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Diversity, Conservation Status and Medicinal Plants of the Family Euphorbiaceae in Tirunelveli Hills, Southern India

M. Ayyanar[1*] and S. Ignacimuthu[2]

[1]Division of Biodiversity and Biotechnology, Department of Botany, Pachaiyappa's College, Chennai - 600030, Tamil Nadu, India; [2]Entomology Research Institute, Loyola college, Chennai – 600 034; Tamil Nadu, India

Abstract
Tirunelveli hills of Tamil Nadu harbour over 2000 species of plants, of which 25% are endemic and 3% are under various categories of threat. An ethnobotanical survey was carried out among the tribal people (kani/kanikaran) inhabiting the Tirunelveli hills of Tamil Nadu and the study revealed that, they are using more than 350 plants to prepare medicine, of which 8% (30 species) are belongs to the family Euphorbiaceae and it is consistent with the claim by the floristic diversity of this family. In floristic survey, Euphorbiaceae is one of the best-represented families in Tirunelveli hills of Tamil Nadu with 124 species of plants belonging to 34 genera and ranks third followed by Leguminosae and Poaceae in terms of number of species. The largest genera in Euphorbiaceae are *Phyllanthus*, *Euphorbia* and *Mallotus*, each with 21, 18 and 11 species respectively. Euphorbiaceae includes more number of endemic plants with 31 sps. and the genus *Phyllanthus* includes five endemic species; *Blachia*, *Drypetes*, *Euphorbia*, *Glochidion* and *Mallotus* with three species. The plants such as *Blachia calycina* Benth., *Blachia umbellata* Baill., *Dimorphocalyx lawianus* (M.Arg.) Hk.f., *Mallotus stenanthus* M.Arg., *Phyllanthus baillonianus* M.Arg. and *Baccaurea courtallensis* M.Arg. are identified as endemic medicinal plants. Majority of the plants present in these hills are rapidly threatened by anthropogenic activities due to several pilgrim and tourist places within the forest area. Its biodiversity is vulnerable due to different factors, and its conservation should be paid enormous attention by involving the local communities and forest representatives in preservation and conservation aspects.

Key words: Tirunelveli hills, Endemism, Euphorbiaceae, Medicinal plants, Threat status

Introduction

Euphorbiaceae is one of the families of cosmopolitan distribution with 322 genera and 8910 species of plants including annuals, biennials and perennials (Sinnott, 2004) and commonly known as spurge family. It is the fourth largest of all angiosperm families and most of the species are abundant in tropical and temperate regions and not well represented in arctic regions. The genus *Euphorbia* contains 1836 species and distributed worldwide. *Phyllanthus* L. is an extensive and heterogeneous genus in tribe *Phyllantheae* and represented by about 800 species and distributed throughout the World (Santiago et al., 2006). West Indies and Brazil are the main centres of *Phyllanthus* speciation. *Phyllanthus* contains herbs with small flowers, floating aquatic plants, or shrubs and subshrubs, whose branches may be modified into phylloclades.

Euphorbiaceous genera commonly available in worldwide are *Euphorbia, Croton, Phyllanthus, Acalypha, Jatropha, Manihot, Ricinus, Tragia, Hevea, Clutia, Sapium, Manadenium, Mallotus* and *Ricinicarpos*. Widespread Indian genera are *Euphorbia* (63 species, 41 are endemic), *Phyllanthus* (27 species), *Croton* (22 species), *Ricinus*, *Pedilanthus*, *Manihot*, *Bischofia*, *Excoecaria*, *Acalypha*, *Mallotus*, *Blachia* and *Hevea*. Identification characteristics of the family are plants with milky latex and Cyathium (*Euphorbia*) type of inflorescence. Euphorbiaceae resembles Geraniaceae and allied families in the characters of the fruit, and characters such as monadelphous or polyadelphous stamens and carunculate seeds bring it close to Sterculiaceae. A milky sap or latex is a characteristic of the subfamilies Euphorbioideae and Crotonoideae and this milky sap is poisonous in the Euphorbioideae, innocuous in the Crotonoideae. Sap of *Excoecaria agallocha* causes blistering on contact and temporary blindness if it contacts the eyes.

