International Journal of Botany Studies
www.botanyjournals.com
E-ISSN: 2455-541X
Received: 15-09-2026, Accepted: 15-10-2026, Published: 30-10-2026
Volume 11, Issue 4, 2026, Page No. 86-90

Alsophila nilgirensis (Holttum) R.M. Tryon: An overview of its ethnomedicinal significance, phytochemical profile, pharmacological potential, and conservation

Sahaya Mary[1*], Kavitha RS[2], Asha D R[1]
[1] Department of Botany, Teresian College, Mysuru, Karnataka, India
[2] Department of Zoology, Teresian College, Mysuru, Karnataka, India
Corresponding Author: Sahaya Mary
DOI: https://doi.org/10.66856/ijbs.2026.11.4.11255

Abstract
Alsophila nilgirensis (Holttum) R.M. Tryon, formerly known as *Cyathea nilgirensis* Holttum, is an endemic tree fern of the Western Ghats of southern India with reported ethnomedicinal significance and emerging pharmacological potential. Traditionally, the plant has been used in indigenous healthcare practices, particularly in the management of diabetes. This review consolidates the available literature on its ethnomedicinal applications, phytochemical constituents, pharmacological properties, and conservation concerns. Particular attention is given to the reported presence of phenolic compounds, flavonoids, and tannins, as well as the application of chromatographic techniques, including high-performance thin-layer chromatography (HPTLC), for phytochemical profiling. Preliminary pharmacological investigations, particularly studies involving antidiabetic, antioxidant, and antimicrobial activities, indicate that the species merits further scientific investigation. However, the existing evidence remains limited, and the biological activities of crude extracts cannot be attributed to individual phytochemicals without further experimental validation. The species' conservation status also highlights the need to integrate biodiversity conservation with responsible bioprospecting. Future research should focus on comprehensive phytochemical characterization, isolation and structural elucidation of bioactive compounds, mechanistic investigations, toxicity assessment, and rigorous validation of traditional medicinal claims through standardized experimental studies. Sustainable cultivation and conservation strategies are equally important to safeguard this threatened tree fern. This review identifies the current knowledge gaps and emphasizes the potential of *A. nilgirensis* as a subject for future research in ethnobotany, natural-product chemistry, and pharmacology.

Keywords: Ethnomedicine, phytochemical profiling, antidiabetic activity, antioxidant activity, antimicrobial activity, tree fern, conservation

Introduction

Pteridophytes constitute an important component of terrestrial plant diversity and are particularly abundant in humid tropical and subtropical environments. Although ferns have received comparatively less pharmacological attention than angiosperms, several species have long been used in traditional medicine to manage various ailments. Ethnobotanical investigations have documented the medicinal applications of ferns and fern allies among indigenous communities, providing a valuable foundation for further phytochemical and pharmacological research (Sathiyaraj *et al*., 2015 [8]; Singh *et al*., 2018).

Tree ferns belonging to the family Cyatheaceae are notable for their distinctive morphology and ecological importance in humid forest ecosystems. Their distribution is often associated with environmental conditions such as high humidity, adequate soil moisture and relatively undisturbed habitats. These ecological requirements make some tree fern species particularly vulnerable to habitat modification. Phytochemical investigations of members of Cyatheaceae have also reported phenolic compounds, flavonoids and tannin-related constituents, highlighting the potential value of this group for further chemical and pharmacological research (Narayanan & Marimuthu alias Antonysamy, 2016) [4]. *Alsophila nilgirensis* (Holttum) R.M. Tryon is a tree fern belonging to the family Cyatheaceae and is endemic to southern India. Originally described as *Cyathea nilgirensis* Holttum, the species continues to be discussed under this earlier name in several ethnobotanical and pharmacological publications. The currently accepted name is *Alsophila nilgirensis* (Holttum) R.M. Tryon, while *Cyathea nilgirensis* Holttum is treated as a synonym in taxonomic databases (Royal Botanic Gardens, Kew, 2026). The species is associated with moist, shaded forest habitats in the Western Ghats, including stream-side environments (Dudani *et al*., 2014) [2].

