

Review Article

Biological and Pharmacological Activities of *Andrographis* spp. (Acanthaceae) Distributed in Southern Eastern Ghats, India

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Abstract	Keywords
<p><i>Andrographis</i> is an important genus of the family Acanthaceae known for its ethnomedicinal claims and for a variety of medicinal properties. The current review briefly summarizes the distribution, phytochemical components, biological and pharmacological activities of <i>Andrographis</i> spp. distributed in Southern Eastern Ghats, South India along with colour photographs of important species. More than 10 species of <i>Andrographis</i> are distributed in Southern Eastern Ghats, South India which includes <i>A. affinis</i>, <i>A. alata</i>, <i>A. beddomei</i>, <i>A. elongata</i>, <i>A. echioides</i>, <i>A. glandulosa</i>, <i>A. lineata</i>, <i>A. ovata</i>, <i>A. paniculata</i> and <i>A. serpyllifolia</i>. Among the different species of <i>Andrographis</i>, only some are studied for their biological and pharmacological activities. The phytochemical components in <i>Andrographis</i> spp. responsible for the biological and pharmacological activities reported in various studies are andrographolide, neoandrographolide, 14-deoxy- 11,12-didehydroandrographolide, 14-deoxy-andrographolide, andrographiside and serpyllin. The important pharmacological effects of <i>Andrographis</i> spp. and their derivatives include the activities like antidiabetic, anticancer, antifertility, anti-inflammatory, antioxidant, antivenom, hepatoprotective, immunomodulatory, antimicrobial, antipyretic, anthelmintic and antiviral (against chikungunya) activity.</p>	<p><i>Andrographis</i> species Andrographolide Medicinal plants Pharmacological activities Southern Eastern Ghats</p>

Introduction

Genus *Andrographis* (Acanthaceae) is medicinally important taxa of 26 species native to India, with extreme species diversity occurring in southern Peninsular India. Southern part of the Eastern Ghats is

comparatively possessing important endemic medicinal plant species and requires attention of conservation. Among the diverse plant species, *Andrographis* contributes more than ten species, such as *A. affinis*, *A. alata*, *A. beddomei*, *A. elongata*, *A. echioides*, *A. glandulosa*, *A. lineata*, *A. ovata*, *A. paniculata* and

A. serpyllifolia (Pulliah et al., 2010). Only a few species are having potential medicinal values namely *Andrographis paniculata* Nees. (Nilavaembu) and it is extensively used in several medicinal systems such as Ayurvedha, Homeopathy, Naturopathy, Amchi, Modern, Unani and Siddha medicine. *A. paniculata*, commonly known as an annual herb and usually called as king of bitters. It is found in wild throughout the plains of India especially in Tamil Nadu, Karnataka, Maharashtra, Orissa and Uttar Pradesh. It is the only species extensively studied for various biological activities.

A. paniculata is known to possess medicinal properties like antidiarrhoeal, anti-inflammatory, choleric, antimalarial, antidote, antihypertensive, antipyretic, antithrombotic, hepatoprotective, and so on that can be found in exclusive review articles concerned with *A. paniculata* (Jarukamjorn and Nemoto, 2008; Akbar, 2011; Anju et al., 2012; Deora, 2014). Since extensive studies and reviews are available for *A. paniculata*, only important activities are highlighted in the present review along with the other species distributed in Southern Eastern Ghats.

Taxonomic position

Kingdom	:	Plantae
Division	:	Angiospermae
Class	:	Dicotyledonae
Order	:	Lamiales
Family	:	Acanthaceae
Genus	:	<i>Andrographis</i> Wall. ex Nees.

Morphological description of the genus *Andrographis*

Erect or prostrate herb or sub-shrub; leaf blade margin entire, rounded to acute at base, obtuse to acuminate at apex. Inflorescences terminal or axillary, panicles, racemes, or rarely solitary sometimes spikes or dense clusters; bracts present; bracteoles small or sometime absent. Calyx deeply 5-lobed; lobes narrow, equal or sub-equal. Corolla tubular to funnel form at base; lower lip 3-lobed; upper lip entire or 2-lobed. Stamens 2, exerted from or included in corolla tube; filaments sometimes pubescent; anthers 2, equal or sub-equal. Capsule linear-oblong or ellipsoid, compressed. Seeds sub-globose or compressed, black or grey. Some of the important species of *Andrographis* distributed in Southern Eastern Ghats, South India are depicted in Fig. 1 and their details are provided in Table 1.