A number of plants of this family have considerable economic importance, viz. *Hevea brasiliensis* (main commercial source for rubber), *Ricinus communis* and *Jatropha curcas* (source of castor oil), *Manihot esculenta* (source of cassava), *Phyllanthus emblica* (source of Amla), *Euphorbia pulcherrima* (famous ornamental plant), etc. However, several plants are poisonous, causing sickness or death if ingested or causing dermatitis if juice contacts the skin. The plants such as *Phyllanthus emblica, Ricinus communis, Phyllanthus amarus, Jatropha gossypifolia, Mallotus philippinensis* are having high medicinal value and are used in several medicinal preparations. The family is represented in India by 450 species belonging to 70 genera and Tamil Nadu harbour 193 species of plants belonging to 53 genera. In the present study, diversity, conservation status (endemic and threat status) and ethnomedicinal uses of Euphorbiaceous plants which are available in Tirunelveli hills of Tamil Nadu are discussed.

Study area

The Western Ghats is a forested tract of relatively smooth, but very old, mountain ranges bordering the South Western coastline of India, starting from Mumbai south to the southern tip of the peninsula, through the states of Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu. There are two main centers of diversity, the Agasthiyamalai hills (Tamil Nadu and Kerala) and the Silent Valley (Kerala). Western Ghats Region in Tamil Nadu includes 33 taluks in eight districts viz., Coimbatore, Erode, Dindigul, Theni, Kanyakumari, Virudhunagar, Madurai and Tirunelveli. Agasthiyamalai hills of Tamil Nadu occupy the forests of Tirunelveli and Kanyakumari districts of south Tamil Nadu and known as 'Tirunelveli hills' (Figure 1). These hills cover an area of nearly 3200 sq. km and lie between the longitudes 77^0 5| - 77^0 40| E and latitudes 8^0 5| - 8^0 50| N. These hills are characterized by numerous folds and extension engulfing small, narrow valleys and the elevation varies from 50 to 1869 m (Manickam et al., 2004).

The vegetation is floristically rich when compared to other regions of Western Ghats and represent several unique habitats viz., Southern tropical dry deciduous forests, Southern tropical moist deciduous forests, Southern tropical semi evergreen forests, Southern tropical wet evergreen forests, subtropical montane forests and grassland at low altitudes. In the Tirunelveli region, the pattern of high endemism and diversity is well illustrated by plant taxa and this region has about 150 localized plant endemics (Johnsingh, 2001). The rich forests of these hills form the catchment area for more than 15 rivers and 10 dams; those form the back-bone of the irrigation network and provide drinking water for Tirunelveli, Tuticorin and Kanyakumari districts in south Tamil Nadu. Major floristically rich areas of Tirunelveli hills include Ainthalaipodhigai, Nagamalai, Kalakad, Sengaltheri, Netterikkal, Thirukurangudi, Mahendragiri, Mancholai, Kakkachi, Kothayar, Muthukuzhivayal and Vanamutti.

A valuable repository of biodiversity in Tirunelveli hills is Kalakad Mundanthurai Tiger Reserve (KMTR). It is the 17th Tiger Reserve in the country and it is a priority area for conservation of its rich floral and faunal diversity, both in terms of species richness and endemism (Melkani, 2001). The Reserve is the southernmost home to some of the endangered mammals such as the Nilgiri tahr and the tiger and also it is one of the few places in South India where

