthus ilicifolius* Linn. (Minocha and Tiwari, 1981).

The seed fatty acid components of a number of plants like *Acanthus mollis*, *A.Spinosus*, *Dicliptera roxburghiana* Nees, *Dipteracanthus prostatus* Nees, *Justicia simplex* D. Don. and

Lepidagathis trinervis are also known.

The other compounds reported from the family are, straight-chain ketones from *Asteracantha longifolia* Nees. (Quasim and Dutta, 1967); naphthaquinones such as Rhinacanthin A and B from *Rhinacanthus nasutus* (Tian-Shung, **et.al., l.c.**) and lignans from *Justicia*.

Apigenin, luteolin, scutellarein are the major flavones of the Acanthaceae. The flavonols seen in the family are kaempferol, quercetin and myricetin and vitexin and isovitexin are the glycoflavones reported. (Daniel and Sabnis, 1987).

The detailed chemical reports are presented in table - 2.

1.4 CLADISTICS :

choices of characters :

characters 1 to 14 : flavones present = 1, flavones absent = Ø.

15 to 19 : flavonols present = Ø, flavonols absent = 1.

According to Harborne (1977) flavonols are more frequent in the primitive families and the flavones are prevalent in the advanced dicots. The replacement of flavonols by flavones is observed in many advanced families. The 6-oxygenated flavones are considered more advanced over the common 6-oxyflavones. Therefore the presence of flavones as well as the absence of flavonols are considered as advanced characters. Flavonols and absence of flavones are primitive character.

characters 2Ø to 23 : glycoflavones present = 1, glycoflavones absent = Ø.

The presence of glycoflavones in advanced woody plants and premitive herbaceous plants of dicots tempted Harborne (1967) to consider it primitive to flavones. Due to the flavone skeleton glycoflavones are advanced over the flavonols. The C-glycosylation precedes O-glycosylation in the biosynthetic pathways (Swain, 1975) and therefore, glyflavones are considered intermediate between the flavonols and the flavones. The presence of glycoflavones in a flavonol-rich family is an apomorphic character.

character 24 :proanthocyanidins present = Ø, proanthocyanidins absent = 1.

Bate-smith (1962) inferred that the presence of proanthocyanidins and flavonols (especially myricetin) is characteristic of woody families.

Correlation studies proved that these primitive chemical characters co-occur with 13 primitive morphological characters. The tendency to eliminate these compounds are seen in the advanced taxa.

Characters 26-39 : Benzoic acids present = Ø, benzoic acids absent = 1.

4Ø-44 : Cinnamic acids present = 1, cinnamic acids absent = Ø.

Benzoic acids like vanillic, syringic, gentisic, protocatechuic acids are considered primitive because some of

them, like vanilic acid and syringic acids, are the components of lignin which is abundant in woody plants. But the advanced herbaceous angiosperms possess less lignin and more of hemicelluloses. The cinamic acids like caffeic , ferulic and coumaric acids are advanced.

1.5 OBJECTIVES :

In the present project, 99 plants have been analysed for their chemotaxonomically significant leaf-constitutents such as the flavonoids, simple phenols, phenolic acids, alkaloids and saponins. Based on the distribution of these chemical characters, the classification and phylogeny of the various taxa at different levels of hierarchy are evaluated. Some of the issues which were taken up in this investigation are :

1. The taxonomic validity of Acanthaceae proposed by different authors.
2. The evaluation of the family status of the Thunbergiaceae which have been often merged with the Acanthaceae.
3. The taxonomic validity of the two series Contorate and Imbricate, on the basis of an aestivation in buds, proposed by Lindau (l.c.)
4. The affinities of the subfamily Nelsonioideae. The subfamily Nelsoniodeae having well-developed endosperm, parietal placentation, albuminous seeds and loculicidal capsule etc. is sometimes taken away from the rest of the Acanthaceae which characteristically show rare occurence of endosperm, axile placentation, exalbuminous seeds etc. and merged with the Scrophulariaceae. But several other characters such as ontogeny

of stomata, embryology, pollen-grains etc. do not agree with this concept.

5. The evolutionary status of the tribe Hygrophileae. This tribe is considered advanced due to its bilabiate corolla and united stamens.

6. The taxonomic validity and circumscription of the tribes Petalideae, Strobilantheae, Andrographideae, Ruellieae, Barlerieae, Lepidagathideae, Pseuderanthemeae, Odontonemeae and justicieae of Lindau (**l.c.**).

7. The generic status of Eranthemum and Daedalacanthus and their affinities with the genus Ruellia.

8. The taxonomic validity of the genus Dipteracanthus and its affinity with the genus Ruellia and the identity of Dipteracanthus patulus which is merged in Ruellia.