Phytochemical components in *Andrographis* species

The chemical composition of *Andrographis* shows a number of diterpenoids and diterpenoid glycosides of similar carbon skeleton. The bitterest compounds among them are andrographolide, neoandrographolide and deoxyandrographolide. Andrographolide is a labdane diterpenoid—the main bioactive component in *A. paniculata* (Jarukamjorn and Nemoto, 2008). Andrographolide is an extremely bitter substance extracted from the stem and leaves of *A. paniculata*. Basically phytochemicals are divided into two groups that are primary and secondary metabolites based on the function in plant metabolism. Primary metabolites are comprise common carbohydrates, amino acids, proteins and chlorophylls while secondary metabolites consist of alkaloids, saponins, steroids, flavonoids and tannins in *Andrographis* spp., all of which are responsible for various biological activities (Chakravarti and Chakravarti 1951; Kirtikar and Basu, 1975; Amroyan et al., 1999; Niranjana et al., 2010; Rajalakshmi et al., 2012; Savithramma et al., 2012; Neeraja et al., 2014). The phytochemical principles and their associated biological and pharmacological activities of important *Andrographis* spp. distributed in Southern Eastern Ghats are summarised in Table 2.

Kishore et al. (2003) reported three different chemical components of flavonoids (5, 7, 2, 3, 4-pentamethoxyflavone, 2-hydroxyl -2, 4, 6-trimethoxychalcone and dihydroscutellapflavone I) from the whole plant of *A. lineata*. Bhaskar Reddy et al. (2003) reported new 2'-oxygenated flavonoids from *A. affinis*. Andrographolide (C₂₀H₃₀O₅) is the major diterpenoid. Diterpenic constituents present in *A. paniculata* are andrographolide, 14-deoxy-11, 12 didehydro-andrographolide, 14-deoxyandrographolide, 3, 14-dideoxyandrographolide, 14-deoxy-12-hydroxy-andrographolide, neoandrographolide, 14-deoxy-andrographolide. The roots give flavones apigenin-7, 4-dio-O-methyl ether, 5-hydroxy-7, 8, 2', 3'-tetramethoxyflavone, andrographin and panicolin and α -sitosterol (Ali et al., 1972). Leaves contain homoandrographolide, andrographosterol and andrographone and also it contain two bitter substances lactone “andrographolide” and “kalmeghin”. Kalmeghin is the active principle that contains 0.6% alkaloid of the crude plant. Andrographolide is abundant in leaves and can be easily isolated from the crude plant extracts as crystalline solid (Govindachari et al., 1969; Patra and Mitra, 1981; Fujita et al., 1984).

Table 1. List of *Andrographis* spp. distributed in Southern Eastern Ghats, India.