Floristic records document the occurrence of *A. nilgirensis* in several localities of the Western Ghats, including Chikkamagaluru, Kodagu, Uttara Kannada and Hassan districts of Karnataka, as well as Idukki in Kerala and the Palani Hills of Tamil Nadu (Sankara Rao *et al*., 2019) [7]. The species has also been recorded in the Kathalekan sacred forests of Uttara Kannada, highlighting the importance of these forest habitats for the conservation of tree fern diversity (Dudani *et al*., 2014) [2]. Its association with humid forest environments emphasizes the need to protect suitable habitats and maintain the ecological conditions required for its persistence. The conservation status of *A. nilgirensis* is a major consideration in evaluating its medicinal potential. While earlier Indian floristic resources reported the species as Near Threatened (Sankara Rao *et al*., 2019) [7], a global assessment published in 2025 classified it as Critically Endangered under criteria C1+2a(i) (Benniamin *et al*., 2025) [1]. The assessment identifies the species as endemic to the Western Ghats, occurring in evergreen forest habitats at elevations of approximately 800–2,000 m. It also reports a

small, fragmented population and a continuing decline, with habitat modification associated with activities such as plantation establishment and road expansion identified among the potential threats (Benniamin *et al*., 2025) [1].

The ethnomedicinal significance of *A. nilgirensis* is particularly evident in its traditional association with diabetes management. An ethnobotanical survey of tribal communities in the Palani Hills documented *C. nilgirensis* as a medicinal fern used for diabetes, with the rhizome recorded as the plant part used (Sathiyaraj *et al*., 2015) [8]. A review of the medicinal applications of pteridophytes also discussed the traditional use of the species for diabetes (Singh *et al*., 2018). In addition, an ethnomedicinal study from the Kolli Hills of the Eastern Ghats reported the oral administration of a rhizome decoction of *C. nilgirensis* for diabetes management (Sathiyaraj *et al*., 2014). Collectively, these records establish an ethnobotanical basis for investigating the potential antidiabetic properties of the species, although traditional use alone does not demonstrate therapeutic efficacy.

Interest in the species has extended to experimental pharmacology. Elavarasi *et al*. (2020) investigated the antidiabetic and antihyperlipidemic effects of an ethanolic extract of *C. nilgirensis* pith in streptozotocin-induced diabetic rats and reported improvements in blood glucose, glycated haemoglobin, insulin and lipid parameters. These findings provide preliminary preclinical evidence warranting further investigation. However, results from experimental animal models cannot be directly extrapolated to humans, and the compounds responsible for the reported effects remain to be established. The conservation status of *A. nilgirensis* also raises important scientific and ethical considerations for medicinal-plant research. Destructive harvesting of rhizomes or whole plants could place additional pressure on vulnerable natural populations. Future investigations should therefore incorporate conservation-oriented approaches, including minimally destructive sampling, chemical fingerprinting using limited quantities of authenticated material, ex situ conservation and appropriate propagation methods. Sustainable cultivation and other conservation-compatible strategies may help support future research while reducing dependence on wild populations. Such precautions are particularly relevant because the development of pharmacological or commercial interest in a threatened species could increase pressure on its natural populations (Benniamin *et al*., 2025) [1].

In view of its documented ethnomedicinal importance, preliminary phytochemical evidence, reported preclinical antidiabetic activity and conservation significance, *A. nilgirensis* warrants further investigation through an integrated approach combining ethnobotany, phytochemistry, pharmacology and conservation biology. The present review synthesizes the available literature on the ethnomedicinal uses, phytochemical composition and reported pharmacological potential of *A. nilgirensis*. It also evaluates the limitations of the existing evidence and identifies research priorities for elucidating its medicinal potential while ensuring that future investigations remain compatible with the conservation requirements of this threatened Western Ghats tree fern.