** Corresponding Author, Email: asmayyanar@yahoo.com, Tel.: +91 44 26640793, Mob: +91 9940376005*

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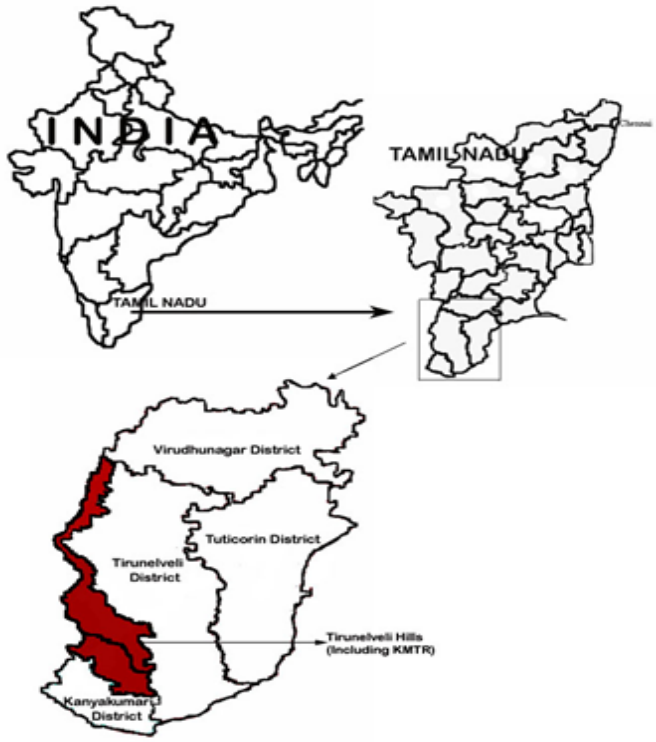
five primate species occur such as lion-tailed macaque, Nilgiri langur, common langur, bonnet macaque and slender loris (Johnsingh, 2001).

Figure 1. Location map of Tirunelveli hills in Tamil Nadu, southern India



Out of about 5000 species of vascular plants reported to occur in peninsular India, Tirunelveli hills harbour more than 2000 species of angiosperms, three species of gymnosperms and 156 species of pteridophytes (Annamalai, 2004). As the area is floristically rich with genetically diverse populations, in the past three decades, more than 40 new plant taxa have been discovered from these hills and most of them are endemic (Henry *et al.*, 1984). Manickam *et al.* (2004) carried out an extensive floristic survey in Tirunelveli hills (1996-2001) and reported 1872 species of vascular plants with six types of vegetations. During their exploration, they discovered 8 new taxa, 8 species of plants with new records for India and 10 species of plants with new records for Tamil Nadu. They have published a Check-list of the Flora of Tirunelveli hills with 153 families and 669 genera.

Indigenous people of the study area

The indigenous people of the study area are called Kani or Kanikaran (plural = Kanis), the oldest group of the branch of ethnic group in South India (Southern states of Tamil Nadu and Kerala). They seem to be the migrants from Thiruvananthapuram of Kerala state and they may have entered into Tamil Nadu through the Courtallam pass (Ignacimuthu et al., 1998). Many Kanis trace their community's knowledge of medicinal plants back to the Hindu saint and holy man, Agasthiyar Muni, who is credited as the founder of Siddha, the Tamil system of medicine. Agasthiyar is said to have lived in the southern Western Ghats (Podhigaimalai) approximately two thousand years ago. There are five Kani inhabiting villages such as Agasthiyar Kani kudiiruppu, Chinna Mayilar, Periya Mayilar, Inchikuzhi and Servalar each consisting of 5–56 families disbursed in various places of Tirunelveli hills. In Kanyakumari district, more than 10 villages are identified as tribal villages which are inhabited by Kanis for example, Kothayar, near to Pechiparai dam, Kallar, Mothiramalai, Kaliankadu, Kutriyar etc.

Methodology

Frequent field surveys were carried out in Tirunelveli hills during September 2004 to June 2006. The Kani settlements were located through a number of field surveys in this region and the information was collected through questionnaire, interviews and discussions among the tribal practitioners in their local language (Tamil). The collected plants were identified by their vernacular names through consultations with the local people, photographed and sample specimens were collected for the preparation of herbarium and voucher specimens were deposited in the herbarium of Entomology Research Institute, Loyola College, Chennai (India). Diversity of each species and their distribution in Tirunelveli hills was determined by the Checklist of the Flora of Tirunelveli hills (Manickam et al., 2004). Rarity of species was determined by field study, literature and herbaria and the criterion for categorization of threatened species was based on IUCN red list of threatened species (IUCN, 2001). The endemic and red list status of each medicinal plant were determined using the published literatures of Ahmedullah & Nayar (1986), Nayar (1996), (FRLHT) and Annamalai (2004).