Sl. No.	Botanical name [Synonyms]	Vernacular name (Tamil)	Habit	Distribution
1.	<i>Andrographis paniculata</i> (Burm.f) Wall. ex Nees. [<i>Justicia paniculata</i> Burm.f <i>Andrographis subspathulata</i> C.B. Clarke]	Nilavaambu	Erect branched herb, 30 to 90 cm tall	Common in deciduous forest and also open waste land on rocky soil.
2.	<i>Andrographis echioides</i> (L.) Nees. [<i>Indoneesiella echioides</i> (L.) Sreemadh. <i>Justicia echioides</i> L.]	Gopuranthaangi	Annual erect herb, to 50 cm tall.	Common, spread all over Eastern Ghats up to 500m altitude in hill areas and plains
3.	<i>Andrographis lineata</i> Wall. ex Nees.	Periyanangai	Erect branched herb up to 1 m tall	Occasional in the hills of Cuddaph and Visakhapatnam districts and endemic Eastern Peninsular India.
4.	<i>Andrographis elongata</i> (Vahl.) T. And. [<i>Justicia elongata</i> Vahl.]	-	Divaricately branched annual herb up to 65 cm tall.	Frequent in forests in the hills of Ganjam and Similipahar; occasional in the hills of Visakhapattam and Chittoor districts (A.P); Simhachalam hills; Kolli hills; Endemic to Andhra Pradesh, Tamilnadu and Orissa.
5.	<i>Andrographis serpyllifolia</i> (Rottl. ex Vahl.) Wight. [<i>Justicia serpyllifolia</i> Rottl. ex Vahl.]	Kaattupooran kodi, Siyankodi	Prostrate, trailing herb	Occasional in hilly dry deciduous forests up to 600m altitude in middle and Southern Eastern Ghats. Endemic to Peninsular India
6.	<i>Andrographis alata</i> (Vahl) Nees. (Gnanasekaran and Murthy, 2015) [<i>Justicia alata</i> (Vahl.)]	Periyanangai	A branched subshrub	Common in grasslands of high elevation in Southern Eastern Ghats
7.	<i>Andrographis affinis</i> Nees.	Kodikkurundhu	Subshrub up to 2m tall	Rare in grasslands of high elevation in Southern Eastern Ghats; Sirumalai hills; Endemic to Peninsular India.
8.	<i>Andrographis ovata</i> (T. And. ex Bedd.) [<i>Gymnostachyum ovatum</i> T. And. ex Bedd.]	-	Erect branched herb, 10-70 cm tall.	Occasional forests of Andhra Pradesh.
9.	<i>Andrographis nallamalayana</i> J.L Ellis	-	Procumbent herb up to 25 to 50 cm tall	Occasional in Nallamalais; Endemic to Andhra Pradesh
10.	<i>Andrographis glandulosa</i> Nees.	-	A straggling under-shrub	Occasional in hills of Nellore and Cuddapah districts; Udayagiri hills; Endemic to Peninsular India.
11.	<i>Andrographis beddomei</i> C.B. Clarke	-	A much branched nearly glabrous under shrub	Occasional in Dry deciduous forests; Endemic to Andhra Pradesh, India.

Table 2. Phytochemical components of *Andrographis* spp. and their pharmacological activities.

Phytochemical components	Pharmacological activity	References
Andrographolide	Anti-inflammatory	Sheeja et al. (2006)
	Hepatoprotective	Jarukamjorn and Nemoto (2008)
	Anti-oxidant	Ojha et al. (2009)
	Antipyretic	Rammohan (2009); Saraswat et al.(1995)
	Anticancer	Kumar et al. (2004)
	Anthelmintic	Padma et al. (2011)
	Antiviral (against chikungunya)	Wintachai et al. (2015)
	Anti-hepatitis C virus activity	Lee et al. (2014)
	Antihyperglycaemic	Rammohan (2009)
Neoandrographolide	Antipyretic activity	Deng (1978); Deng et al. (1982)
	Anti-inflammatory and antioxidant activities	Batkhuu et al. (2002); Liu et al. (2007)
	Hepatoprotective	Mohamed Saleem (2010)
14-deoxy- 11,12-didehydroandrographolide	Antipyretic	Deng et al. (1982)
	Anti-inflammatory and anti-oxidant activities	Parichatikanond et al. (2010); Yin and Guo (1993); Kumar et al. (2004); Deng et al. (1982)
	Anticancer activity	Geethangili et al. (2008); Kumar et al. (2004)
	Cardiovascular activity	Sheeja et al. (2007); Woo et al. (2008); Thisoda et al. (2006); Reyes et al. (2006)
14-deoxyandrographolide	Antipyretic	Deng (1978); Deng et al. (1982)
	Anti-inflammatory effect	
	Anticancer activity	Kumar et al. (2004)
Andrographiside	Hepatoprotective effect	Kapil et al. (1993)

The chemical constituents present in *A. serpyllifolia* exert biological activity of the flavones like apigenin 7, 4'-dimethyl ether, tectochrysin, acylated flavone and glucosides components with their specific activity. Serpyllin, which comes under the category of flavone, has been isolated from *A. serpyllifolia* and its structure has been determined as 5-hydroxy-7, 8, 2', 3', 4'-pentamethoxyflavone.

