ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

OBSERVATIONS ON THE MEDICINAL PLANT DIVERSITY OF MALAPPURAM DISTRICT OF KERALA WITH SPECIAL REFERENCE TO FOLK AND INDIAN SYSTEMS OF MEDICINES

Pius. O.L[-], Sujanapal. P[1] and Udayan. P.S.[2]

State Medicinal Plants Board, Kerala, Thrissur - 680 022, Kerala, India

[1]Kerala Forest Research Institute, Peechi, Thrissur - 680653, Kerala, India

[2]Sree Krishna College, Guruvayur, Thrissur - 680102, Kerala, India

Manuscript Info

Manuscript History:

Received: 12 December 2014
Final Accepted: 26 January 2015
Published Online: February 2015

Key words:

Corresponding Author

Pius. O.L

Abstract

Intensive field exploration and literature survey on the medicinal plants of Malappuram district resulted in the documentation of 869 taxa including 70 endemics used in folk and various Indian systems of medicines. Among the 869 taxa, 772 species belonging to 144 families are used in folk system. Ayurveda with 484 taxa belonging to 107 families and Siddha with 393 taxa in 103 families are other major systems. Among the 869 species, deciduous forests lodges 399 species followed by semi-evergreen forest with 207 species and evergreen forest with 169 species. 499 species includes exotics were recorded from non-forest areas. Leaves of 300 species and root of 251 and whole plant of 217 species are used in various systems. Useful parts with respect to number of taxa are fruits of 179, bark of 176, seeds of 118, Rhizome/tubers of 65, flowers of 63, stem of 31, exudates of 31 and wood of 21 species respectively. A total of 168 commercially high demanding species and 49 medicinal plants under various threat categories were also recorded.

INTRODUCTION

Malappuram is the third largest district of Kerala covering a geographical area of 3,550 sq. km, which is 9.13 per cent of the total area of the State and lies between 10° 41' 33" to 11° 30′ 32"N latitude and 75° 49' 25" to 76° 32' 40" E longitude. The word '*Malappuram'* derived from its topographical characteristic, means *'terraced place atop the hills'*. The elevation of the district ranges from sea level to 2554 m at Mukuruthi region. Most of the high lands are occupied by forests. The topography of the district is highly undulating; it flinches from the dense forest on the eastern part of Nilgiri hills and gradually slopes down to the valleys, small hills and ends along the costal belt in the west. The district is bounded on the north by Wayanad and Kozhikkode districts, northwest by Kozhikode District, on the northeast by Tamil Nadu, on the southeast and south by Palakkad District, on the southwest by Thrissur District, on the west by the Arabian Sea. The district comes under Nilgiri phytogeographical region of Western Ghats and is remarkable for its unique natural beauty, the undulating hills and the meandering rivers that flow to reach the coconut-fringed seacoast. The district is renowned for its wealth from timber and other non-wood forest products, especially of medicinal plants. Apart from the classical Ayurvedic heritage, the district has a rich ethno-medical, cultural, historical and political heritage.

Study area

Malappuram is situated in the central part of the State with hilly terraced tract starting from the Core of Nilgiris traversed through lateritic midlands up to sea coast (Fig. 1). The innumerable streams that roam these hills reach the

coconut fringed and picturesque sea coast. Compared to other districts, Malappuram has a unique composition of three natural divisions, Lowland, Midland and the Highland. The low land region stretches along the sea coast belt with mangroves and an array of wetlands; the midland is the centre part with fertile and thick coconut groves in the midst of lateritic habitats. The high land region covers the east and north eastern parts with dense forests and extensive Teak plantations. Malappuram district is mainly drained by the Kadalundi, Chaliyar and Bharathapuzha.

