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Samydurai Ponnusamy
Department of Botany,
School of life Sciences,
Bharathiar University,
Coimbatore, Tamil Nadu,
India

Rajendran Arumugam
Department of Botany,
School of life Sciences,
Bharathiar University,
Coimbatore, Tamil Nadu,
India

Sarvalingam Ariyan
Department of Botany,
Sri Kaliswari College
(Autonomous), Sivakasi,
Tamil Nadu, India

Rajasekar Chinnaiyan
Department of Botany,
School of life Sciences,
Bharathiar University,
Coimbatore, Tamil Nadu,
India

Correspondence
Samydurai Ponnusamy
Department of Botany,
School of life Sciences,
Bharathiar University,
Coimbatore, Tamil Nadu,
India

Ethnobotanical knowledge of threatened plant species *Andrographis* in Nilgiris biosphere reserve, Tamil Nadu, India

**Samydurai Ponnusamy, Rajendran Arumugam, Sarvalingam Ariyan and
Rajasekar Chinnaiyan**

Abstract

Andrographis Wall ex Nees, is a large genus of herbs with greater species diversity occurring in the southern Western Ghats. Among the different species of *Andrographis*, the present study provides the ethnobotanical data of 9 rare, endemic/endangered species collected from the Nilgiris of the southern Western Ghats. The nine species show narrow distributional range and are vulnerable to unsustainable utilization. This study provided data on diversity, distribution and habitats for conservation and prioritization of the valuable species.

Keywords: *Andrographis* species, diversity, distribution, Nilgiris, Ethnobotany

1. Introduction

Traditional systems of medicine such as Ayurveda, Homeopathy are gaining popularity and interest throughout the globe due to their approaches in preventive and therapeutic measures [1]. Despite the availability of complicated, innovative developments of technology and modern medicine, traditional practices are still having prime importance for treating various diseases worldwide including India [2]. An estimated, 350 million of the world's people depend almost entirely for their sustenance and daily needs on forests. In rural India around 200 million people are particularly depend on forest resources for their livelihood [3].

The Western Ghats of India, known for its rich species diversity and endemism. It is home to a great variety of ethno-medicinally important plant species, and is ranked sixth among twelve mega diversity countries of the World [4]. The interest in biodynamic phytotherapy has increased many folds all over the world because of impressive record of safety and efficacy for many common diseases and several chronic ailments [5]. The ethnic medicinal plants are of great significance to the health of individuals, ethnic communities and traditional healer for demand of medicinal plants has increased numerous folds in the therapeutic remedies of various ailments due to active phytoconstituents [6].

The *Andrographis* is a large genus of family Acanthaceae [7]. About 21 species of *Andrographis* are reported to occur in India [8, 9, 10]. On hilly habitats nearly all the plants of a species flower as a rule in the same season [11]. Species of the genus *Andrographis* have been used in local folklore medicine for a wide variety of diseases such as fever, malaria, diarrhea, cough, muscular pains and used for the expulsion of worms, in the tribal and rural communities. Many pharmacological studies have been conducted as an attempt to authenticate its use as a multipurpose medicinal agent [12, 13, 14].

As far as threatened species of *Andrographis* of the Western Ghats are concerned, no detailed inventory was undertaken in the past. In the past few years some reports have been appeared on the floristic studies of Nilgiris Biosphere Reserve [15, 16, 17, 18]. Some of the species may be lost without gaining any attention. Since most of the threatened species in NBR, Western Ghats are located near the human settlements, human disturbance in these forest are progressively increasing [19, 20]. In view of the above facets, the present study was conducted to identify the threatened plant taxa of *Andrographis* in Nilgiri's Biosphere Reserve forest.

2. Materials and Methods

2.1 Study area

The Western Ghats of Nilgiri's, one of the 34 globally recognized biodiversity hotspot also forms a significant part of the state area of 2,479 square kilometres (957 sq mi) the mountains central location is 11°22'30"N 76°45'30"E [21, 22]. In fact, Tamil Nadu is the only state where both the hill ranges of Western Ghats and Eastern Ghats, meet at the Nilgiri hills exhibits great

phytodiversity due to immense variety of climate, vegetation, altitude and edaphic factors [23]. The Nilgiri's biosphere reserve has a large number of indigenous communities, most of them forest dwellers and hunter gatherers. The ethnic tribes of Irula, Paniya, Kurumba, Mullukurumba, toda and kotas of these distinct ethnic groups have small populations and live in geographical regions of upper Nilgiris.