Results and Discussion

Euphorbiaceae is the third largest family with 124 species of plants belonging to 34 genera and considered as one of the best-represented families of Tirunelveli hills followed by Leguminosae and Poaceae which are represented with 163 and 136 species, respectively. The largest genera in Euphorbiaceae are *Phyllanthus*, *Euphorbia* and *Mallotus*, each with 21, 18 and 11 species respectively and other dominant genera are given in table 1. Plants found throughout the hills are *Acalypha ciliata, Acalypha indica, Antidesma alexiteria, Antidesma menasu, Blachia calycina, Blachia reflexa, Claoxylon mercurialis, Croton bonplandianus, Croton klotzschianus, Euphorbia hirta, Euphorbia nivulia, Glochidion ellipticum, Phyllanthus amarus, P. emblica, P. maderaspatensis, P. polyphyllus, P. reticulatus, P. virgatus, Sebastiana chamaelea* and *Securinega virosa*.

Table 1. Dominant genera of Euphorbiaceae with no. of species

Genera	No. of Species
Phyllanthus	21
Euphorbia	18
Mallotus	11
Glochidion	07
Croton	06
Claoxylon	06
Acalypha	04
Antidesma	04
Sauropus	04

Conservation status

A large concentration of endemic species is found in tropical semi evergreen and deciduous forests on the Western Ghats and to a lesser degree in Eastern Ghats. In Tamil Nadu, species level endemism is very high in Agasthiyamalai hills followed by the Nilgiris and Anamalais of Western Ghats. Of the recorded flora of Tirunelveli hills 25% of the plants are endemic and 3% of the plants found in this region come under various categories of threat. Euphorbiaceae includes more number of endemic plants with 29 sps. and the genus *Phyllanthus* includes five endemic plants and, *Blachia*, *Drypetes*, *Euphorbia*, *Glochidion* and *Mallotus* with three endemic plants each (table 2). There are 12 species of this family which are under threat status such as rare, vulnerable, endangered and critically endangered. In *Glochidion*, five species are endemic to Tamil Nadu alone. The plants such as *Dimorphocalyx beddomei, Euphorbia santapaui, Glochidion ellipticum, Micrococca wightii* and *Phyllanthus singampattiana* found in Tirunelveli hills are identified as strict endemic plants (Annamalai,2004).

Table 2. Conservation status of Euphorbiaceous plants in Tirunelveli hills

Botanical Name	Availability in Tirunelveli hills	Conservation status
Baccaurea courtallensis M. Arg.	Courtallam, Papanasam and upper Kothayar	Endemic/Vulnerable
Blachia calycina Benth.	Throughout the hills	Endemic
Blachia reflexa Benth.	Throughout the hills	Endemic
Blachia umbellata (Willd.) Baill.	Courtallam, Papanasam and Thirukurangudi	Endemic
Claoxylon anomalum H.f.	Courtallum	Endemic/Endangered
Cleistanthus travancorensis Jabl.	Chemunji	Endemic
Coelodepas calycinum Bedd.	Sivasailam and Sivagiri	Endemic/Endangered
Croton malabaricus Bedd.	Near to Manimuthar falls	Endemic
Dimorphocalyx beddomei (Benth.) A.Shaw	Sivasailam, Papanasam and Mahendragiri	Endemic/Critically Endangered
Dimorphocalyx glabellus Thw. Var. *lawianus* Hk.f.	Courtallam, Papanasam, Kalakad and Mahendragiri	Endemic
Dryptes malabarica (Bedd.) Airy. Shaw.	Vaalayar	Endemic
Dryptes oblongifolia (Bedd.) Airy. Shaw.	Upper Kothayar	Endemic
Dryptes porteri (Gamble) PAx. & Hoffm.	Kothayar	Endemic
Epiprinus mallotiformis (M.Arg.) Croizat	Upper Kothayar, Papanasam and Kalakad	Endemic
Euphorbia santapaui A.N. Henry	Papanasam	Endemic/Endangered
Euphorbia susan-holmesiae Binoy & Gopal	Papanasam	Endemic/Vulnerable
Euphorbia vajravelui Binoy & Baskar	Sivagiri	Endemic/Vulnerable
Glochidion bourdillonii Gamble	Upper Kothayar and Mahendragiri	Endemic
Glochidion ellipticum Wt. Var. *ellipticum*	Throughout the hills	Edemic/Endangered
Glochidion malabaricum Bedd.	Mancholai	Endemic
Jatropha maheshwari Subr. & NAyar	Kalakad	Endemic
Mallotus aureo-punctatus M.Arg.	Chemunji	Endemic
Mallotus beddomei Hk.f.	Courtallum, Upper Kothayar and Mahendragiri	Endemic
Mallotus stenanthus M.Arg.	Papanasam, Courtallam, Sivasailam and Upper Kothayar up to 600m	Endemic
Micrococca wightii (Hk.f.) Prain.	Kalakad and Thirukurangudi	Endemic/Endangered
Phyllanthus baillonianus M.Arg.	Papanasam and Upper Kothayar up to 1000m	Endemic
Phyllanthus beddomei (Gamble) Mohan	Kannikatty and Sengaltheri	Endemic/Critically Endangered
Phyllanthus longiflorus B.Heyne ex Hk.f.	Thirukurangudi, Sivagiri and Courtallum	Endemic.Endangered
Phyllanthus maderaspatensis L.	Throughout the hills	Endemic
Phyllanthus singampattiana (Seb & Henry) Kum. & Chandr.	Papanasam and Upper Kothayar	Endemic/Critically Endangered