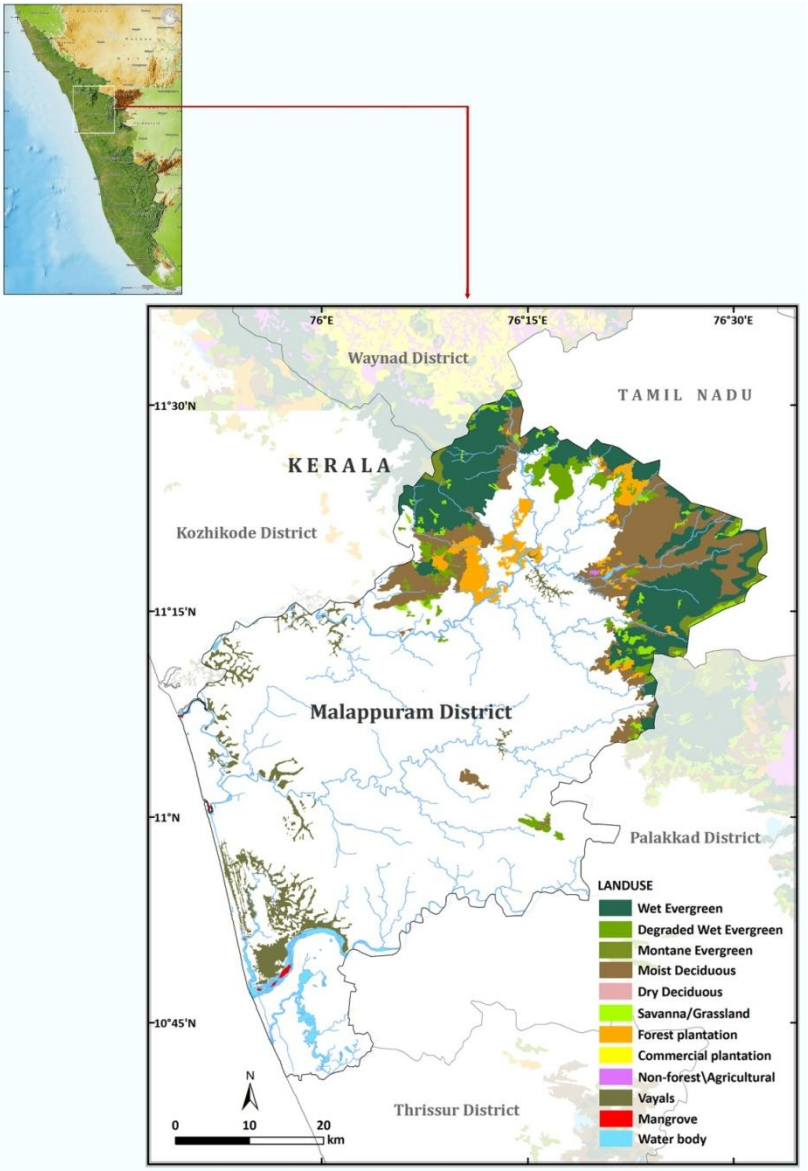


Fig. 1. Land use details of Malappuram district

The agriculture areas of the district favours dense growth of medicinal plants, especially coconut plantations and paddy fields. In most of the homesteads in midland and highland region, medicinal trees such as *Terminalia bellirica*, *Oroxylum indicum*, *Stereospermum colais*, *Phyllanthus emblica*, *Wrightia tinctoria*, etc. are common. Under shrubs such as *Helicteres isora*, *Hemidesmus indicus*, *Sida spp. Pseudarthria viscida*, *Desmodium gangeticum*, *Curculigo orchioides*, *Glycosmis pentaphylla*, *Gymnema sylvestre*, *Tinospora cordifolia*, *Curcuma spp.*, *Zingiber spp. Costus speciosus*, etc. are also common. Aquatic medicinal plants are rich in the lowland region. Sacred groves and laterites within the thickly populated area maintain the diversity of medicinal plants to a certain extent, which provides resources for the local people for their primary health care. Most of the agriculture areas in the district are suitable for medicinal plant intercropping, which will add additional income to the farmers.

Ethnic groups

There are seven Scheduled Tribes in Malappuram district with a total population of 14410, mainly distributed in the hill ranges of Nilambur and Eranad Taluks. Cholanaickens, Kattunaickens, Malamuthans, Paniyans, Aranadans and Kurumans are the major scheduled tribe communities in the District. Cholanaikkans are the most primitive and vanishing tribes of Kerala. They are only seen in the Karulai and Chungathara forest ranges in Nilambur. They are one of the last remaining hunter-gatherer tribes of South India, still preferring to live in rock shelters or crude huts beside brooks. They are the worshipers of trees and are the major information providers with regard to ethno-botanical knowledge. Kattupaniyans/Kurinhipaniyans are different from the other Paniyans of the State and also have primitive habits. Majority of the other tribal groups in the area are freely mingling with the local people and following a modern lifestyle.

Vegetation

The varied topographical peculiarities, high rainfall and geologic conditions have favoured the formation of different type of vegetation from shola forests on the mountain valleys to the mangrove forests along sea coasts and estuaries. The vegetation in the district is illustrated under two broad sections such as vegetation in forest area and non-forest area (Fig. 1).

By following Chandrasekharan (1962c, d, e) and Champion and Seth (1968) the natural vegetation in the forest area is classified into west coast tropical evergreen forests, west coast semi-evergreen forests, southern moist mixed deciduous forests, southern subtropical hill forests, southern montane wet temperate forests-shola, southern montane wet temperate grasslands and littoral forests. Certain edaphic types recognised are Bamboo brakes, Cane brakes, Reed brakes, laterites and Riparian forests. By virtue of its geographic location, the forest area occupies the western slope of Nilgiri plateau. The upper reaches of New Amarambalam and adjacent forests form part of the core area of the Nilgiri Biosphere Reserve. Due to various factors, secondary forests of evergreen and moist deciduous are also seen in the area.

Sacred groves, Lateritic areas, wetlands and mangroves are the major centre of vegetation in outside forest area. Altogether 14 sacred groves of various sizes were recorded from the district. Laterite hill plateau can be considered as an amphibious ecosystem and it forms the watersheds. Ephemerals are common and it is a centre of rare herbs and a treasure house of many rare medicinal plants. Mangroves are confined mainly in three localities of the estuaries and banks of backwaters such as Kadalundi, Ponnani and Parappanangadi, though they are highly fragmented. Due to the presence of three rivers and coastal belt, Malappuram is enriched with an array of wetlands in lowland and midland region.

Materials & Methods

There are various tools employed for studying the medicinal plant diversity of Malappuram. They are:

1. Intensive field studies
2. Authentic literature
3. Information from Herbaria and Musea
4. Other information (*from tribal markets, tribal festivals and other ceremonies*)

Field studies holds the prime status, intensive survey and collections were carried out from different habitats of the district during 2004-2013 for collecting field data and recording ethno-botanical information. Sampling survey was conducted to assess the diversity. Ethno-botanical Information were collected from the knowledgeable informants during the field work or from the referred voucher specimens to the elder knowledgeable tribesmen in various settlements (Rao, 1989a; Martin, 1995). Information gathered from each of them was authenticated by consulting other members, and only those information which were found identical were recorded. All information on the local names of the plants, parts that are used, medicines prepared, formulation of the drugs and their application etc. were gathered and the mode of applications were often eye witnessed. To ascertain the authenticity of the information gathered on plant utilization, '*Credibility Rating*' were given to each and every documentation based on Balick (1996) as given in Table 1.

Table1. Credibility rating for use information collected

No.	Category	Credibility Rating
A.	Collector uses or directly observed use	1
B.	Informant uses or directly observed use	2
C.	Informant heard/knew from a further source	3
D.	Use reported from the literature	4
E.	Common knowledge	5
F.	Credibility of use information unknown	6

Attempts were made to collect data on the local names, medicinal use(s), parts used, other ingredients, mode of preparation of drugs and method of their administration, dose and duration of treatment etc. Plant specimens from Malappuram district represented in the local regional herbaria such as KFRI, MH, CALI etc. were also studied and ethno-botanical notes if any were gathered. Plant specimens collected during the fieldwork were neatly processed, preserved and prepared into herbaria as per the standard specification (Fosberg & Sachet, 1965; Bridson & Forman, 1991).