Skullcapflavone I 2'-O-β-D-glucopyranoside and Andrographidine C are the two new acylated flavone glycoside, determined as skullcapflavone I 2'-O-β-D-(3''-E-cinnamoyl) glucopyranoside and skullcapflavone I 2'-O-β-D-(2''-E-cinnamoyl) glucopyranoside and both were isolated from the whole plant of *A. serpyllifolia*. Structural elucidation of the glycosides was achieved by various NMR techniques including 2 d NMR (1H-1H COSY, HMQC, HMBC and ROESY experiments, FAB-mass spectrometry, saponification and acid hydrolysis (Govindachari et al., 1968; Damu et al., 1999). Different categories of chemical compounds in *Andrographis* spp. and their molecular structure are given in Fig. 2.

Fig. 1-A: *Andrographis affinis* Nees.

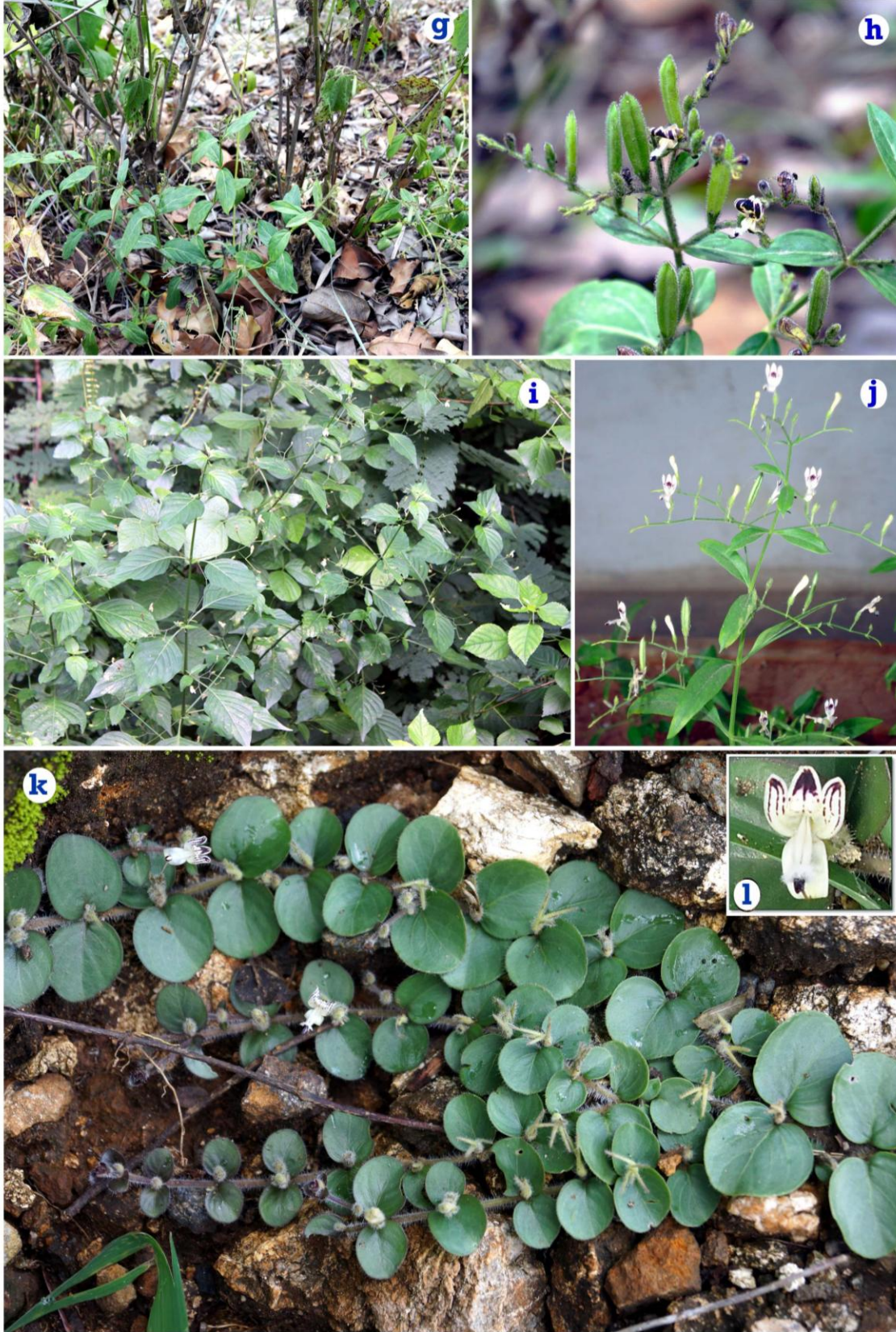


Fig. 1-B: Important *Andrographis* species distributed in Southern Eastern Ghats, South India.