9. The placement of Crossandra. This genus is kept in Acantheae by some authors whereas others (notably, Balkwill and Norris, **l.c.**) have formed a subtribe within Acantheae on the basis of floral morphology and palynology.

1Ø. The distinct identity of Adhatoda from Justicia. Adhatoda zeylanica is sometimes treated under Justica.

11. An evalution of the taxonomy of Justicia. This is a hetrogenous genus subdivided into sections. **Rostellularia,** a section has been raised to generic status (Bremekamp, 1948). The two sections, **Betonica** Clarke. and **Rostellularia** clarke. are also taxonomically in question.

12. To find out substitute sources of alkaloids saponins, and flavonoids.

13. Cladistic analysis of the family. Since all the

classificatory schemes are subjective, an attempt is made to use cladistics methods to arrive at an infrafamilial classification.

ORNAMENTAL PLANTS.

	NAME OF PLANTS	VERNACULAR NAME	NATIVE
1.	Acanthus ilicifolius	-	Tropical Asia
2.	Acanthus mollis	"Greek Acanthos"	So. Europe
3.	Acanthus montanus	"Mountain thistle"	W.Tropical Africa
4.	Acanthus pubescens	-	Kenya
5.	Adhatoda zeylanica	-	-
6.	Aphelandra aurantiaca	"Fiery spike"	Mexico
7.	A. chamissoniana	"Yellow pagoda"	Brazil
8.	A. fascinator	-	Colombia
9.	A. fuscopuricta	"Epple's findling"	Colombia
10.	A. nitens	-	Colombia
11.	A.sinclairiana	"Coral aphelandra"	C.America, Panama,Darien
12.	A.squarrosa	"Fritz Prinsler" or"Saffrone spike"	Brazil
13.	A.squarrosa var. louisae	"Zebra plant"	Brazil
14.	A.tetragona	-	W.Indies, So.America
15.	Asystasia gangetica	"Coromandel"	India,Malaysia
16.	Beloperone guttata	"Shrimp plant"	Mexico
17.	Chamaerathemum verlosium	-	Brazil
18.	Crossandra infundibuliformis	"Mona Wallhead"	
19.	C.pungens	-	Tanzania, Usambaras
20.	Eranthemum nervosum	"Blue Sage"	India
21.	Fittonia verschaffeltii	"Mosaic plant"	Peru
22.	F.verschaffeltii 'Argyroneura'	"Nerve plant"	Peru
23.	Graptophyllum pictum	"Caricature plant"	Hortense,South-east Asia
24.	G.pictum 'tricolor'	-	New guinea
25.	Hemigraphis colorata	"Red ivy"	Java
26.	H. 'Exotica'	"Purple waffle plant"	New guinea

CONTINUED....

27.	H.repanda	-	Malaysia
28.	Jacobinia carnea (Justicia magnifica)	"Flaming plant"	Brazil
29.	Jacobinia velutina	"Brazilian plume"	Brazil
30.	Justicia aurea (umbrosa)	-	Mexico, C.America
31.	Justicia betonica (Jacobinia)	"White shrimp plant"	Trop.Asia, So.Pasific
32.	J.ovata	-	Texas to Verginia and Florida
33.	J.pohliana obtusior (Jacobinia)	-	Brazil
34.	J.rizzinii (Jacobinia pauciflora)	-	Brazil
35.	Mackaya bella (Asystasia)	-	So.Africa
36.	Pachystachyus coccinea (Jacobinia)	"Cardinal's guard"	Trinidad, So.America
37.	P.lutea	"Lollypops"	Peru
38.	Peristrophe hyssopifolia ("Aureo-variegata" /Angustifolia variegata)	"Marble-leaf"	Java
39.	Porphyrocoma pohliana (lanceolata)	-	Brazil
40.	Pseuderanthemum alatum	"Chocolate plant"	Mexico
41.	P.atropurpureum	'Tonga'	So.Pasific
42.	P.atropurpureum 'variegatum'	-	Polynesia
43.	P.reticulatum	-	New Hebrides
44.	P.sinuatum	-	New Caledonia
45.	Ruellia affinis (Speciosa)	-	Brazil
46.	R.amoena (graecizans)	"Red-spray ruellia" or "Red Christmas pride"	So.America
47.	R.colorata	-	Brazil,Amazon
48.	R.macrantha	"Christmas pride"	Brazil
49.	R.makoyana	"Monkey plant"	Brazil
50.	R.squarrosa (Dipteracanthus)	-	Okinawa

CONTINUED....