Apart from the field work and ethno-botanical survey, the details of medicinal plant were collected from the authentic literature such as Indian medicinal plants (Kirtikar & Basu, 1935), The Wealth of India (CSIR, 1948-1976), Indian Materia Medica (Nadkarni, 1954), Glossary of Indian medicinal plants (Chopra *et. al.*, 1956), Medicinal plants of India and Pakistan (Dastur, 1962), Pharmacognosy of Ayurvedic Drugs-Kerala (Narayana Aiyar *et. al.*, 1957-1963), Supplement to glossary of Indian medicinal plants (Chopra *et. al.*1969), Single drug remedies (Mooss, 1977), Studies on the Medicinal Plants of Kerala Forests (Nambiar *et. al.*, 1985), Ayurvedic Pharmacopoeia of India Volumes I-VIII (AYUSH, 1990 to 2010), Second Supplement to Glossary of Indian Medicinal Plants with Active Principles (Asolkar *et. al.*, 1992), A compendium of Indian Medicinal Plants (Warrier *et. al.*, 1994-1996), Ayurvedic Drugs and Their Plant Sources (Sivarajan and Indira Balachandran, 1994), The Siddha Pharmacopeia of India vol-1 (AYUSH, 2008), Medicinal Plants of Bangladesh (Yusuf *et. al.*, 2009), Medicinal Plants of AryaVaidya Sala Kottakkal (Udayan and Indira Balachandran, 2009), Ethnobotany and medicinal plants of Indian subcontinent (Maheswari, 2000), Healing Plants of Peninsular India (Parrotta, 2001). Recently a number of studies have been carried out by various institutions, departments and individuals in regional ethno-botany, plant chemistry, diversity, etc. Some important works related to the region are An outline of Ethnobotanical research in India *(*Binu *et. al* 1992*)*, Ethnobiological studies related to the Tribals living in and around Periyar Tiger Reserve (Sasidharan. 2002), *Ethnobotanical studies on Pathanamthitta district* (Binu, 1999), *Floristic and Ethnobotanical Studies of Periyar Tiger Reserve* (Jomy, 2000), Enthobotanical and Vegetation Studies in the Attappady Valley Kerala, India (Harinarayanan, 2006), *Ethnobotanical studies on Tribal groups of Palakkad district* (Remesh, 2007), Taxonomic and Ethno-botanic studies of endemic angiosperms of Kerala (Shaju, 2011). Ethnobotanical studies in Kannur district (Ramachandran and Nair, 1981), Ethno medicines, A case study from the Shola forests of Kerala (Kishore Kumar and Sasidharan, 2002) are incorporated in the study for getting more specific and accurate information. Moreover, online databases available (Envis, 2014) were also referred.

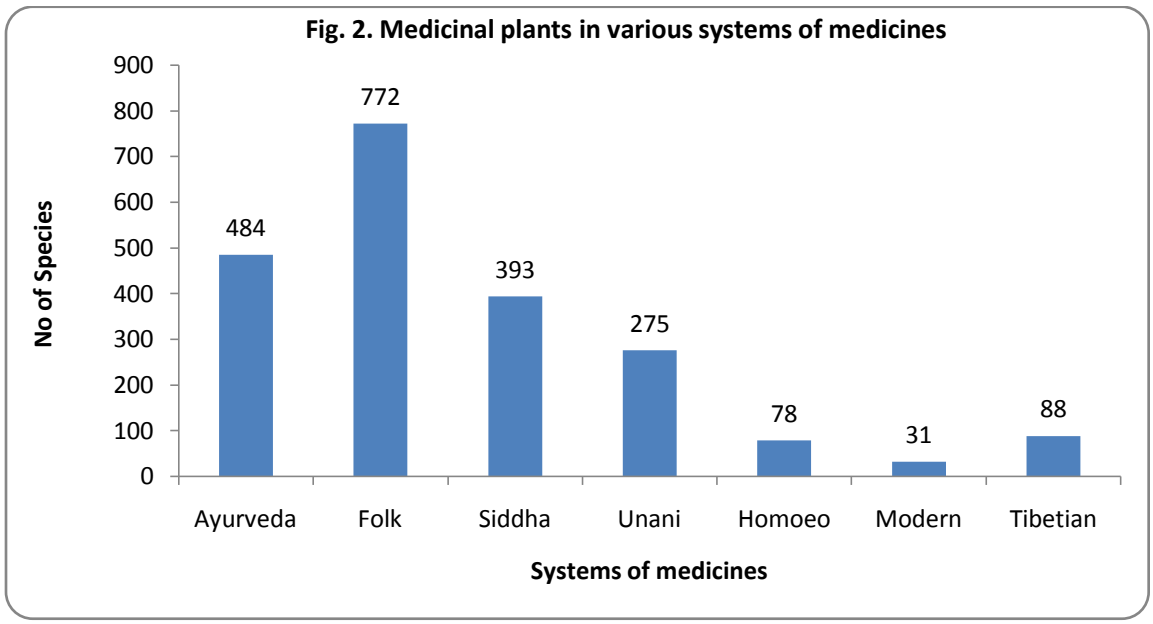
Results

The present study for assessing the medicinal plant diversity of Malappuram district resulted in the documentation of 869 taxa belonging to 146 families used in folk and various Indian systems of medicines, which is about 43 percent of the angiosperms recorded from the district. Higher diversity of medicinal plants indicates the rich traditional knowledge, varied topography

and diverse vegetation. Detailed analysis based on various systems, habit, habitat, family and useful part were carried out in detail. During the present study, ethno-botanical knowledge of aboriginal communities like *Cholanaikkans*, *Kattunaikkans*, etc. were also recorded. Among the information gathered several were recorded for the first time. Though the folk medicines are prominent, medicinal plants diversity with respect to Ayurveda and Siddha are also rich. Among the 869 medicinal plants out of total 1986 taxa of angiosperms recorded from the district, non-forest areas contribute a major part because of mosaic vegetation pattern in coastal and mid-lands of Malappuram district.