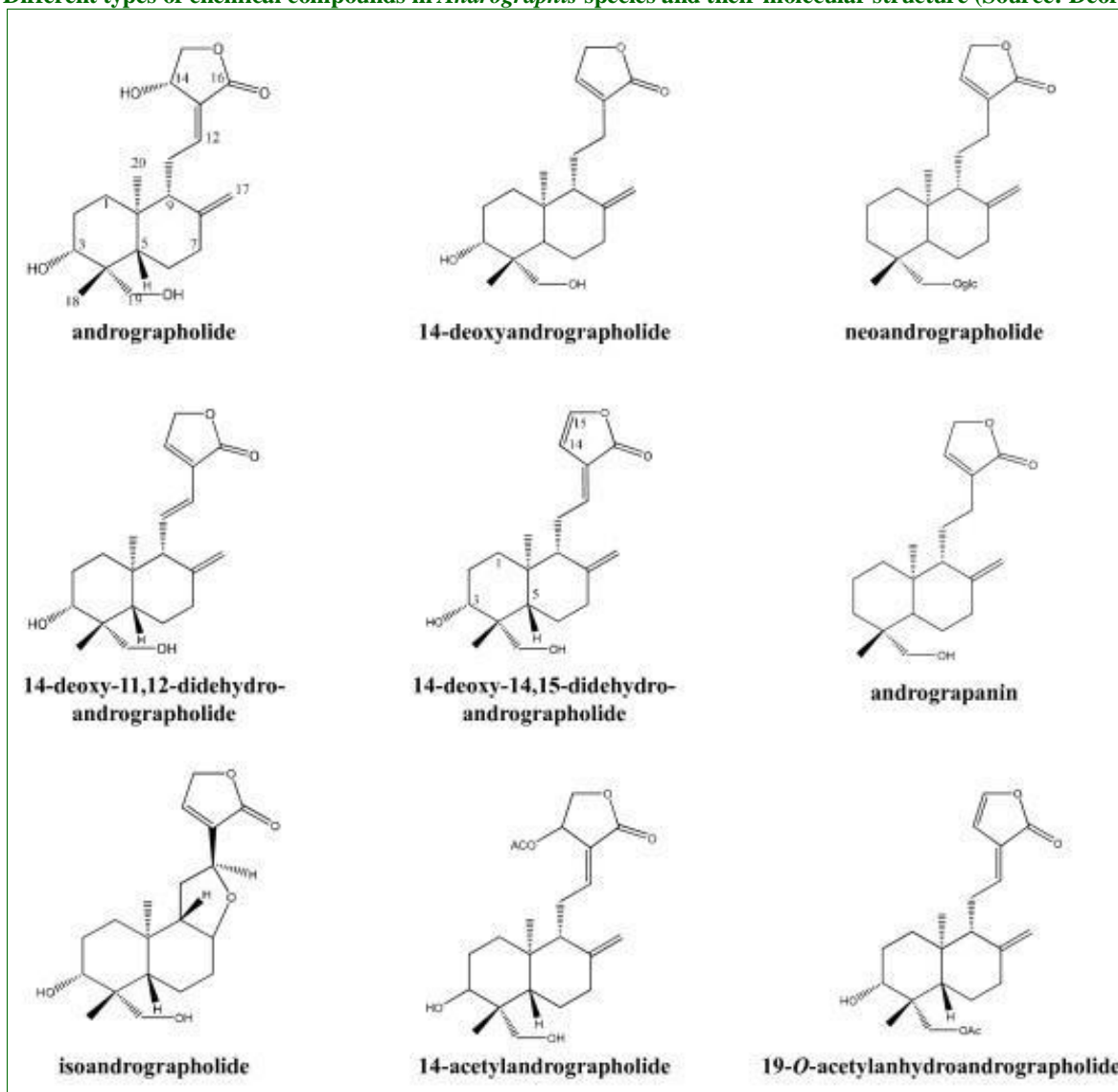
a-c: *Andrographis alata* – a) habit; b) inflorescence; c) flower; d: *Andrographis echioides*-habit; e-f: *Andrographis elongata* – e) habit; f) flowers with young fruit.