Ethnomedicinal Uses

Alsophila nilgirensis (Holttum) R.M. Tryon, previously reported as *Cyathea nilgirensis* Holttum, has been documented as a medicinal pteridophyte in the traditional healthcare practices of southern India. Pteridophytes have historically been used by indigenous communities for various ailments, although their ethnomedicinal and pharmacological potential remains comparatively underexplored relative to that of medicinal angiosperms.

In an ethnomedicinal survey of the Palani Hills in the Western Ghats, Sathiyaraj *et al*. (2015) [8] documented 50 species of ferns and fern allies belonging to 35 genera and 19 families that were traditionally used by tribal communities. The survey recorded medicinal species, plant parts used, ailments treated and methods of preparation, providing valuable information on the traditional therapeutic significance of pteridophytes in the region. Among the species documented, *C. nilgirensis* was associated with the traditional management of diabetes, particularly through the use of its rhizome (Sathiyaraj *et al*., 2015) [8]. Other ethnomedicinal accounts have associated the plant, particularly its pith, with applications against snakebite and the traditional treatment of throat infections. These additional uses should be included in the final manuscript only after their original sources have been verified. The traditional use of *C. nilgirensis* for diabetes provides an ethnobotanical basis for investigating its potential antidiabetic properties. However, traditional knowledge alone does not establish therapeutic efficacy or safety. Experimental pharmacological evidence relating to diabetes is discussed in the section on Antidiabetic Potential.

Phytochemical Profile

The phytochemical composition of *Alsophila nilgirensis* remains incompletely characterized. Nevertheless, available chromatographic and preliminary phytochemical investigations indicate the presence of several classes of metabolites, including phenolics, flavonoids, tannin-related constituents and alkaloids. Earlier studies investigated the species under the name *Cyathea nilgirensis* Holttum; these findings are therefore relevant to the phytochemical assessment of the currently accepted species, *A. nilgirensis*. Narayanan and Marimuthu (2016) [4] investigated three *Cyathea* species from the Western Ghats, *C. nilgirensis*, *C. gigantea* and *C. crinite* using high-performance thin-layer chromatography (HPTLC), with particular emphasis on phenolic compounds, flavonoids and tannins. Their study provided preliminary chromatographic fingerprints for characterizing the chemical constituents of the species examined.

1. Phenolic Compounds

HPTLC analysis of the ethanolic extract of *C. nilgirensis* identified a band at a retention factor (Rf) of approximately 0.75 as quercetin. Its concentration was reported to be approximately 0.19% in the investigated extract, and its identity was further supported by high-performance liquid chromatography (HPLC) analysis (Narayanan & Marimuthu, 2016) [4].

Catechin was also reported, with an HPTLC band at approximately Rf 0.28 assigned to this compound. Additional bands, including one at approximately Rf 0.80, indicated the presence of other phenolic constituents that were not individually identified. These findings suggest that the phenolic profile of the investigated material extends beyond the two identified compounds, although the identities and concentrations of the remaining constituents

require further investigation. Quercetin and catechin are widely studied plant phenolics with reported biological activities in the broader phytochemical literature. However, their detection in *C. nilgirensis* does not, by itself, demonstrate that the plant exhibits particular pharmacological effects. Such effects must be established through experiments using authenticated plant material and appropriately characterized extracts or isolated compounds.

2. Flavonoids

Flavonoids were reported in *C. nilgirensis* through chromatographic investigation and preliminary phytochemical screening. The HPTLC study detected flavonoid-associated bands at Rf values of approximately 0.05, 0.23, 0.30, 0.43 and 0.73 across the *Cyathea* species investigated (Narayanan & Marimuthu, 2016) [4]. These chromatographic bands indicate the presence of multiple flavonoid-associated constituents; however, the individual compounds represented by most of the bands were not identified. The reported values should therefore be interpreted as part of the chromatographic profile of the investigated species rather than as definitive identification of individual flavonoids. Further separation, isolation and structural characterization are needed to establish the identities of these compounds and determine their potential biological significance.