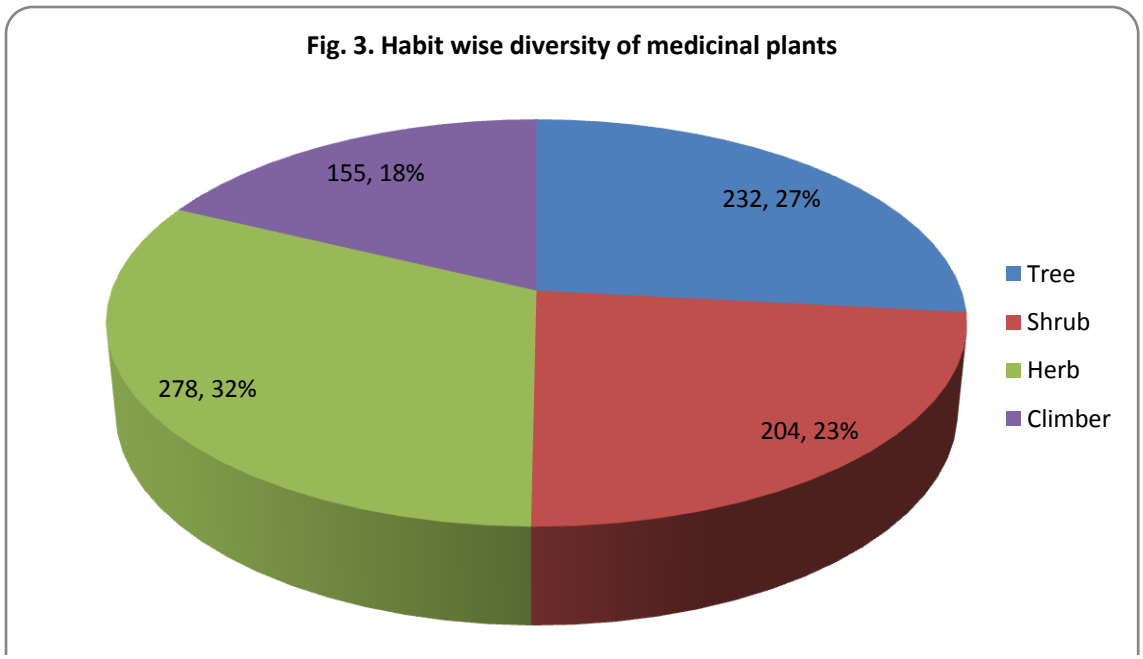
Medicinal plants in various systems of medicines

An analysis based on medicinal plants used in various systems of medicine shows that, 772 species out of 869 used in folk medicine dominates among the other systems, which is about 89 per cent of medicinal plants recorded from the area. Number of species used in Ayurveda is 484 (56 %) belonging to 107 families followed by Siddha with 393 (45%) species in 103 families. Medicinal plants diversity with regard to Unani is also high and is represented by 275 (32 %) species in 86 families. Homeopathy with 78 species and Tibetan with 88 species are the minor system with respect to the diversity of medicinal plants (Fig.2). All the above data indicates the need of micro-screening of information, especially in folk medicine for extracting innovative and unique traditional knowledge. 31 species of medicinal plants used in modern medicine and higher percentage folk medicines indicates the need of further detailed phytochemical and pharmacological studies, which may lead to the development of novel drugs.



Habit wise assessment of medicinal plants diversity

Medicinal plants in Malappuram are composed of trees to aquatic and coastal herbs. Herbs are the major group with 278 (32 %) species belonging to 70 families followed by trees with 232 species (27 %) belonging to 58 families. Shrubs are represented with 204 species (23%) belonging to 56 families and climbers with 155 species (18 %) belonging to 42 families (Fig.3).



The habit wise analysis with respect to various systems of medicines shows that among the 484 species of medicinal plants in Ayurveda, 142 are trees. Uses of herbs, shrubs and climbers are 141, 101 and 100 respectively. The analysis revealed that the presence of trees and herbs in Ayurveda system is almost equal. Shrubs and climbers are also found representing in similar pattern. Most of this species are from deciduous forests with bark and roots as useful parts. Out of 772 species used in folk medicine, herbs are dominating with 235 species, followed by trees with 213 species. Shrubs are represented with 186 species and climber with 138 species respectively. It illustrates that in folk system, leaves and whole plants are the major items for the treatment. In Unani, among 275 species, trees are represented by 93 species followed by herbs with 81 species, shrub with 55 species and climber with 46 species. Among 393 species used in Siddha, 124 are trees followed by 105 herbs, 89 shrubs and 75 climbers. Shrubs are the major components in Homeopathy. Among the 78 species, shrubs, trees, herbs, and climbers are represented in the order 25, 22, 17 and 14 respectively.

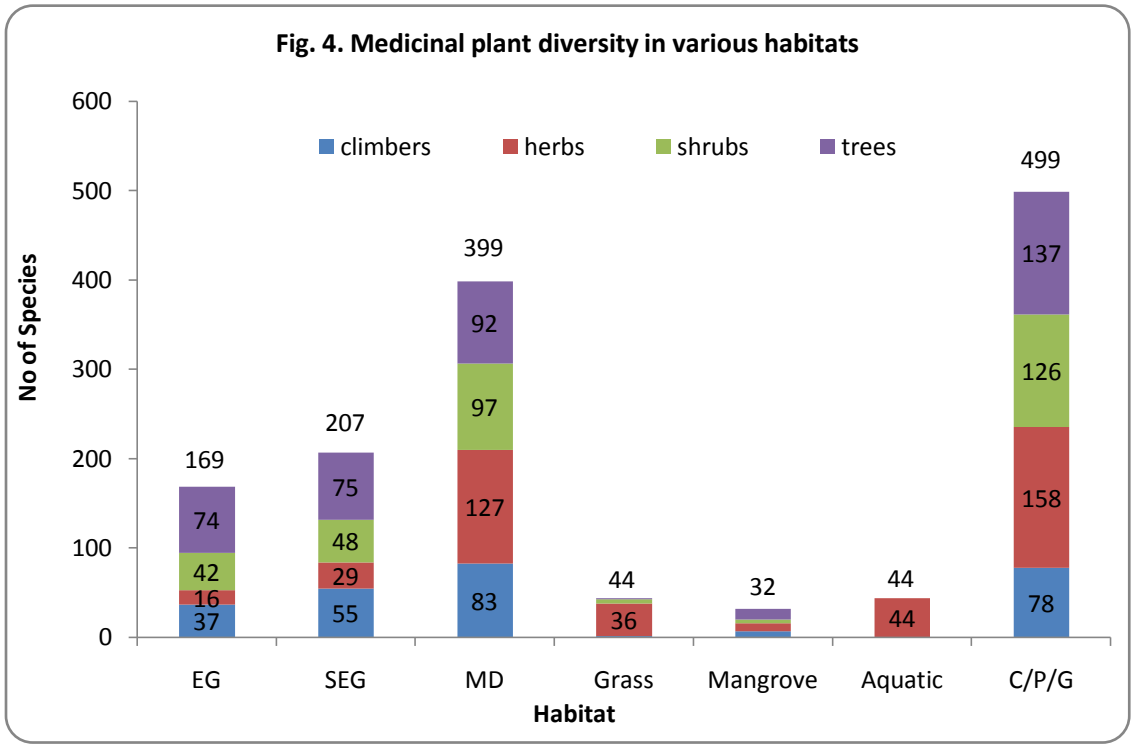
An overall assessment of habit in relation to Indian Systems of medicines shows that tree are dominating in Ayurveda, Siddha and Unani, followed by herbs, shrubs and climbers respectively. But in the case of folk system herbaceous members are dominating. Contradictory to that, in Homeopathy, shrubs are the major components. The above assessment reveals the pattern and style of drug applications in these systems.

