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REVIEW ARTICLE

An overview of some pharmacologically relevant therapeutic plants from Kerala's sacred groves

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ABSTRACT

In Kerala's native culture, sacred groves are referred to as "Kavu" and have long been used as archives for traditional knowledge and biodiversity. Many medicinal plants with strong pharmacological properties can be found in these distinctive habitats, and they have historically provided local populations with medicine. Studying the pharmacological significance of plants from Kerala's sacred groves will help us to gain a better understanding of the value of nature-based therapies in a time when both natural resources and traditional knowledge systems are more crucial than ever. This comprehensive review article seeks to study wide variety of medicinal plants present in Kerala's sacred groves, including *Murdannia pauciflora*, *Osbeckia muralis* and *Indoneesiella echioides*, offering light on their historical use and pharmacological qualities that have been proven.

Keywords: Sacred groves, Kerala, Medicinal plants, Pharmacology

1. INTRODUCTION

Sacred groves are nature preserves with richest biodiversity, indigenous plant life, and an abundance of religious, cultural traditions and customs [1]. Sacred groves act as an association between people, the surrounding environment, sociocultural norms, and spiritual and cultural identities [2]. There are essentially three kinds of sacred groves: those associated with temples, those linked to burial grounds, and traditional sacred groves [3]. Throughout the 761 sacred groves of Kerala, there are an estimated 722 species of plants, distributed throughout 474 genera and 128 families [4]. The majority of Kerala's sacred groves are owned and preserved by ancestral families, joint families, communities, or temple trusts. Several are governed by Kerala government [5].

Kerala's sacred groves have protected a wide variety of plant species throughout history, many of which have extraordinary therapeutic applications. These ecosystems not only highlight how humans and the environment can survive, but they also offer a fascinating perspective into the long-standing medicinal practices of the region. The indigenous populations of Kerala have long regarded the sacred groves—known as "Kavu" in the native Malayalam—as holy places, and their significance transcends all bounds of religion and belief. The objective of this review article is to explain the phytochemical and pharmacological importance of medicinal plants found in Kerala's sacred groves. Through this investigation, we hope to illuminate the therapeutic potential of the plant species providing details on their historical applications and current scientific support.

2. A REMARK ON KERALA'S DIFFERENT SACRED GROVES

A significant component of Kerala's rural environment are sacred groves. Research carried out within the State has already demonstrated that, with regard to a variety of biological characteristics, the State's well-preserved sacred groves are equivalent to the surrounding natural forests [6]. Numerous research has been carried out on these holy areas to record the flora and fauna present, demonstrating the need of preserving these ecosystems. Table 2.1. contains a list of some of Kerala's most significant sacred groves.

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Table 1. Some important sacred groves of Kerala

Sacred grove	District
Edayilekkavu kadu	Kasargod
Sree Deviot Kavu	Kannur
Mani Kavu	Wayanad
Muchukkunnu Kotta Kavu	Kozhikode
Karakkode Kavu	Malappuram
Ayyappan Kavu	Palakkad
Chedangotu Kavu	Thrissur
Aruvikkal Kavu	Ernakulam
Kalloor Appan Kavu	Kottayam
Valamchuzhi Kshethrakavu	Pathanamthitta
Vetticode Kavu	Alappuzha
Pazhangala Kavu	Kollam
Thrikunnath Kavu	Thiruvananthapuram

3. DESCRIPTION OF MEDICINAL PLANTS

***Acacia auriculiformis* A. Cunn. Ex Benth.**

Acacia auriculiformis is an evergreen tree. The bark is vertically fissured, and the trunk is twisted. Roots are thin and widely dispersed. Leaves are thick and leathery. Flowers are creamy yellow and of sweet smell [7].

***Aphanamixis polystachya* (Wall.) R.N. Parker.**

It is a 20-meter-tall tree. Leaves are stalked and pinnate. Its leaflets are leathery and oblong. On both surfaces, the midrib is visible. Male and bisexual flowering stalks are up to 50 cm long, compared to up to 110 cm for female flowers. It's cream to golden to bronze flowers have an attractive smell. *Aphanamixis polystachya* is a species that is widely distributed throughout western Malaysia and Indo-China. It is indigenous to Taiwan, Malaysia, Singapore, and Indonesia. In India, it's frequently referred to as "Amoora" [8].