3. Tannins

Tannin-related bands were observed at Rf values of approximately 0.05, 0.09 and 0.82 in the *Cyathea* species examined by Narayanan and Marimuthu (2016) [4]. These findings provide preliminary chromatographic evidence for tannin-related constituents in the investigated material. However, the individual tannins and their concentrations have not been comprehensively established. Tannins are polyphenolic compounds that have been investigated for several biological activities, including antioxidant and antimicrobial effects. Nevertheless, the presence of tannin-related bands in *A. nilgirensis* should not be regarded as direct evidence of those activities in the plant. Further chemical characterization and biological evaluation are required.

4. Other Phytochemicals

Preliminary phytochemical screening by Sahaya Mary and Mahesh (2015) [5] reported carbohydrates, alkaloids and flavonoids in extracts of *C. nilgirensis*. The study also reported antibacterial and antifungal activity in the investigated extracts. These findings provide additional preliminary evidence of the chemical and biological properties of the species.

5. HPTLC Fingerprinting and Quality Control

The HPTLC findings provide a preliminary chemical fingerprint of the investigated *Cyathea* material. Chromatographic fingerprinting may support comparative studies, preliminary species characterization and the assessment of chemical consistency between samples. Quantitative estimation and quality-control applications, however, require validated analytical procedures and appropriately authenticated reference material. Because the 2016 investigation included three *Cyathea* species, the species-specific attribution of individual bands should be checked against the original chromatograms and results. This is particularly important when the fingerprints are used to distinguish *A. nilgirensis* from related species or to establish a reference profile for future studies.

Summary of Phytochemicals Reported in *A. nilgirensis*

Phytochemical class or compound	Evidence reported	Findings and limitations
Phenolic compounds	HPTLC	Several bands were detected; most individual constituents remain unidentified.
Quercetin	HPTLC and HPLC	Identified in the investigated ethanolic extract; approximately 0.19% was reported.
Catechin	HPTLC	A band at approximately Rf 0.28 was assigned to catechin.
Flavonoids	HPTLC and preliminary screening	Flavonoids were reported; most chromatographic bands were not individually identified.
Tannin-related constituents	HPTLC	Bands were reported across the *Cyathea* species investigated; species-specific attribution requires verification.
Alkaloids	Preliminary phytochemical screening	Presence reported; individual compounds and concentrations remain uncharacterized.
Carbohydrates	Preliminary phytochemical screening	Presence reported; detailed characterization was not provided in the information available.

6. Factors Affecting Phytochemical Variation

The phytochemical profile reported by Narayanan and Marimuthu (2016) [4] was based on material collected from a particular natural population near Kakkachi stream in the Tirunelveli Hills, at approximately 1,725 m elevation, according to the information provided in the study summary. Consequently, the observed chemical profile may not fully represent the variation occurring across the geographical range of *A. nilgirensis*. Phytochemical composition can vary with geographical location, altitude, soil characteristics, temperature, rainfall, moisture availability, season, plant age, developmental stage and the plant part examined. These environmental and physiological factors may influence the qualitative and quantitative accumulation of secondary metabolites. Comparative investigations involving authenticated populations from different parts of the Western Ghats would help determine whether the reported chemical constituents are consistently present across the species or whether their occurrence and abundance vary between populations. Such studies would also support the development of a more representative phytochemical reference profile.

Pharmacological Potential

1. Antidiabetic Potential

The traditional association of *Cyathea nilgirensis* with diabetes management among tribal communities of the Palani Hills was documented by Sathiyaraj *et al*. (2015) [8].