Medicinal plant diversity in relation to habitats of Malappuram

Malappuram district abode diverse habitats from shola forest to coastal plain. Because of the inter-distribution of medicinal plants between the related habitats clear-cut classification is difficult. The species that occurs in semi-evergreen may be found in deciduous, evergreen and non-forest areas also. For the analysis, the habitats are classified into seven broad categories such as Evergreen/shola, semi evergreen, deciduous, montane grassland, mangroves, aquatic and plain. Technically, for the analysis purpose plains denote the vegetation outside forest areas and include sacred groves, lateritic areas, agricultural land, homesteads and plantations within the human habitats. Values used for the analysis is based on their occurrence in the respected habitat. Hence one species can occur and representing in two or more habitats.

Among the 869 species, 499 are found in plains. This area lodges high diversity of medicinal plants due to the presence of varied habitats including agricultural land and homesteads. However, density and frequency are very low. Among the 499 species, 76 are cultivated or grown in homesteads, which do not occur in forest areas and other natural habitats. Some species are restricted to certain micro-habitats such as laterites and sacred groves. These habitats are highly threatened due to various anthropogenic activities including large scale land conversion and mining. Special programme should be initiated to protect the species from endangerment. Among the plants in plains, majority are used in folk medicines. Among the habitats in forest

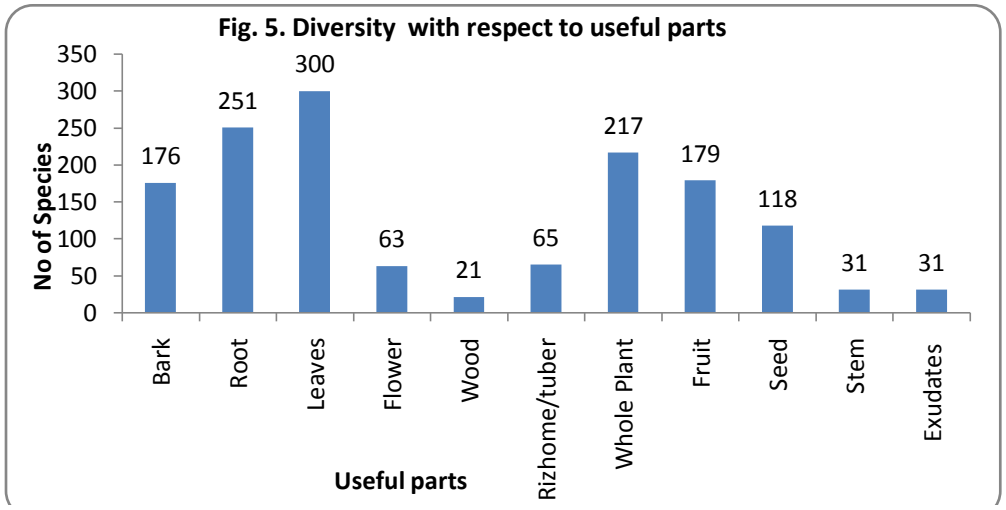
areas, deciduous forest supports 399 species followed by semi-evergreen forest with 207 species and evergreen forest with 169 species. Many of the species in these habitats are used in classical medicines like Ayurveda. Malappuram district have large array of wetlands in its coastal and mid-lands, its aquatic habitat supports 58 species and mangrove areas supports 44 species of medicinal plants (Fig 4).



Analysis with respect to the habitat wise occurrence in relation to various systems of medicines shows that 63 per cent medicinal plants used in Ayurveda occurs in plain and 51 per cent in deciduous. Semi-evergreen lodges 19 per cent medicinal plants of Ayurveda and evergreen with 13species. In Folk medicine, 57 per cent of plants occur in plain, 46 per cent in deciduous, 25 per cent in semi-evergreen and 21 per cent in evergreen. In Unani, the percentage of occurrence in different habitats are 70 per cent in plain, 48 in deciduous, 17 per cent in semi-evergreen and 12 per cent in evergreen. In Siddha, the habitat wise distribution of plants are 65 per cent in plain, 50 per cent in deciduous, 20 in evergreen and 13 per cent in evergreen. In Homeo, 83 per cent occurs in plain, 45 per cent in deciduous, 11 per cent in semi evergreen and 10 per cent in evergreen.