The plants such as *Blachia calycina* Benth., *Blachia umbellata* Baill., *Dimorphocalyx lawianus* (M.Arg.) Hk.f., *Mallotus stenanthus* M.Arg., *Phyllanthus baillonianus* M.Arg. and *Baccaurea courtallensis* M.Arg. are identified as endemic medicinal plants. Among these plants *B. calycina* and *B. umbellata* are abundantly available throughout the hills and *B. courallensis* is only found in the upper elevations. The fruit of *B. courallensis* is ate by the Kani tribals and also used in medicinal preparations. Majority of the plants present in these hills are rapidly threatened by anthropogenic activities by means of several pilgrim and tourist places within the forest area. Thus, the hills have high conservation value. Its biodiversity is vulnerable due to different factors, and its conservation should be paid enormous attention by involving the local communities and forest representatives in preservation and conservation aspects.

Ethnomedicinally important plants of Euphorbiaceae

Kani people were using more than 350 plants to prepare medicine. In terms of the number of medicinal plant species, Euphorbiaceae (18 genera and 30 species, 8% of total collected plants) is the most predominant family of ethnomedicinal importance (table 3) and it is consistent with the claim that it is one of the best represented floristic family (124 species) of the region next to Leguminosae and Poaceae (Manickam *et al*., 2004). Tribal practitioners of Kani tribals are using specific plant parts and specific dosages for the treatment of diseases and majority of the remedies are taken orally. Among the different plant parts, the leaves are most frequently used for the treatment of diseases solely or mixed with the other plant parts. For topical use, the most important methods used are direct application of the paste or ointment (with oil) and mostly deals with diseases like skin disorders, wounds, heel cracks, poison bites, rheumatism, body pain and headache. Some of the ailments are treated by internal consumption as well as topical application such as poison bite, rheumatic and body pain.