Fig. 1-C: Important *Andrographis* species in southern Eastern Ghats, South India.



g-h: *Andrographis lineata* – g) habit; h) flowering branch with fruits; i) *Andrographis ovata* – habit; j) *Andrographis paniculata* – a flowering twig; k-l: *Andrographis serpyllifolia* – k) habit; l) a flower.

Fig. 2: Different types of chemical compounds in *Andrographis* species and their molecular structure (Source: Deora, 2014).



Biological and pharmacological activities of *Andrographis* species

Andrographis spp. show a variety of biological and pharmacological activities, and *A. paniculata* is the most studied species. Antidiabetic, anticancer, antifertility, anti-inflammatory, antioxidant, antivenom, hepatoprotective, immunomodulatory, antimicrobial, antipyretic, anthelmintic and antiviral (against chikungunya) activities are the major biopharmacological activities reported from different species of *Andrographis*. Some of the important pharmacological activities of *Andrographis* spp. distributed in Southern Eastern Ghats are given in detail under specific activities and a brief summary of the biopharmacological activities are given in Table 3.

Antidiabetic activity

Umashankar and Shruti (2011) and Zoha et al. (1989) reported that *A. paniculata* has antidiabetic properties. Plant materials which are being used as traditional medicine for the treatment of diabetes are considered one of the good sources for a new drug. Plant extract or different folk plant preparations are being prescribed by the traditional practitioners in treating diabetic conditions. The hypoglycemic and hypolipidemic effects in high-fat-fructose-fed rat administered with *A. paniculata* or its active compound andrographolide has been reported by Nugroho et al. (2012). Andrographolide has potential as a leading compound in the prevention or treatment of obesity and insulin resistance (Ding et al., 2014). Andrographolide prevents

type 1 diabetes by maintaining Th1/Th2/Th17 homeostasis in autoimmune diabetic NOD mice by inducing immune tolerance (Zhang et al., 2014). The anti-diabetic effect of andrographolide-enriched extract of *A. paniculata* in combination with asiaticoside-enriched extract of *Centella asiatica* also showed blood glucose lowering activity (Nugroho et al., 2013).

Anticancer activity

A good number of studies on anticancer activities of *Andrographis*, ranging from cell line studies to nanoparticle development, are available. Three compounds were isolated from chloroform and methanolic extract of *A. paniculata* which were coded as AND-6, AND-4, AND-11. The compound AND-4 has an anti-proliferative activity in Hep G2 and HCT-116 cell lines (Sirisha Mulukuri et al., 2011). Hazra et al. (2015) studied the development of anticancer drugs from andrographolide and their semisynthesis, bioevaluation, QSAR analysis and pharmacokinetic studies. Also Elangovan et al. (2015) studied the phyto-mediated biogenic synthesis of silver nanoparticles using leaf extract of *A. echinoides* and its bio-efficacy on anticancer activity and antimicrobial activity. The study by Puntawee et al. (2015) reported that the encapsulated 19-triphenylmethyl ether andrographolide (AG 050-P) exhibited sustained release pattern and excellent cytotoxicity activity against cholangiocarcinoma (KKU-M213) and nanoencapsulation of AG 050-P implicated its potential development for clinical use in cholangiocarcinoma treatment. The pharmacological principle from *Andrographis*, andrographolide and its analogues in cancer prevention has been well documented by Mishra et al. (2015).

Antifertility activity

Antifertility effect of *A. paniculata* leaves at a dose of 20 mg per day for 60 days had an in male rats have been reported by Zoha et al. (1989) and Akbarsha et al. (1990 and 2000).