***Bridelia stipularis* (L.) Blume.**

Bridelia is a climbing, evergreen plant. The leaves are elliptic-obovate or orbicular-oblong and somewhat leathery. Small, axillary clusters of flowers or long spikes of flowers are present. On very short stalks, male blooms can be seen. Fruits rest on an extended calyx. The plant, commonly called as Climbing Bridelia is found throughout South Asia, particularly in Bangladesh, China, India, Indonesia, Malaysia, Myanmar, Nepal, Sri Lanka, and Vietnam [9].

***Citrus aurantifolia* (Christm.) Swingle**

C. aurantifolia is a thorny, shrubby tree commonly called as key lime. The scientific name *aurantifolia* refers to the leaves' likeness to those of the orange *Citrus aurantium*. The flowers are yellowish white with a subtle purple tinge on the borders. Although they appear all year round, fruit and flowers are mostly found from May through September [10].

***Corchorus aestuans* L.**

The plants are usually tall, annual herbs. They are either unbranched or have a limited number of side branches. The leaves are simple, alternating, lanceolate with a coarsely serrated or lobed border. The fruit is a multi-seeded capsule, and the blooms are tiny (2–3 cm in diameter) and yellow with five petals. The plant can be located over wide range of locations like Australia, Tropical Africa, India, China, etc [11].

***Derris scandens* Aubl.**

Derris scandens commonly called as jewel wine is an evergreen, twining shrub with climbing branches. The leaves are compound, alternating, with solid, woody leaf axes. Leaflets are whole, blunt, and elliptical in shape. A raceme of pea-like flowers is present. Flowers have a light rose color. The plant is distributed over Asia and South East Asia [12].

***Evolvulus alsinoides* (L.) L.**

Evolvulus alsinoides is an exceedingly slender herb. The stems are single. The leaves are lanceolate to ovate, blunt with a small point at the apex. They

are thickly covered in white and silky hairs. The flowers are pale blue in color. Fruit (capsule) often has four seeds inside. The plant is common in India and is used in variety of forms in traditional medicine [13].

***Elephantopus scaber* L.**

Elephantopus scaber is a hairy herb with forked stems. The majority of the leaves are oblong-ovate to oblong-lance-like. There are approximately 4 purple-colored flowers per head. At the tips of the branches, flowering heads are borne in clusters. Fruits have ribs and are achenes. The plant is distributed all over Asia, Australia, America, etc [14].

***Fimbristylis aestivalis* (Retz.) Vahl**

These are usually herbs with scabs. The leaves are oblong to rectangular or oblanceolate. Flowers 2–5, bisexual. Corolla is purple with a tube that is 5-6 mm long. Fruits are 4-5 mm length achenes. The plant is distributed worldwide in both tropical and temperate regions [15].

***Hedyotis corymbosa* L.**

Hedyotis corymbosa is an herb that is perennial and grows upright. Lance-shaped leaves with smooth edges are their characteristic. White flowers with slender ovate petals can be seen. Four evenly spaced horns on about spherical, light green fruits are present. The plant is commonly found in India and is used as a traditional medicinal herb [16].

***Holigarna arnottiana* Hook.f.**

Holigarna arnottiana is a tree with fissured bark and presence of white latex. Simple, alternating, spirally arranged leaves are grouped at the ends of twigs. In leaf axils or at branch tips, panicles of golden yellow pubescent flowers are produced. Fruit is 3 cm long, smooth, rounded at the tip, and one-seeded. The plant is mostly seen in Western Ghats [17].

***Indoneesiella echioides* (L.) Nees**

The plant has hairy stems branching from the base. The leaves are oblong-spade-shaped and narrow at the base. Both sides of the leaves are hairy. Long spike-like racemes with flowers are produced. The plant is commonly called as false water willow and is distributed all over South India [18].

***Ludwigia hyssopifolia* (G. Don) Exell**

Ludwigia hyssopifolia is an upright herb or under-shrub. The leaves are alternating and ovate-lanceolate Flowers are carried solitary in leaf axils on two-bracteole stalk. The plant is extensively grown in India, Bangladesh and Ceylon [19].

***Murdannia pauciflora* (G. Bruckn.) G. Bruckn.**

Murdannia pauciflora is a prostrate lower node-rooted herb. The leaves are ovate-lance-shaped. Brownish-yellow terminal cymes can be seen. Brownish-yellow, oblong, and pointed petals are present [20].