Diversity with respect to useful parts

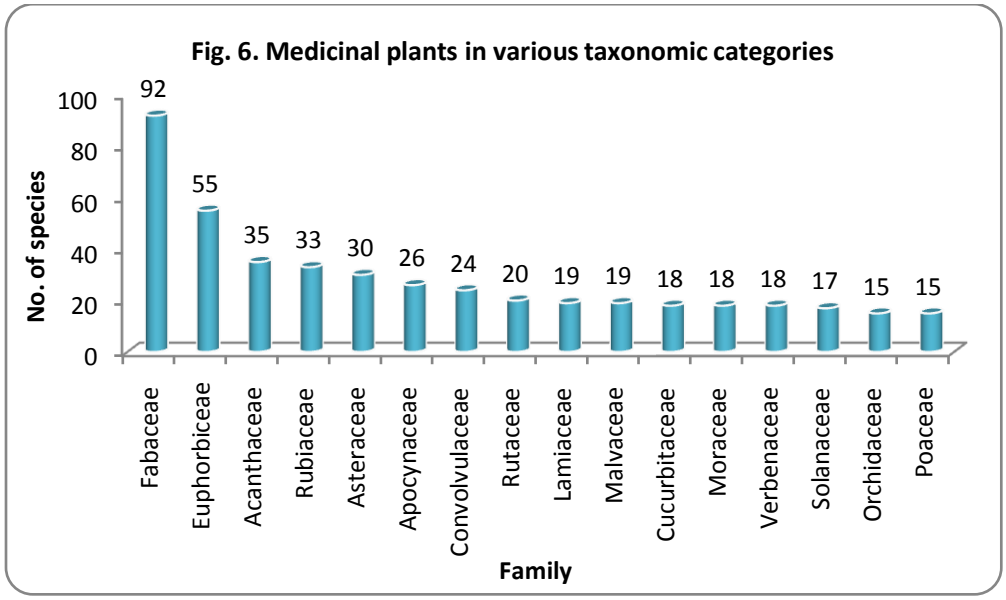
Population and survival of a medicinal plant is directly related to the useful part. The collection of root, wood and bark leads to the destruction of the plant and ultimately death. The collection of fruits, flowers and leaves has less adverse immediate impact. However, it influences the seed production, thus resulting in population depletion. Based on useful parts, the medicinal plants in the district are broadly categorised under seven groups namely whole plant, root, rhizome/tubers, bark, wood, leaves, flowers, fruit, seed and exudates (gum, resin, latex, etc.). Among the 869 species, root of 251 and whole plant body of 217 species are used in various systems. Number of medicinal plants in other categories are leaves with 300 species, fruits with 179, bark with 176, seeds with 118, rhizome/tuber with 65, flower with 63, stem with 31, exudates with 31and wood with 21 species (Fig 5).



In folk system, leaves and other aerial parts are mainly used for treatments, hence the highest value belongs to leaves as useful part. But in classical systems such as Ayurveda, Siddha and Unani, root and whole plant are the major components in the production of medicine.

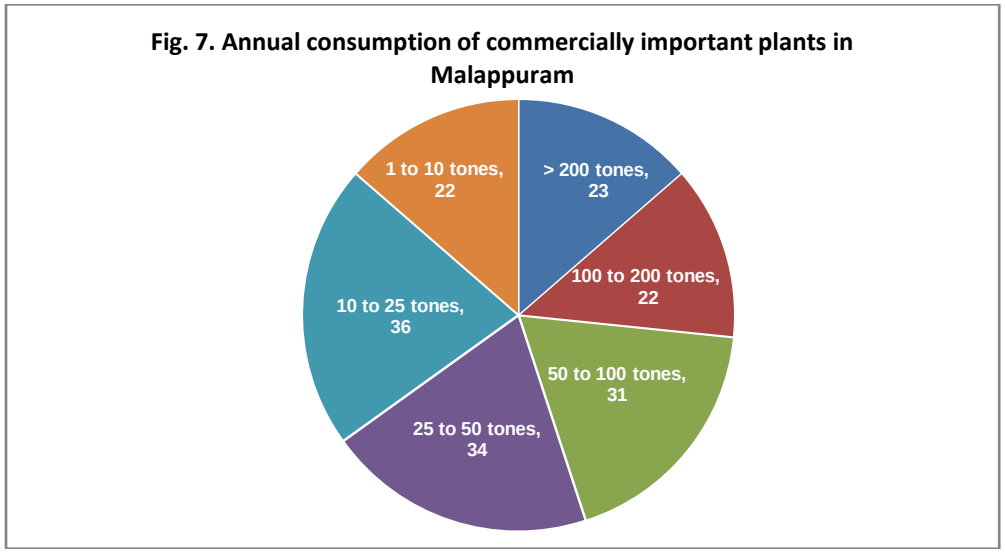
Medicinal plants in various taxonomic categories

A systematic analysis based on the taxonomic categories showed that 869 taxa of medicinal plants recorded from Malappuram district belongs to146 families. Fabaceae with 92 species (10.5%) is the largest family having the highest number of medicinal plants. Among these, trees, shrubs, herbs and climbers combinations are 24, 27, 18 and 23 respectively. The family Euphorbiaceae with 55 species stands second in the order of dominance. Among the 55 species, 18 are trees, 23 shrubs and 14 herbs. Acanthaceae comes in the third position with 35 species. Out of 146 families, 46 families are represented with a single species, 29 families with 2 species and 17 families with 3 species. The result also illustrates that majority of the medicinal plants restricted to a few families. Diversity of medicinal plants in various plant families based on the order of dominance are Fabaceae (92), Euophorbiaceae (55), Acanthaceae (35), Rubiaceae (33), Asteraceae (30), Apocynaceae(26), Convolvulaceae(24), Rutaceae (20), Laminaceae (19), Malvaceae (19), Cucurbitaceae (18), Moraceae (18), Verbenaceae (18), Solanaceae (17), Orchidaceae (15) and Poaceae (15) (Fig. 6).



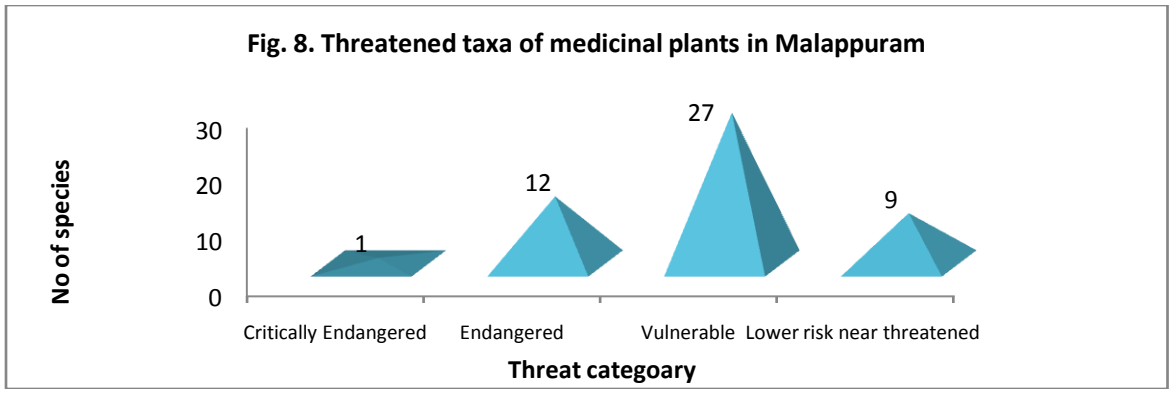
Commercially important medicinal plants with high demand in market