Table 3. Ethnomedicinally important plants of Euphorbiaceae in Tirunelveli hills

Botanical name	Local Name	Parts used	Ethnomedicinal uses
Acalypha fruticosa Forssk.	Chinni chedi	Leaf	Toothache, headache and fever
Acalypha indica L.	Kuppaimeni	Leaf	Skin diseases (itching) and wounds
Acalypha racemosa Baill.	Visha karappan	Root and leaf	Skin diseases
Antidesma menasu Miq.	Puliccha maram	Fruits	Edible
Baccaurea courtallensis (Wight) Muell.-Arg..	Moottu /poovan pazham	Fruits	To induce fertility in men and women Edible
Blachia calycina Benth.	Kutthu maanthai	Leaf	Eye infections
Blachia umbellata (Willd.) Baill.	Aatthu maanthai	Leaf	Rheumatism
Breynia retusa (L.) Spreng.	Neela avuri	Leaf	Venereal diseases
Croton klotzschianus (Wight.) Thwaites	Chenkalai	Leaf	Menstrual disorders
Dimorphocalyx lawianus (M. Arg.) Hook.f.	Siru kottai maram	Leaf	Felon
Euphorbia antiquorum L.	Sathura kalli	Latex (stem)	Wounds
Euphorbia cyathophora Murr.	Siru anavanthan	Leaf and root bark	Hydrocele
Euphorbia hirta L.	Paal chedi	Latex & leaf	Wounds
Excoecaria crenulata Wight	Thillai chedi	Fruit and root	Stomachache
Suregada multiflora (Juss.) Baill.	Kootta pilaa	Stem bark	Hair growth
Jatropha curcas L.	Kaattananakku	Milky juice & Seed oil	To increase lactation and skin diseases
Jatropha gossypifolia L.	Adhalai	Resin	Foul odour of the mouth & wounds in lips and tongue
Macaranga peltata (Roxb.) Muell.- Arg.	Vatta kanni	Fruits	Skin diseases
Mallotus philippinensis (Lam.) Muell-Arg.	Kutthu senkalai / Kamala maram	Stem bark and leaf	Hydrocele and stomachache
Mallotus rhamnifolius (Willd.) Muell.- Arg.	Chenkalai	Leaf	snakebite and scorpion sting
Mallotus stenanthus Muell.-Arg.	Siru thuvarai	Leaf, unripe fruit and root	Rheumatism
Manihot esculenta Crantz.	Mara valli kilangu	Rhizome	Edible
Phyllanthus amarus Schumach & Thonn.	Keela nelli/Keelkai nelli	Leaf	Jaundice
Phyllanthus baillonianus Muell.- Arg.	Kaattu karuveppilai	Leaf	Body cooling
Phyllanthus emblica L.	Periya nelli	Fruits	Body strength
Phyllanthus longiflorus Heyne	Karu nelli	Leaf	Jaundice
Phyllanthus polyphyllus Willd.	Aatru nelli	Root and stem bark	To induce fertility and sperm production
Phyllanthus virgatus G. Forst.	Kutthu keelanelli	Leaf	Jaundice and stomachache
Ricinus communis L.	Amanakku	Seed oil	Nervous disorders
Tragia involucrata L.	Senthatti	Root	Skin diseases

Phyllanthus is one of the important genera with 6 species of ethnomedicinal plants which are used by the Kanis. For example *P. amarus* and *P. emblica* are the chief ingredients used in most of the medicinal preparations employed by Kanis. Very near to the Karayar dam, an old woman practices the tribal knowledge to treat jaundice with the herbal preparation of *P. amarus* for a long time and a number of persons from Tirunelveli, Thoothukudi and Virudhunagar districts meet her to get cure from jaundice. *Mallotus, Euphorbia* and *Acalypha* are the other important genera with three species of ethnomedicinal plants. Tubers of 'Tapioca' (*Manihot esculenta*) is a major food among the Kanis and most of the Kani people in deep forest areas are still dependent on the tubers of this plant for staple food.

Conclusion

Tirunelveli hills have great diversity of plants with varied ethnomedicinal uses and economical importance and most of the species are endemic and threatened. It is expected that some more species of medicinal plants are facing threat to their existence in the wild and some of them have become extinct. Conservation of such medicinally and commercially important plants is neccessary for the preservation of natural biodiversity. Hence, efforts must be taken to protect the biodiversity in this area by involving the local communities in preservation and conservation aspects. Furthermore, conservation measures targeted at the endemic and threatened plants as well as other medicinal plants of the reserve will prevent the forest exploitation and help in the long-term protection of the natural vegetation. To improve the conservation measures, collaborative research projects such as medicinal plant gardens and plantation gardens should be made in the tribal surrounding areas and a multifaceted approach to biodiversity conservation is needed at this juncture. These efforts may help the indigenous people to improve their lives and this will also help to protect the biodiversity. From the economic point of view, there is no doubt that Tirunelveli hills and adjacent areas have a great economic potential and hence they should be managed for long-term conservation.

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