2.2 Survey and documentation

The present study was conducted in the Nilgiri's Biosphere Reserve (NBR), the Western Ghats of India. The plant collection and identification of the threatened category ethnomedicinal plant species from different localities of NBR was carried out during the tenure of 2016-2017. The collected specimens were made into herbarium for identification with standard method. The primary identification of plant specimen is done with help of local and regional Floras [8, 10, 24, 25] and the conformity of identification was compared with authentic herbarium deposited in Botanical Survey of India, Southern Region, Coimbatore and Phytodiversity Research Laboratory, Department of Botany, Bharathiar University, Coimbatore, Tamilnadu, India.

2.3 Investigation methods from tribes

Medicinal uses were collected through questionnaires and discussions among the informants in their local language. Information was collected from tribes of *Irular*, *Toda*, *Kota*, *Kurumba*, *Kattunayaka* and local elder persons of the family. The questionnaire allowed responses on the plant prescribed, part of the plant used, medicinal uses for each part, mode of preparation (i.e., decoction, paste, powder and juice), form of usage (either fresh or dried) and additional plants used as ingredients. The voucher specimens were deposited in Bharathi Herbarium, Department of Botany, Bharathiar University, Coimbatore, Tamil Nadu, India.

2.4 High Performance liquid chromatography (HPLC) analysis

The wild collection of *Andrographis lobelioides* was dried and powdered using extracted in 75% methanol (x 3 10 mL) and filtered. The filtrate was defatted with an equal volume of n-hexane (x 3). The defatted extract was partitioned with equal volumes of chloroform (x 3). The chloroform fractions were pooled, evaporated to dryness, dissolved in 5 ml methanol (HPLC grade solvent), clarified using Millipore filters (0.22µm) and subjected to HPLC Shimadzu LC solution Analysis and data were taken from the chromatogram.

3. Results

The present study observed that traditional knowledge of the medicinal uses of these plants is maintained well within all the ethnic tribes of Nilgiri's Biosphere reserve (NBR). Data collected through the questionnaires highlighted the indigenous uses and reflected the collection, trade and reliance of these ethnic people on these medicinal plants. The community elders and women folks have a handsome knowledge of the forest plants and their medicinal plants usage for human life. The tribal communities are involved in the different works such as cattle farming, collection of fire woods, honey, resins and medicinal plants for their improvement of livelihoods of day to day life (Fig. 2).

Medicinal plants used by the tribal groups residing in 20 villages in and around the Nilgiri's Biosphere Reserve area and mode of preparation, consumption for health benefits were enumerated (Tab:- 1, Fig. 1). The survey results showed

a countable numbers of 9 threatened species which are utilized in tribal and traditional Indian medicine system for the treatment of a wide range of ailments including those of the digestive system, lungs and circulatory system. The principal plant part used is the bitter tasting leaves of *Andrographis* species may be sustain to the biological properties of antioxidant, diabetic and all types of cancer. Numerous recent investigations have interpreted the medicinal properties of the different species of *Andrographis* supported the veracity of various traditional ethnomedicinal claims.

The ethnobotanical uses of *Andrographis* species were studied by HPLC analysis of wild collection of *Andrographis lobelioides*. The dry powder of methanol extract contains 11.260% of Andrographolide, 42.676% of Neoandrographolide, 4.621% of 14-Deoxy grapholide and 5.096% of Andrograpanin. The percentage of improved active chemical constituents was compared with standard compounds (Fig. 3).

4. Discussion

Approximately 90% of the ingredients used in Ayurveda, Unani, siddha and homeopathy medicines are plant based; modern allopathic medical system has 25% of its formulation from herbal sources. The present export of Ayush products has jumped to 190693.9 million INR in 2011-12 with an annual growth rate of 471% reported by AYUSH official data. The WHO has estimated 80% of the world's population is still dependent on traditional medicine and in India 65% of the population in the rural area use traditional form of medicine to meet their primary health needs [26].

