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## Phylogenetic classification of ethnobotanical plants used by the tribes of Nilambur forest, Malappuram district, Kerala, India

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**Abstract**

The present paper deals with an attempt to classify the ethno botanical plants collected during the study conducted for a period of 6 years among the 6 tribal inhabitants of Malappuram district, Kerala, based on APG IV system. The present study describes 333 wild, naturalized and cultivated flowering plant species in 267 genera, 82 families, 35 orders and 8 clades based on the APG system. The 333 species are included under the clade Magnolids, Monocots, Eudicots, Core Eudicots, Superrosids, Rosids, Superasterids and Asterids. Of these Rosids are the most represented clade with 140 species. Leguminosae was the most-frequently cited family with 34 species followed by Apocynaceae and Acanthaceae with 17 species each. Lamiaceae, Malvaceae, Combretaceae, Euphorbiaceae, Zingiberaceae, Cucurbitaceae, Phyllanthaceae, Rubiaceae and Asteraceae are the other families. The Phylogenetic Classification of ethnobotanical plants used by the tribes in Malappuram district will provide an opportunity for efficient management of the biodiversity information databases.

**Keywords:** angiosperm phylogeny group, APG IV, classification, ethnobotany, Malappuram district

### 1. Introduction

Ethnobotany is a multidisciplinary branch of science which deals with the study of indigenous knowledge of rural and tribal people on plant resources and it also deals with all aspects of plant conservation and consumption. Tribals are the distinct ethnic group who are usually confined to definite geographical areas, and are culturally homogenous and a unifying social organization. The Malappuram district is inhabited by six tribal communities, Arnadan, Cholanaikkan, Kattunaikkan, Kuruman, Muthuvan and Paniya. Plant systematics form a key component of ethnobotanical studies, as it helps in efficient management of ethnobotanical databases through adopting a stable and universal classification system. The field of plant systematics has undergone resurgence during the past two decades and the Angiosperm Phylogeny Group (APG) classification with the incorporation of DNA sequence data into the phylogenetic reconstruction has evolved to establish a consensus view of the taxonomy of angiosperms that would reflect new knowledge about their relationships based upon phylogenetic studies. As of 2016, four versions of a classification system (APG I to IV) have resulted from this collaboration (APG, 1998; 2003; 2009; 2016) [2, 3, 4, 5]. The present paper deals with an attempt to classify the ethnobotanical plants collected during the study conducted for a period of 6 years among the six tribal inhabitants (Arnadan, Cholanaikkan, Kattunaikkan, Kuruman, Muthuvan and Paniya) of Malappuram district, Kerala, India, based on APG IV classification [5].

### 2. Materials and Methods

#### 2.1 Study area

The study was conducted in the tribal areas of Malappuram district, Kerala, India, an area adjacent to the tropical mountain forests of Nilgiris, significant for floristic explorations. The tribals are mainly found in the regions of Nilambur valley, and the valley is divided into 3 forest range namely Nilambur, Chungathara and Karulai.

#### 2.2 Ethnobotanical data collection

In order to explore plants used as ethnomedicines by the tribal communities of Malappuram district, 3-4 field surveys were conducted every year, from 2010-2016 in the entire study area. A total of 169 key informants from six tribal communities, the Arnadan, Cholanaikkan, Kattunaikkan, Kuruman, Muthuvan and Paniya, were interviewed. Surveys were organized periodically during the flowering period of most of the higher plants, so as to enable the

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informants to identify the plants by their local names and also genuine plant specimens were available for the herbarium purpose. Information on medicinal plants used by the tribes were collected using a questionnaire survey, interviews with key informants, field observation, etc. The collected specimens were cross checked for their local names with the help of key informants and development agents. Only unique specimens were collected for confirmation of identity and deposition in the herbarium. Specimens were processed for mounting following standard protocol as per Jain & Rao (1977)<sup>[9]</sup> and voucher specimens were deposited in the CMPR Herbarium for future reference. The identity of the specimens collected was confirmed by comparison with the specimens previously deposited in the Herbarium at CMPR and final identification was done after detailed laboratory studies, using stereomicroscope and light microscope or after consulting relevant floristic literature such as Flora of Presidency of Madras (Gamble, 1915-1936)<sup>[7]</sup>, The Flora of British India (Hooker, 1872-1897)<sup>[8]</sup>, Flora of Kerala (2005)<sup>[12]</sup>, Flora of Nilambur (2007)<sup>[13]</sup> and Flora of Calicut (1982)<sup>[11]</sup>. Systematic position and accepted names were confirmed using The Plant List (2017), Integrated Taxonomic Information System (ITIS) and International Plant Names Index (IPNI). The classification system followed is APG IV (APG 2016)<sup>[5]</sup> and all the taxa are arranged as per the system;