As per the recent studies, a total of 217 species are high demanding and largely used by the Ayurveda industries of Kerala (Sasidharan, 2009). Many of them are imported from other States and region with different agro-climatic conditions. North-eastern Himalayas and Deccan are the major sources. Among the 183 species of commercially high demanding species occurs in the climatic situation of Kerala, 168 species are recorded from the district. Available literature shows that, among the 168 species, the usage of 23 are more than 200 tones, 22 are between 100 to 200 tones, 31 are between 50-100 tones, 34 are between 25–50 tones,36 are 10-25 tones and 22 are between 1- 10 tonnes in Kerala (Fig. 7). Highly demanded species like *Sida rhombifolia, Phyllanthus emblica, Tinospora cordifolia, Pterocarpus marsupium, Terminalia bellirica, Pseudarthria viscida, Desmodium gangeticum*, etc. are common, especially in forest areas of Malappuram district. Compared to other districts, Ayurvedic industries and cultivators are more in Malappuram district. Large numbers of farmers are involved in medicinal plants cultivation, mainly as intercropping. Hence non-forest areas contribute much in the supply of medicinal plants. It helps to reduce the pressure on forest. Some of the important medicinal plants cultivated in the area are *Vetiveria zizanioides, Holostemma ada-kodien, Curcuma longa, Trichosanthes cucumerina, Zingiber officinale, Plumbago indica, Indigofera tinctoria, Phyllanthus emblica, Caesalpinia sappan, Bacopa monnieri, Acorus calamus etc.* It is observed that commercially important species such as *Pseudarthria viscida, Desmodium gangeticum, Piper longum, Justicia adhatoda, Aloe vera, Andrographis paniculata etc.* are also suitable for large scale cultivation in the district.



Medicinal plants of conservation concern in Malappuram district

Natural habitats having varied topographical conditions in the hotspots of Nilgiri phytogeographical region of Western Ghats favored the rich diversity with large number endemic, rare and threatened species in the district. Among the 869 medicinal plants recorded from the district, 70 species are endemic and 49 are coming under various threat categories (IUCN, 2014; Ravikumar, *et. al.*, 2000; Nayar, 1997). Though some of the medicinal plants have wider distribution pattern, their population is under severe threat due to indiscriminate extraction and large scale land use changes. The unscientific and illegal extractions are the other major reasons. Out of the 49 species, *Coscinium fenestratum* is critically endangered, other 12 are endangered, 27 are Vulnerable and 9 species are under Lower Risk and near threatened categories (Fig. 8).



Many of the endangered medicinal plants such as *Oroxylum indicum, Acorus calamus, Terminalia cuneta, Salacia oblonga, Holostemma ada-kodien, Saraca asoca, Santalum album, Aegle marmelos, Pseudarthria viscida, Rauvolfia serpentina, Symplocos cochinchinensis, Dysoxylum malabaricum* etc. are largely used in various Indian systems of medicines. Adequate conservation measures should be taken to conserve these species in the wild. By promoting cultivation of these species in homesteads or revenue land may reduce the pressure on forest and also serve as a germplasm for sound genetic resources for the future. Some species like *Coscinium fenestratum, Embelia ribes, Dysoxylum malabaricum,* etc. are highly specific to microhabitat. Such plants can be enriched in the same habitat. *In situ* conservation of RET species is most effective if they are occurring in Protected Areas. Sixteen species of medicinal plants in the district are both endemic and threatened. Immediate conservation measures should be taken to protect these species and its remaining repositories from the danger of extinction.

Acknowledgements

We are thankful to the authorities of Kerala Forest Research Institute, Peechi and Kerala Forest Department for all the facilities and support extended during the study. We are grateful to Sri. K.G. Sreekumar, Chief Executive Officer, State Medicinal Plants Board, Kerala; Dr. Indira Balachandran, Project Director, Centre for Medicinal Plants Research, Arya Vaidya sala, Kottakkal and Dr. N. Sasidharan, Kerala Forest Research Institute for their guidance and encouragement. We are also thankful to Sri. Vijith K.T, Sri. Jayan V, Sri. M. M. Roy, Sri. A. J. Robi and Sri. K. J. Dantas for their various help rendered during the study.

References

Asolkar, L. V., Kakkar, K. K. and Chakre, O. J. 1992. Second Supplement to Glossary of Indian Medicinal Plants with Active Principles. Part-1 (A-K), CSIR, New Delhi, India.

AYUSH 1990–2110. The Ayurvedic Pharmacopoeia of India Vol. I to VIII, Ministry of Health and Family Welfare, Govt. of India,, New Delhi.

AYUSH 2008. The Siddha Pharmacopeia of India, Vol.1 Ministry of Health and Family Welfare, Govt. of India,, New Delhi.

Babu, A. 1990. *Flora of Malppuram District*.Ph.D. Thesis, University of Calicut.

Balick, M. J. 1996. Transforming ethnobotany for the new millenium. *Ann. Missouri Bot. Gard.*83: 58 – 66

Binu, S., T. S. Nayar and P. Pushpangadan. 1992. An outline of Ethnobotanical research in India. *J. Econ. Tax. Bot*. (Addl. Ser.) 10: 405 - 428.

Binu, S. 1999. Ethnobotany of Pathanamthitta District, Kerala, India. PhD Thesis, University of Kerala.

Bridson, D. M. and L. Forman. 1991. *The Herbarium Handbook*. Royal Botanic Gardens, Kew.

Champion, H. G. and S. K. Seth. 1968. *A revised survey of the forest types of India*. Govt. of India Press, Nasik.

Chandrasekharan, C. 1962c. Forest types of Kerala State. Part II. *Indian For.*88 (10): 731-747.

Chandrasekharan, C. 1962e. A general note on the Vegetation of Kerala State. *Indian For.*88: 440-441.

Chandrasekharan, C.1962d. Forest types of Kerala State. Part III. *Indian For.*88 (11): 837-847.

Chopra, R.N., I.C. Chopra and B.S. Verma, 1969. Supplement to Glossary of Indian Medicinal Plants. Publication and Information Directorate (CSIR), New Delhi.

Chopra, R.N., S.L. Nayar and I.C. Chopra, 1956.Glossary of Indian Medicinal Plants. Council of Scientific and Industrial Research, New Delhi, India, pp: 170.