Anti-inflammatory activity

Radhika et al. (2009) determined carrageenan induced rat hind paw oedema model for acute inflammation by administering *A. paniculata* stem, and the chloroform extract was observed to possess statistically significant effect and the results were comparable with the standard anti-inflammatory drug ibuprofen. Low et al. (2015)

conducted an *in vitro* study to find out the anti-inflammatory activity of standardised *A. paniculata* extracts and pure form of andrographolide. Aqueous extract of *A. paniculata* was more potent than ethanolic extract in antioxidant activities; compared with andrographolide, aqueous extract also possessed potent antioedema and analgesic activities (Lin et al., 2009). Shen et al. (2013) studied the anti-inflammatory effects of *A. echinoides*.

Antioxidant activity

The antioxidant significance was observed in activity-guided isolation of antioxidant compounds from *A. stenophylla* leaf in various extracts of using *in vitro* ferric thiocyanate method. Some of the chemical compounds (andrographolide, acacetin and isosakuranetin) were isolated from leaf of *A. stenophylla* (Neelaveni and Jayanta, 2010). Kurzawa et al. (2015) reported the antioxidant activities of *A. paniculata* using FRAP, CUPRAC and DPPH procedures. Whereas, Zhao et al. (2014) reported that six compounds are positively correlated to DPPH free radical scavenging and ferric reducing capacities, and four compounds are negatively correlated to DPPH free radical scavenging and ferric reducing capacities in 'Andrographis Herba'.

Antimicrobial activity

Antimicrobial activity has been reported in *A. echinoides*, *A. elongata*, *A. affinis*, *A. paniculata* and *A. serpyllifolia*. Several extracts like ethanol, methanol, acetone, chloroform and petroleum ether were used for to measure their activity against different microorganisms as shown in Table 3 (Savithamma et al., 2012; Kanchana et al., 2014; Alagesaboopathi, 2011a; Alagesaboopathi, 2013; Alagesaboopathi and Sivakumar, 2011; Suparna et al., 2014; Rao et al., 2014).

Antibacterial activity of leaf extracts *A. paniculata* revealed that petroleum ether extract inhibited *Shigella* sp., *Proteus vulgaris*, *Klebsiella pneumoniae* with maximum inhibition zones being 5mm at 1mg/ml. antibacterial activity exhibited by the presence of andrographolide was conformed through HPLC analysis. Standard andrographolide inhibited all the bacterium except *E. coli*. Although andrographolide was effective against diverse gastrointestinal pathogens it does not have any harmful effect on the other microorganisms (Anitha and Rayunukaa, 2013).

Table 3. Bio-pharmacological activity of *Andrographis* spp. distributed in Southern Eastern Ghats, India.

Sl. No.	Botanical name	Bio-pharmacological activity studied	References
1.	<i>Andrographis paniculata</i>	Antimicrobial activity (endophytes)	Arunachalam and Gayathri (2010) Radha et al. (2011)
		Antifertility effect	Zoha et al. (1989)
		Anti-plasmodial activity	Panneerselvam et al. (2011)
		Anticancer activity	Sirisha Mulukuri et al. (2011) Umashanker and Shruti (2011)
		Antidiabetic activity	Prem Kumar et al. (2012) Zhang and Tan (2000) Umashanker and Shruti (2011)
		Hepatoprotective activity	Neha and Rawal (2000)
		Cerebroprotective and nootropic	Radhika et al. (2012)
		Antioxidant activity	Suparna et al. (2014)
		Antioxidant and gastroprotective	Wasman et al. (2011)
		Prophylactic activity	Rattanachaikunsopon and Phumkhachorn (2009) Rajalakshmi et al. (2012)
		Antibacterial activity	Mishra et al. (2009) Sukesh et al. (2011)
		Anthelmintic activity	Venkata Raju et al. (2011)
		Antivenom activities	Balu and Alagesaboopathi (1995)
		Anti-malarial	Mishra et al. (2009) Dua et al. (2004)
2.	<i>Andrographis echioides</i>	Anti-inflammatory	Shen et al. (2013)
		Antimicrobial activity	Kanchana et al. (2014)
		Mosquito larvicidal activity	Rajkumar et al. (2012)
3.	<i>Andrographis lineata</i>	Hepatoprotective activity	Sangameswaran et al. (2010) Nikhil Chakravarthy et al. (2014)
		Antivenom activities	Balu and Alagesaboopathi (1995)
		Antimicrobial	Alagesaboopathi (2011a)
4.	<i>Andrographis elongata</i>	Antibacterial	Alagesaboopathi (2013)
5.	<i>Andrographis serpyllifolia</i>	Hypolipidemic activity	Chelluboina and Manga (2010)
6.	<i>Andrographis alata</i>	Antimicrobial activity	Alagesaboopathi (2011b)
		Antivenom activities	Balu and Alagesaboopathi (1995)
7.	<i>Andrographis affinis</i>	Antimicrobial activity	Alagesaboopathi (2011c)
8.	<i>Andrographis ovata</i>	Antimicrobial activity	Alagesaboopathi (2011d)
9.	<i>Andrographis nallamalayana</i>	Anti-psoriatic activity	Parlapally et al. (2015)