**3. Results and Discussion**

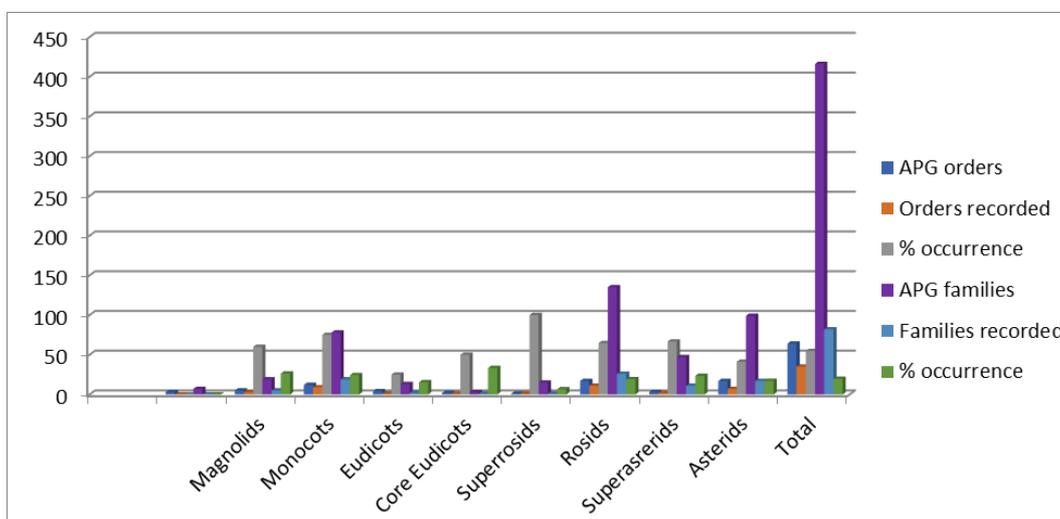
The APG system of classification is mainly based on the combination of information from morphological to molecular data, about the relationships of angiosperm using phylogenetic methods. According to APG IV system angiosperm species are included under 416 families in 64 orders (APG, 2016)<sup>[5]</sup>. The diversity of flowering plants is not evenly distributed. The present study has revealed the

presence of 333 wild, naturalized and cultivated flowering plant species in 267 genera. Based on APG system of classification, all these taxa recorded were classified under 82 families and 35 orders under 8 clades such as Magnolids, Monocots, Eudicots, Core Eudicots, Superrosids, Rosids, Superasterids and Asterids (Table 1).

**Table 1:** Grouping of the taxa recorded from the Nilambur forest, Malappuram according to APG system of classification (APG, 2016)

No.	Clade	Orders	Families	Genera	Species
1	Magnolids	3	5	7	12
2	Monocots	9	19	40	50
3	Eudicots	1	2	8	8
4	Core Eudicots	1	1	1	1
5	Superrosids	1	1	1	1
6	Rosids	11	26	106	140
7	Superasterids	2	11	17	19
8	Asterids	7	17	87	102
Total from the study area		35	82	267	333

Of the 8 clades, Rosids are the most represented one with 140 species (42.04%) and 106 genera (39.70%) belonging to 26 families (31.32%) and 11 orders (31.42%), followed by Asterids with 102 species (30.63%) in 87 genera (32.58%) of 17 families (20.73%) and 7 orders (20%). Eleven families are included in Superasterids under two orders. Magnolids constitute 5 families under 3 orders with 7 genera and 12 species. Monocots are represented by 50 species (15.02) in 40 genera (14.98%) belonging to 19 families (23.17%) under 9 orders (25.71%). Both Core Eudicots and Superrosids are represented by one family each with 1 genus and species and Eudicots consisted of two families with 8 genera and 8 species<sup>[5]</sup>.



**Fig 1:** Comparison of orders and families within various clades recorded during the study from the Nilambur forest, Malappuram with that in the APG IV system of classification

All the eight clades as per the APG system was represented in the ethnobotanical flora of Nilambur recorded during the study. Comparison of the orders and families with that of the APG IV system indicated that out of the total 64 orders and 416 families in the APG system, 35 and 82 respectively are represented (54.68% and 19.75%) in the ethnobotanically important flora in the region. In the APG system the number of orders in each clade is in the order Rosids = Asterids> Monocots> the number of families in each order are in the order Rosids>Asterids> Monocots

>Superasterids>Magnolids>Superrosids>Eudicots> Core Eudicots. (Fig 1)

According to APG system, nearly all species belong to the eudicot (75%), monocot (23%) and magnolid (2%) clades. The remaining 5 clades contain a little over 250 species in total, i.e., less than 0.1% of flowering plant diversity, divided among 9 families. In the present study, the total species collected are represented within 19.7% and 54.68% of the APG families and orders. Among the different clades included under APG system, the rosids comprise 140 families

and close to one-third of all angiosperm species (Soltis *et al.*, 2005) [14]. Like rosids, asterids are a large clade, encompassing nearly one-third of all angiosperm species (80,000 species) classified in 114 families (Albach *et al.*, 2001 [1]; Soltis *et al.*, 2005) [15]. In the present study also most represented clades are Rosids followed by Asterids with maximum number of families and species. Using APG III system of classification Chase and Reveal (2009) [6] reported phylogenetic classification of land plants. Lin and Chung (2017) [10] reported phylogenetic classification of seed plants of Taiwan with the help of APG IV system.