51.	Kuttya fruticosa	–	So.Africa
52.	Sanchezia nobilis glaucophylla	–	Ecuador
53.	Stenandrium lindenii	–	Peru
54.	Strobilanthes dyerianus (Perilepta)	"Persian shield"	Burma
55.	S.lactatus	–	Brazil
56.	S.maculatus	–	Himalayas
57.	Thunbergia alata	"Black-eyed Susan"	So.E.Africa
58.	T.erecta	King's mantle"	W.Africa
59.	T.fragrans	–	India,Sri Lanka
60.	T.gibsonii	"Golden-glory creeper"	Trop.E.Africa
61.	T.grandiflora	"Clock vine"	India
62.	T.grandiflora 'Alba'	"Trumpet vine" or "Sky flower"	
63.	T.gregorii (gibsonii)	"Orange clock-vine"	Trop.Africa
64.	T.laurifolia	–	India
65.	T.mysorensis	–	So.India

CHEMICALS FROM PLANTS

PLANT NAME	COMPOUNDS	REFERENCE
Acanthus ilicifolius	Steryl esters	Misra, Chaudhury et. al. (1984).
	Triterpene, lipid, sterol.	Ghosh, Misra, et.al. (1985).
	α-L-arabinofuranosyl -(1-->4) - -D-B glucuronopyrranosy (1-->3) 3 - hydroxyl up 20 (29)-ene. (triterpenoidal saponin).	,,
Acanthus mollis	B-sitosterol, caffeic acid rhamnoglucoside, chlorogenic acid, luteolin -7-0- glucoside fathy acids(6), Amino acids (free-14).	Loukis and Philianos. (1980).
Acanthus spinosus	B-sitosterol,caffeic Rhamnoglucosite, Luteolin-7 glucoside, Apigenin-7- galactoside. Fatty acids and free Amino acids.	Loukis and Philianos. (1980).
Adhatoda beddomei	Vasicine, vasicinone, deoxy vasicinone, B-sitosterol and its glucsides.	Jain and Srivastava. (1986).
Adhatoda zeylanica	2',4- Dihydroxy chalcone 4-glucoside.	Bhartiya and Gupta. (1982).
	1,2,3,9- tetrahydroxy -5- methoxypyrrolo- (2,1-b) quinazoline -3-0-1.	Chaudhury and Bhattacharya. (1985).
	Vasicine, Vasicinone (artifect).	Brain and Bhupendra. (1983).
	Vasicol (alkaloid) 1,2,3,4,9,11- hexahydropyrrolo [2,1-b] quinazolin -3,11 -diol.	Dhar, Jain Kaul and Atal. (1981).
	2.3- cycloalkylene- 4H- pyridol [1,2-a] pyrimidin 4ones.	Bernath et.al. (1979).

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:Aphelandra squarrosa	:Aphelandrine (spermine alkaloid).	:Daetwylen, Heinz, et.al. (1978).
:Aphelandra tetragona	:-18-Ø-Methylchaenorpine and iso -18-Ø-methylchaenorpine. (spermine alkaloids).	:Tawil, Ji-ping et.al. (1989).
:Asterracantha longifolia	:Apigenin -7-Ø- glucuronide.	:Balraj and Nagarajan. (1982).
	:Apigenin -7-Ø- glucoside	
	:Asteracanthine :Asteracanthicine.	:Basu and Rakhit. (1957).
	:Straight chain Keton :and mixture of Ketons.	:Quasim and Dutta. (1967)
	:Luteolin and luteolin :-7- rutinoside.	:Nair and Nagarajan.
:Asystasia bella.	:Iridoial glucosides.	:Demuth, Soren and Bent. (1989).
:Asystasia travancorica	:Apigenin -7- :rutinoside, Apigenin :-7- glucoside, :Delphinidin 3,5- :diglucoside, Apigenin :-7- glucuronide :isisalipurposide, :flavanone.	:Subramanian and Nair. (1971).
:Andrographis paniculata	:Andrographolide.	:Bandopadhyay, Dutta and :Sukul. (1986).
	:Deoxyandrographolide :19-B-D- glucoside.	:Chen and Liang.
	:14- :deoxyandrographolide; :14- deoxy -11,12- :didehydroxydrographolide	:Balmain and Joseph. (1973).
	:14- deoxy -11- :oxoandrographolide.	
	:2- cis, 6- trans :farnesd, 2- trans, 6- :trans farnesol.	:Overton and Frank. (1973).
	:Neoandrographolide	:Chan, Taylor et.al. (1972).
	:new minor diterpeenoids.	:Fujita, et.al. (1984).