***Osbeckia muralis* Naudin**

Osbeckia muralis is an erect. Leaves are elliptic to oblong with thick pubescent long hairs on both sides. Flowers are found in terminal cymose clusters. The herb is endemic to Eastern Himalayas and Western Ghats [21].

***Olea dioica* Roxb.**

Olea dioica is native to the Indian subcontinent. The bark is smooth and grey. Leaves are oblong-elliptic with pointed at both ends. They have leathery, hairless with distantly serrated edges. Small, greenish-white flowers may have with reddish hue can be seen. A spherical, purple fruit is present. The plant is commonly found in Southern parts of India and Western Ghats [22].

***Panicum maximum* Jacq.**

Panicum maximum have erect grass with thick clumps. The plant can also grow new roots at the lower nodes of the culms in addition to having frequently short-creeping rhizomes at the base. The plant produces tufts that are as least 30 cm broad and tillers extensively. The plant is most commonly seen in Africa and all tropical parts of the world [23].

***Pothos scandens* L.**

Pothos scandens is an ascending shrub with aerial roots. The leaves are leathery, bright green,

and obovate. The base of the leaf is wedge-shaped or rounded, with a sharp or long-pointed tip. The spadix is yellow and the stipe is deflexed. Spadices can be globose, ovoid, or just barely oblong [24].

4. CONTEMPORARY THERAPEUTIC USES OF MEDICINAL PLANTS

The majority of naturally occurring medicinal plants have their own unique therapeutic properties. People have relied on the local flora for immediate needs since prehistoric times. For the same reason, similar practices have always been transferred to the next generation. Table 4.1. lists a few significant medicinal plants from Kerala's sacred groves along with their vernacular name and medicinal benefits.

Table 2. Medicinal properties of plants from Kerala's sacred groves

Scientific name	Local name	Family	Medicinal use	Reference
Acacia auriculiformis A. Cunn. Ex Benth.	Karuvela	Fabaceae	Seeds are used as a spermicide.	[25]
Aphanamixis polystachya (Wall.) R.N. Parker.	Ponnambazham	Meliaceae	Barks and seeds are used for the treatment of tumors, rheumatism, abdominal diseases etc.	[26]
Bridelia stipularis (L.) Blume.	Kanikottom	Euphorbiaceae	Roots are used for the treatment of urinary disorders, pregnancy associated haemorrhage and bladder stones.	[26]
Citrus aurantifolia (Christm.) Swingle	Vadanaragam	Rutaceae	Roots and leaves are used for the treatment of diarrhoea and low blood pressure.	[25]
Corchorus aestuans L.	Chanachedi	Tiliaceae	Leaves and seeds are extensively used for the treatment of stomach disorders, wound healing, skin rashes, poisoning, etc.	[26, 33]
Derris scandens Aubl.	Ponnamvalli	Fabaceae	Unripe beans enable digestive tract to become loose. Plasma-like leaves work well for erysipelas. Fish poison is made from the plant.	[26]
Evolvulus alsinoides (L.) L.	Vishnukranthi	Convolvulaceae	Whole plant is used for enhancing memory power as well as a blood purifier.	[25]
Elephantopus scaber L.	Anachuvadi	Asteraceae	Leaves, roots and entire plant is used for the treatment of hair fall, heart diseases and gall bladder stones.	[27]

Fimbristylis aestivalis (Retz.) Vahl	Kanappullu	Cyperaceae	Medicinal preparations from the rhizomes have cooling effect. It is also used for the treatment of inflammation.	[26]
Hedyotis corymbosa L.	Parppattakappullu	Rubiaceae	Whole plant is used for the treatment of jaundice and skin diseases.	[27]
Holigarna arnottiana Hook.f.	Cheru	Anacardiaceae	Fruits are used for the treatment of tumors, ulcers, diabetes, leprosy, etc.	[26]
Indoneesiella echioides (L.) Nees	Gopuramthangi	Acanthaceae	The plant is used for the treatment of fungal infections, fever, malaria, etc.	[28]
Ludwigia hyssopifolia (G. Don) Exell	Neergrampu	Onagraceae	Whole plant is used for the treatment of burns, boost strength, promotes delivery in women, etc.	[26]
Murdannia pauciflora (G. Bruckn.) G. Bruckn.	Thaalippullu	Commelinaceae	Whole plant is used for the treatment of skin diseases.	[26]
Osbeckia muralis Naudin	Cherkulathi	Melastomataceae	Flowers are used for the treatment of skin diseases.	[26]
Olea dioica Roxb.	Edana	Oleaceae	Bark and leaves act as an astringent, aphrodisiac and emetic.	[26]
Panicum maximum Jacq.	Ginippullu	Poaceae	Whole plant is used for the treatment of malaria. It also has analgesic activity.	[25]
Pothos scandens L.	Anapparuva	Araceae	Whole plant is used for the treatment of boils, swellings, wounds, vomiting, etc.	[26]