The most diverse families of flowering plants, in their APG circumscriptions, in order of number of species, are: Asteraceae or Compositae (23,600 species); Orchidaceae (22,075 species); Fabaceae or Leguminosae (19,400 species); Rubiaceae (13,150 species); Poaceae or Gramineae (10,035

species); Lamiaceae or Labiatae (7,173 species); Euphorbiaceae (5,735 species); Melastomataceae (5,005 species); Myrtaceae (4,620 species) and Apocynaceae (4,555 species). In the present investigation, Leguminosae (= Fabaceae), the third highest in the APG circumscription, was the most-frequently cited family with thirty four species (11.11%) in twenty eight genera, followed by Apocynaceae, the tenth in the APG circumscription, and Acanthaceae with 17 species each (5.1%). Lamiaceae, Malvaceae, Combretaceae, Euphorbiaceae, Zingiberaceae, Cucurbitaceae, Phyllanthaceae, Rubiaceae and Asteraceae are the other prominent families represented by 10 to 14 species. These families constitute 26.64% of the total species documented (Fig. 2). Forty six families are represented by one or two species only.

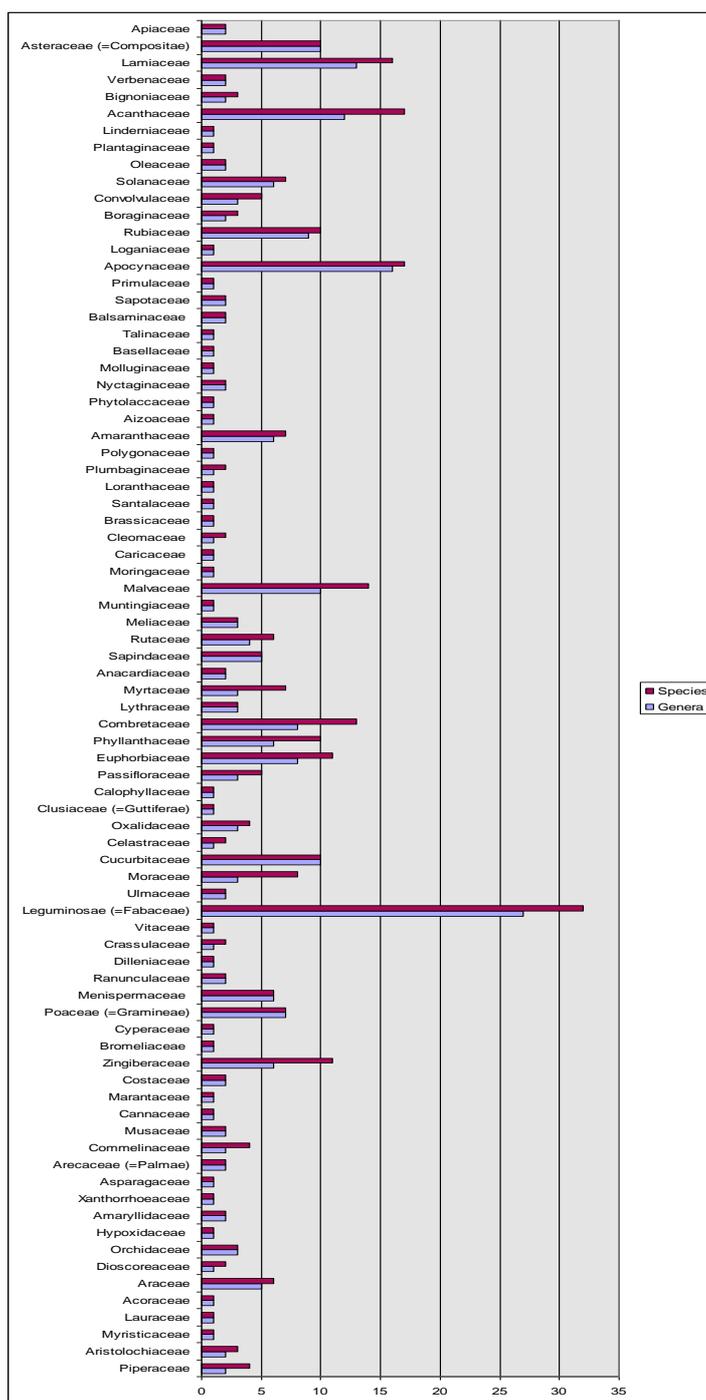


Fig 2: Comparison between the genus and species in various families according to APG system (families with single genera and species are excluded)

#### 4. Conclusion

The present study explains phylogenetic classification of 333 plant species used by the tribal inhabitants of Malappuram district, Kerala state. The adoption of APG IV will provide better opportunities for efficient management of the biodiversity information collected during the study.

#### 5. Acknowledgement

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