The study documented the uses of nine species of *Andrographis*, all these plant species are used to cure common ailments like cough, cold, headache, asthma, fever, bronchitis and stomach pain by all the six ethnic tribes and rural communities, some species like *Andrographis stellulata*, *Andrographis affinis*, *Andrographis alata* used in the treatment of aphrodisiac. *Andrographis neesiana* used to treat more than one disease, viz., skin disease, poison bites. In most of these species the highly utilized part is leaf and some rarely whole plant or other parts in the form of paste or decoctions (Table 1). Recently reported that the ethnobotanical knowledge of malayali tribes of Shevaroy hills is being used eight species of *Andrographis* plant leaf decoction mixed with curd, goat or buffalo milk for the treatment of jaundice and liver swollen [27]. The ethnomedicinal uses and animal model biological properties of antimicrobial, antioxidant, diabetic and cancer curing the potential bitter compounds like andrographolide from *Andrographis* species has been reported previously [28, 29, 30].

All the 9 species are to be conserved right away due to destruction and over exploitation from natural habitat. Among the given species population under vulnerable category is *A. neesiana*, *A. producta*, *A. affinis* and *A. stenophylla* are Endemic to Western Ghats and peninsular India and endangered category is *A. lawsonii*, *A. lobelioides* and *A. stellulata*, the continuous usage of these plant counts to be a one of the reason for their conservation. On the other hand maintained tradition of knowing the use of these plants paves the new way to conserve, manage and utilize this treasure of nature. The loss of the medicinal plant species in the specified sites is attributed by the key informants to the natural degradation, loss of habitat, besides the climatic and edaphic factors.

The high performance liquid chromatography analysis of *Andrographis lobelioides* contains potential bioactive

phytoconstituents of Andrographolide, Neo-andrographolide, 14-Deoxy grapholide and Andrograpanin (Table 2). The above list out medicinal plants of *Andrographis* species mentioned snake bite, fever, diabetic and many ailments cured by oral administration of leaf decoction due to the presence of Andrographolide (Fig.4). Recently many authors reported that the traditional knowledge of ethnic communities using

Andrographis species for snake bite and other ailments responsible of andrographolide and other derivatives [31, 32, 33, 34]. Hence the *Andrographis lobelioides* there is no literature available for scientific and clinical data on various ailments, the result of the high performance liquid chromatography analysis proved that andrographolide compounds existence in crude extract.

Table 1: List of enumerated ethnobotanical knowledge of *Andrographis* species used by the tribes of Nilgiri's Biosphere Reserve (NBR).

S. No	B. Name	Life Form/Habitat	Local Name	Location/Tribes	Mode of consumption/health benefits	Status
1	<i>Andrographis affinis</i>	Subshrub	Keeripparandai	Kotagiri/ Kota tribes	Decoction of whole plant is taken orally administered for snake-bite, sugar control and jaundice.	Endemic to Western Ghats and Peninsular India
2	<i>Andrographis alata</i>	Subshrub	Kattu seriyanangai	Coonoor/ Kurumba tribes	Leaf decoction was orally administered for snake bite, scorpion and centipede bite and heavy fever like malaria and typhoid.	Rare
3	<i>Andrographis neesiana</i>	Subshrub	Kattuperiyanangai	Upper part of Coonoor/Kurumba and Kattunayaka tribes	Leaf juice is taken orally to treat aphrodisiac, jaundice, skin allergy and fever.	Vulnerable and Endemic to Western Ghats and Peninsular India
4	<i>Andrographis lawsonii</i>	Erect herb	Kodiseriyanangai	Lakkadi lake, Avalanche/Local communities	Local elder men said its substitute or mixed with <i>Andrographis paniculata</i> powder for the treatment of various ailments.	Endangered and Endemic to Western Ghats
5	<i>Andrographis lobelioides</i>	Erect herb		Avalanche/Toda tribes	Leaf decoction was used orally mixed with buffalo milk for the treatment of viral fever, snake bite and jaundice.	Endangered and Endemic to Western Ghats
6	<i>Andrographis serphyllifolia</i>	erect herb	Kaatuppooraankodi	Gudalur (Mayor, Musinagudi)/Kota tribes	Whole plant extract used orally administered for snake bite, dog bite (rabbits) and fever like malaria and typhoid.	Rare
7	<i>Andrographis stellulata</i>	Subshrub		South division of Nilgiris/Toda tribes	Leaf extracts was orally administered with buffalo milk for treatment of poison bites and cold fever, jaundice.	Endangered and Endemic to Western Ghats
8	<i>Andrographis stenophylla</i>	Erect herb		Foot hills of Nilgiris/Irular tribes	Leaf decoction was mixed with cow milk and orally used for heavy fever and snake bite.	Endemic to western Ghats
9	<i>Andrographis producta</i>	Subshrub	Unknown	Sispara Ghats (Naduvattum Range)/Local communities	Elder men said its used for skin diseases	Endemic to Western Ghats