5. PHYTOCHEMICAL PROFILING OF MEDICINAL PLANT

Insight about phytochemical constituents of a plant can provide light into its future pharmacological activities. Studies on the isolation and quantification of phytochemical substances aid in understanding the plant's chemical makeup. The majority of medicinal plants are submitted to phytochemical screening in order to better understand their potential applications. An overview of the phytochemical components of therapeutic plants from Kerala's sacred groves is provided here.

Two significant compounds identified from *Acacia auriculiformis* that satisfy Lipinski's 'Rule of Five' and have strong pharmacological activity are 2-4-Ditert-butylphenol and 3-dihydroxy-damascone [29]. Prominent chemical compounds isolated from the stem bark of *Aphanamixis polystachya* include lignan, polystachyol, and myristicin-eugenol [30]. The phytochemical compounds recovered from hexane,

chloroform and ethyl acetate extracts of *Bridelia stipularis* by GC-MS analysis include 1-dodecanol, oxalic acid, and cyclo-butyl octadecyl ester [31]. Some key pharmacologically relevant phytochemical elements identified from *Citrus aurantifolia* include limonexic acid, isolimonexic acid, and limonin [32]. Some of the phytochemical aspects identified from *Corchorus aestuans* that contribute to its nutritional quality include trypsin, glycosides, carbohydrates, and methyl esters [33]. Betulinic acid, lupeol, scandedin, and scandenin A are some of the most important secondary metabolites identified in *Derris scandens* [49].

Some phytochemicals obtained from ethanolic extracts of *Evolvulus alsinoides* include scopoletin, umbelliferone, ferulic acid esters, and caffeic acid [34]. Some of the biologically active compounds identified by GC-MS analysis from *Elephantopus scaber* include stigmasterol, lupeol, stearic acid, and deoxyelephantopin isomers [35]. *Fimbristylis aestivalis*' principal phytochemical components include quinones, saponins and alkaloids, which contribute to its several established pharmacological properties [36]. Hedyotine and auricularine are two significant chemical compounds extracted from *Hedyotis corymbosa* roots and leaves [37]. Some of the major bio-active compounds determined in the bark of *Holigarna arnottiana* through GC-MS analysis are 1-tetradecene, hexadecenoic acid, and silicone oil [38]. Echioidinin, and skullcapflavone derivatives are just a few of the phytochemical substances derived from *Indoneesiella echioides* that support its liver-protective properties [39]. Vitexin, orientin, isovitexin, and iso-orientin are some of the major phytochemicals extracted from *Ludwigia hyssopifolia* extracts [40]. *Osbeckia muralis*'s preliminary phytochemical contents include flavonoids, tannins, and terpenoids [41]. Through GC-MS analysis, active chemical compounds derived from *Olea dioica* include lupeol tri-fluoroacetate, octadecenoic acid, and hexadecanol [42]. Alkaloids, cardiac glycosides, tannins, saponins are preliminary phytoconstituents from *Panicum maximum* that attest to its anti-inflammatory activity [43]. Syringoyl, luteolin, and apigenin are major phytochemical components extracted from parts of *Pothos scandens* using GC-MS analysis [44].

6. PHARMACOLOGICAL ACTIVITY OF THE MEDICINAL PLANTS

Research on the pharmacological importance of therapeutic plants has repeatedly facilitated pathways for the research and development of important pharmaceuticals. Science focuses an extensive amount of capacity on medicinal plants, and for many years, researchers have been studying about these in an effort to identify chemical compounds that are novel. In order to demonstrate the validity of the traditional treatment used by the locals, a thorough explanation of the significant findings produced from the medicinal plants of Kerala's sacred groves in the domains of pharmacology and phytochemistry is provided here.