CSIR, 1948-1976. The Wealth of India: Raw Materials. Vol. 1 –10, Publications and Information Directorate, C.S.I.R., New Delhi.

Dastur, J. F. 1951. Useful plants of India and Pakistan. 2nd Indian ed. D. B. Taraporevala Sons & Co., Ltd., Bombay, India.

Dastur, J.F. 1962.Medicinal Plants of India and Pakistan.D.B. Taraporewala& Co. Pvt. Ltd., Bombay.

Fosberg, F. R. and M. M. Sachet. 1965.*Manual of Tropical Herbaria*. Reg. Veg. 39. Utrecht.

Harinarayanan, M.K. 2006. Enthobotanical and Vegetation Studies in the Attappady Valley Kerala, India. Ph.D. thesis (unpublished), University of Calicut, Thenhippalam, India.

IUCN 2010. IUCN Red List categories, IUCN Publications,Gland, Switzerland.

Jomy Augustine. 2000. *Floristic and Ethnobotanical Studies of Periyar Tiger Reserve*. Ph. D. Thesis, University of Calicut, Calicut.

Kirtikar, K.R. and B.D. Basu. 1935. Indian Medicinal Plants. Vols. I. II, III & IV.Bishan Singh Mahendra Pal Singh, Dehradun.

Kishore Kumar, K. and Sasidharan, N. 2002. Ethno medicines: A case study from the Shola Forests of Kerala, India. Ethn. Pharm., 1: 201-214.

Maheswari, J.K. 2000. Ethnobotany and medicinal plants of Indian subcontinent. Scientific Publishers (India), Jodhpur, Pp 672.

Martin, C. J. 1995. *Ethnobotany: A conservation Manual*. Chapman and Hall, London.

Moos, N.S. 1977. Single drug remedies. Vaidyasarathy Press, Kottayam, Kerala.

Nadkarni, K.M. 1954. Indian MateriaMedica with Ayruvedic, Unani- Tibbi, Siddha, Allopathic, Homeopathic, Naturopathic & Home Remedies, Volume 1, 3rd edition. Popular Book Depot. Bombay.

Nambiar, V. P. K. 1985. Studies on the Medicinal Plants of Kerala Forests.Kerala Forest Research institute, Peechi, Kerala.

Nambiar, V.P.K., Sasidharan, N., Renuka, C. and Balagopalan, M. 1985. Studies on the Medicinal Plants of Kerala Forests. KFRI Research Report No. 42. Kerala Forest Research Institute, Peechi.

Narayana Aiyar K., Namboodiri AN., Kolammal M. 1957–63. Pharmacognosy of Ayurvedic Drugs (Kerala). The Central Research Institute, Trivandrum.

Nayar, M.P. 1997. Biodiversity challenges in Kerala and Science of conservation Biology. In: Pushpangadan, P., Nair, K.S.S. (eds.) Biodiversity of Tropical Forests the Kerala Scenario. STEC, Kerala, Trivandrum

Parrotta, J.A. 2001. Healing Plants of Peninsular India. CABI Publishing, CAB plants 5 vol. Orient Longman Ltd. International, UK. Pp 917.

Ramachandran, V.S. and Nair, V.J. 1981. Ethnobotanical studies in Kannur district – Kerala State (India). Journal of Economic and Taxonomic Botany 2: 65-72.

Rao, R. R. 1989a. Methods and techniques in Ethnobotanical Study and Research: Some Basic Considerations. In: S. K. Jain (ed.) *Methods and Approaches in Ethnobotany*, pp. 13-23, Society of Ethno botanists, Lucknow, 192 p.

Ravikumar, K., Ved, D.K., VijayaSankar R. and Udayan, P. S. 2000. Illustrated Field Guide to 100 Red Listed Medicinal Plants of Conservation Concern in southern India. FRLHT, Bangalore.

Remesh, M. 2007. Ethnobotanical Studies on Tribal Groups of Palakkad District, Kerala. Ph.D. thesis (unpublished), University of Calicut, Thenhippalam, India.

Sasidharan, N. and Muraleedharan, P. K. 2009. The Raw Drugs Requirement of Ayurvedic medicine manufacturing industry in Kerala. KFRI Research Report No. 435. Kerala Forest Research Institute, Peechi.

Sasidharan, N. 2011. Flowering Plants of Kerala VER 2.0. KFRI DVD No. 14. Kerala Forest Research Institute, Peechi.

Shaju, T. 2011. Taxonomic and Ethno-botanic studies of endemic angiosperms of Kerala. Ph.D. thesis (unpublished), University of Calicut, Thenhippalam, India.

Sivarajan, V.V. and Indira Balachandran. 1994. Ayurvedic drugs and their plant resources, Oxford IBH, New Delhi.

Sivarajan, V.V. and Philip Mathew. 1997. *Flora of Nilambur*. Bishen Singh Mahendra Pal Singh, Dehra Dun.

Swarupanandhan, K. 1985. Taxonomic and Ethnobotanical Studies on Asclepiadaceae (R.Br.) of Kerala. Ph.D. thesis (unpublished),University of Calicut, Thenhippalam, India.

Udayan, P. S. and Indira Balachandran. 2009. Medicinal Plants of AryaVaidya Sala Herbal garden, AryaVaidyaSala Kotttakkal, Malappuram, Kerala. 525p.

Ved, D. K., Suma Tagadur, Suresh Chandra, Vijay Barve, Vijay Srinivas, SathyaSangeetha, K. Ravikumar, Kartikeyan R., Vaibhav Kulkarni, Ajith S. Kumar, S.N. Venugopal, B. S. Somashekhar, M.V.Sumanth, Sugandhi Rani, Surekha K.V. and Nikhil Desale. 2002-2014. (*envis.frlht.org /frlhtenvis.nic.in*). FRLHT's ENVIS Centre on Medicinal Plants, Bangalore

Warrier, P.K., Nambiar, V.P.K. and Raman Kutty, C. 1994-1996. Indian medicinal plants, 5 vol. Orient Longman Ltd.

Yusuf, M., Begum, J., Hoque, M. N. and Chowdhury, J. U. 2009. Medicinal Plants of Bangladesh (revised and enlarged). Bangladesh Council of Scientific and Industrial Research Laboratories, Chittagong, Bangladesh. 794p.