Antivenom activity

The ethnomedicinal reports, antivenom activities were noticed in three different *Andrographis* species like *A. paniculata*, *A. alata* and *A. lineata*. In an *in-vitro* HRBC membrane lysis assay, *Andrographis paniculata* showed a maximum antivenom activity when compared with other two species studied (Balu and Alagesaboopathi, 1995). The ethanolic extract of *A. paniculata* when given along with anti-snake venom, the antivenom effect is potentiated (Premendran et al.,

2011). Uawonggul et al. (2006) reported that *A. paniculata* is possessing antidote activity against scorpion venom with low cytotoxicity.

Activity against Protozoans

The antiplasmodial activity of these nanoparticles was studied against *Plasmodium falciparum* (Panneerselvam et al., 2011). Herbal extracts of *A. paniculata* is known as hepato-protective and fever-reducing drugs since ancient time and they have been used regularly by the

people in the south Asian sub-continent. Anti-malarial (against *P. falciparum*) activity of methanolic extracts of *A. paniculata* has been reported by Mishra et al. (2009). Nanoparticles derived using andrographolide has considerable activity against a protozoan parasite, *Leishmania* –causative agent of leishmaniasis (Roy et al., 2010).

Hepatoprotective activity

A. paniculata is used extensively in the Indian traditional system of medicine as a hepatoprotective and hepatostimulative agent. The aqueous extract of the leaves of *A. paniculata* has traditionally been used for treatment of various liver disorders and jaundice. The inhibition of liver toxicity by aqueous extract, antihepatotoxic activity of methanolic extract of the plant, biochemical parameters like serum transaminases, SGOT and SGPT, serum alkaline phosphatase, serum bilirubin and hepatic triglycerides as a measure of liver functionality have been well reported for *A. paniculata* (Handa and Sharma, 1990; Bhardwaj et al., 2011; Neha and Rawal, 2000). Sutha et al. (2010) reported hepatoprotective effect of methanolic extract of *A. paniculata* leaves in mice model.

Immunomodulatory activity

The immunomodulatory activity of *A. paniculata* is well-studied by many researchers. The extract of *A. paniculata* and purified andrographolide was reported to stimulate an innate immune response in mice and proliferation of splenic lymphocytes (Puri et al., 1993). Andrographolide not only stimulates immune system, but also exhibits immunosuppressant activities. The proliferation of lymphocytes of various kinds by andrographolide has been reported by Panossian et al. (2002), Rajagopal et al. (2003) and Kumar et al. (2004). *In vitro* and *in vivo* studies reveal that andrographolide could interrupt T-cell activation (Iruetagoiena et al., 2005).

Conclusion

More than 10 species of *Andrographis* are distributed in Southern Eastern Ghats, South India viz., *A. affinis*, *A. alata*, *A. beddomei*, *A. elongata*, *A. echioides*, *A. glandulosa*, *A. lineata*, *A. ovata*, *A. paniculata* and *A. serpyllifolia*. The major phytochemical principle responsible for the medicinal activity is found to be andrographolides. The most studied species among

Andrographis is *A. paniculata*. The important pharmacological effects of *Andrographis* spp. and their derivatives include the activities like antidiabetic, anticancer, antifertility, anti-inflammatory, antioxidant, antivenom, hepatoprotective, immunomodulatory, antimicrobial, antipyretic, anthelmintic and antiviral (against chikungunya) activity.

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