The anti-inflammatory property of *Acacia auriculiformis* has been established using membrane stabilization (BSA) and protein denaturation technique using egg albumin. Testes conducted *in vivo* using Brewer's yeast-induced pyrexia model shown that the isolated chemical compound 2-4-ditert-butylphenol had substantial thrombolytic and antipyretic properties [29]. When studied *in vitro*, Acaciaside-B (Ac-B), which was extracted from the seeds of *A. auriculiformis*, showed spermicidal action with complete sperm motility inhibition in under 20 seconds, demonstrating its ethnobotanical significance [46]. CNS depressive, anti-inflammatory, analgesic, hepatoprotective, antioxidant, and antibacterial activity are only a few of the pharmacological effects of *Aphanamixis polystachya* extracts. An *in vivo* investigation using the Freud complete adjuvant induced arthritis model in Sprague Dawley rats determined the anti-inflammatory properties of *Aphanamixis polystachya* extract [47].

Studies using ethanolic crude extracts of *Bridelia stipularis in vivo* and *in silico* on Sprague Dawley rats demonstrated the anti-allergic and neuropharmacological action of it. Following the treatment of the extract, TDI-induced allergies in rats was decreased. Extracts were administered to mice using the open field method, which demonstrated their potential for usage as CNS depressants [48]. *Citrus aurantifolia* fruit extracts indicated that they have antihypertensive/hypotensive properties when given to Sprague Dawley rats and BALB/c mice. The fruit extracts induced an endothelium-independent vasorelaxation that resulted in concentration-dependent decrease of SBP, DBP, MAP, and heart rate [49]. Green synthesized nanoparticles from the extracts of *Corchorus aestuans* has shown excellent antimicrobial activity against gram negative and gram-positive bacteria showing its efficacy to be used as a source of medicine for infectious diseases. *Derris scandens* methanolic extracts have demonstrated antioxidant action. Extracts of the

roots and stems were found to contain two coumarins, four triterpenes, two steroids, and other compounds with anti-dysentery and anti-diarrheal properties [49].

The pharmaceutical benefits of *Evolvulus alsinoides* extracts include anti-stress, anti-amnesic, antioxidant, gastroprotective, and immunomodulator properties. Only a few studies have been done on the ability of *E. alsinoides* extracts to enhance energy [34]. *Elephantopus scaber* extracts have undergone significant research to understand their pharmacological potentials, including their antitumor, anti-inflammatory, antibacterial, antifungal, hepatoprotective, and analgesic effects [35]. *V. parahaemolyticus*, a human virus that causes severe seafood-borne gastroenteritis, may be regulated by using extracts of *Holigarna arnottiana* [53]. An outstanding result was obtained when *Indoneesiella echioides* ethanolic extracts were tested for their capacity to stop CCl_4-induced liver damage in rats, demonstrating their potential for further use in the treatment of injury to the liver [54]. The influence of *Ludwigia hyssopifolia* whole plant extracts in hexane, ethyl acetate, and methanol on carrageenan-induced rat paw edema, acetic acid-induced writhing, and diuresis in mice were explored to obtain an excellent result of anti-inflammatory and diuretic activity [55].

According to the Red Data List, *Murdannia pauciflora* is in the vulnerable category and hasn't been the subject of any pharmaceutical research so far [56]. *Olea dioica* extracts' aphrodisiac effects were investigated in Wistar albino rats utilizing measures such anogenital sniffing, genital grooming, mount frequency, mount latency, intromission frequency, and intromission latency [57]. Significant dose-dependent reduction was observed in albino mice and rats during the anti-inflammatory and antipyretic activities of *Panicum maximum* extracts, showing their potential for use in therapeutics [58]. *P. scandens* inclines towards wound healing, as evidenced by the fact that *P. scandens* extract treated animals epithelized in 22 days while the solvent control and untreated rats epithelized in 35 and 40 days, respectively, showing a significant wound healing property [59].

7. CONCLUSION

The "Kavu" or sacred groves, of Kerala serve as living examples of the complex interactions between environment, culture, and medicine. These preserves have cultivated an abundant supply of medicinal plants with important pharmacological properties through many centuries, providing conventional treatments for a variety of human diseases. A wide variety of plant species, each with its own distinct therapeutic capabilities, have been conserved owing to the traditional knowledge of the local inhabitants. Generations have found hope and healing in these sacred groves, which have protected treatments for infectious diseases, metabolic problems, and chronic illnesses. This study has shown that the majority of plant species collected from sacred groves have their own phytochemical and pharmacological significance, which can be further developed and used to produce medications with a high market value. The preservation of these sacred gardens is a moral and scientific necessity since the synthesis of conventional wisdom and modern science can open up new pharmacological and medical research directions.

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