Table 2: High performance liquid chromatography analysis of crude extract of *A. lobelioides* from wild collection.

S. No	Retention Time	Area (MV.s)	Height (MV)	Concentration %	Chemical name
1	8.962	757939	75.188	11.260	Andrographolide
2	10.598	167498	31.718	42.676	Neo- Andrographolide
3	11.403	53568	11.505	4.621	14-Deoxy grapholide
4	12.782	39807	86.88	5.096	Andrograpanin
Total				63.65%	



Fig 1: The habitat of threatened medicinal plant species of *Andrographis* from Western Ghats of Nilgiris biosphere reserve (NBR): a- *Andrographis alata*; b- *A. affinis*; c- *A. lwansonii*; d- *A. lobelioides*; e- *A. stenophylla*; f- *A. stellulata*.

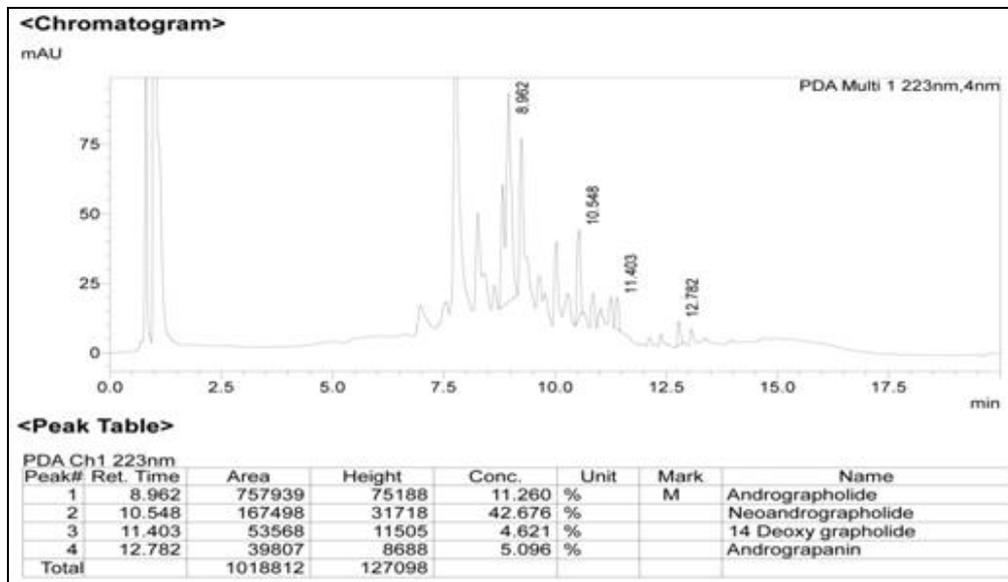


Fig 2: Chromatogram of high performance liquid chromatography analysis from wild collection of *Andrographis lobelioides* methanol extract.

5. Conclusion

Intensive studies on indigenous medicinal plants of *Andrographis* species are very important in traditional system of medicine and bioactive constituents of andrographolide very effective presence in the study species. With all these background information and having realized that the habitats of medicinal plants are important to maintain to keep ethnic knowledge in mentality lonely without any written documents. The ethnobotanical knowledge on useful plants acquired and accumulated through generations is gradually

getting lost through urbanization. Hence, the vanishing ethnobotanical knowledge of the threatened *Andrographis* species is to be well documented for constantly and recommended for cultivation practices and explores the clinical research for future.

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