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	:5-hydroxy- 7,8 :dimethoxy flavone; 5, :-hydroxy- 7,8- :dimethoxy flavanone; 5- :hydroxy- 3.7.8.2 tetra :mrthoxy flavanone.	:Gupta, Dhar et.al. :(1983).
:Barleria lupulina	:6-Ø- acetylshanzhiside :methyl ester; :ipolamifdoside.	:Byrne et.al. (1987).
:Barleria prionitis	:Barlerian, Acetyl :Barlerin, Scutellarein :-7- rhamnosyl glucoside.	:Harborne et.al. (1971).
:Blephairs edulis	:A flatoxin; citrinin	:Roy and V.Kumari. :(1991).
:Blepharis sindica	:9-Hydroxydodecanoic :acid.	:Ahmed, Sherwani, et.al. :(1983).
:Dicliptera :roxburghiana	:Apigenin; Kaempferol; :luteolin; apigenin :-7-Ø- glucoside; fatty :acids.	:Bahuguna, Jangwan :et.al. (1987).
:Dipteracanthus :prostratus	:Palmitic acid; stearic :acid, Oleic acid; :Linoleic acid.	:Tiwari. (1973).
:Hygrophila erecta	:Verbascoiside.	:Henry, Jean-Louis and :Claude. (1987).
:Justicia sp.	:Justicidin B; Diphyllin :(lignan).	:Momose, Takefumi, :et.al. (1978).
:Justicia extensa	:Justicidin P (lignan :lacton)	:Wang and Ripka. (1983).
:Justicia flava	:Orosunol; 8- :demethylorosunol. :(1-aryl, -2,3- :naphthalide lignan).	:Olaniyi. (1982).
:Justicia :gendarussa	:aromatic amines.	:Chakravarti, Ghosh, :et.al. (1982).
:Justicia :pectoralis var. :stenopylla	:Betaine (ubiguitous :compound), coumarine, :umbelliferone.	:Macrae and Neiltowers. :(1984).
:Justicia :procumbens	:Peonidin -3- glucoside, :Justicisaponin.	:Tiwari, et.al. (1978).
:Justicia simplex	:Oleanolic acid 3-Ø-B-D. :glucopyranosyl -4-o- :ferulate.	:Ghosal, Srivastava :et.al.1).
:Phlogacanthus :thyrsiflorus	:Phlogantholide :-A-19-o-B-D	:Barua, Biswas, et.al. :(1987).

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	:glucopyranoside; ΒΒ-	
	:15,18- trihydroxyent-	
	:labol 8(17), 13-dien	
	:-16-oic lactone.	
:Rhinacanthus	:Rhinacanthin A,	:Tian-Shung et.al.
:nasutus	:Rhinacanthin B, lupeol,	:(1988).
	:Β- sitosterol,	
	:stigmasterol,	
	:Β-sitosterol glucodide,	
	:stigmasterol glucoside.	
:Ruellia tuberosa	:Apigenin, luteolin;	:Subramanian and Nair.
	:(lvs.) Apigenin -7-o-	:(1974).
	:glucuronide; Apigenin	
	:-7-o glucoside;	
	:apigenin -7-o-	
	:rutinoside; Luteolin	
	:-7-o- glucoside;	
	:malvidin -3,5-	
	:diglucoside (AS.)	
:Ruellia prostrata	:Apigenin glucuronide.	:Subramanian and Nair.
		:(1974).
:Rungia grandis	:Macrorine, isomacrorine	:Adesomoju. (1982).
	:(alkaloids).	
:Strobilanthes	:isoborneol; 8	:Weyerstahl et.al.
:auriculatus	:(-isobutyryloxy-)	:(1987).
	:isobornyl isobutyrate;	
	:isobutyrate isoborneol.	
:Thunbergia	:apigenin -7-	:Subramanian and Nair.
:grandiflora	:glucoronide; luteolin;	:(1971).
	:luteolin -7- glucoside;	
	:inalvidin-3, 5-	
	:diglucoside.	
:Thunbergia	:Β- sitosterol- D	:Subramanian and Nair.
:fragrans	:glucoside; apigenin	:(1971).
	:-7-o-Β-D- glucuronide;	
	:apigenin -7-o-	
	:rutinoside.	
:Hypoestes rosea	:1,2,3,3a =	:Okogun, et.al. (1982).
	:4,5,6a,7,8,9,1Øa-	
	:dodecahydro- 5 hydroxy-	
	:3 isopropyl-	
	:3a-6-oxa-6,9,1Øa =	
	:trimethyl- dicyclopenta	
	:[a,b] cycloocten-	
	:1-one. (Roseanalone).	
:Phaylopsis	:Sesamin and eudesmin	:Adesomoju and Okogun.
:falcisepala	:(lignans).	:(1985).
:Monechma ciliatum	:coumerin, Β-	:Hussein, Babiker and
	:sitosterol,	:Maat. (1983).
	:stigmasterol and	
	:campesterol.	
:Lepidagathis	:Oleic acid.	:Mukarram, Ahmed and
:trinervis		:Farooqi. (1986).