The rhizome was recorded as the medicinal plant part associated with this use, providing an ethnobotanical basis for further investigation. Experimental evidence was subsequently reported by Elavarasi *et al*. (2020), who investigated the antidiabetic and antihyperlipidemic effects of an ethanolic extract of *C. nilgirensis* pith in streptozotocin-induced diabetic rats. According to the information provided, the animals received the extract at 200 mg/kg body weight for 48 days. Treatment was reported to improve elevated blood glucose and HbA1c levels and increase serum insulin levels. Improvements in lipid parameters were also reported, including reductions in total cholesterol, triglycerides, LDL and VLDL, together with an increase in HDL (Elavarasi *et al*., 2020).

These findings provide preclinical evidence supporting further investigation of the traditional antidiabetic use of the species. However, results obtained using an experimental diabetic rat model cannot establish efficacy or safety in humans. The findings should also be interpreted in the context of the experimental design, sample size, control groups, statistical analyses and limitations reported in the original publication. The phytochemical findings of Narayanan and Marimuthu (2016) [4], including the identification of quercetin and catechin, provide a basis for investigating the chemical constituents of the species. Nevertheless, the available evidence does not establish that either compound is responsible for the antidiabetic effects reported in the animal model. Bioassay-guided fractionation, compound characterization and mechanistic investigations would be required to examine this possibility.

2. Antioxidant Potential

The detection of quercetin, catechin and additional phenolic constituents in *C. nilgirensis* provides a rationale for investigating its antioxidant potential (Narayanan & Marimuthu, 2016) [4]. However, the presence of compounds associated with antioxidant activity in other plants does not establish the antioxidant efficacy of the whole extract or species. Direct experimental evaluation is therefore necessary. Future investigations could combine chemical assays, such as DPPH radical-scavenging activity, ABTS radical-cation scavenging activity and ferric-reducing antioxidant power (FRAP), with suitable biological assays where appropriate. Lipid-peroxidation and metal-chelating assays may also be considered according to the research objectives. Results should be interpreted in relation to extract concentration, solvent system, positive controls, assay limitations and the chemical composition of the tested material. Such studies would help determine whether the extracts possess measurable antioxidant activity and whether this activity can be associated with particular constituents.

3. Antimicrobial Activity

The antimicrobial potential of *Cyathea nilgirensis*, currently accepted as *Alsophila nilgirensis* (Holttum) R.M. Tryon, has been investigated using different plant extracts and fractions. Sahaya Mary and Mahesh (2015) [5] reported antibacterial and antifungal activities in plant extracts, while Sahaya Mary (2016) [6] demonstrated antimicrobial activity in the *n*-hexane fraction against selected bacterial and fungal pathogens. The latter study also reported the preliminary characterisation of a potentially bioactive compound, although its chemical identity remained to be established. These findings suggest that *A. nilgirensis* may contain compounds with antimicrobial potential. However, further studies are necessary to identify the active constituents, establish their mechanisms of action, and validate their efficacy and safety.

4. Anti-inflammatory Activity

The anti-inflammatory potential of *Cyathea nilgirensis*, currently accepted as *Alsophila nilgirensis* (Holttum) R.M. Tryon, has been investigated using different plant extracts and fractions. Sahaya Mary *et al*. (2015) [5] reported anti-inflammatory activity in chloroform and ethanol extracts, while Sahaya Mary (2016) [6] observed a reduction in carrageenan-induced paw oedema following treatment with the *n*-hexane fraction. These studies provide preliminary evidence of the anti-inflammatory potential of *A. nilgirensis*. However, further research is required to identify the active compounds, elucidate their mechanisms of action, and establish their safety and pharmacological efficacy

Conservation and Future Research Directions

The conservation status of *Alsophila nilgirensis* is an important consideration in planning future phytochemical and pharmacological research. The draft identifies the species as Critically Endangered and cites Benniamin *et al*. (2025) [1]. Authenticated ex situ material, sustainable cultivation, spore propagation and tissue-culture approaches may provide alternatives for obtaining plant material, provided that the methods are appropriate for the species and are supported by relevant evidence. Establishing standardized material from cultivated sources could also improve the reproducibility of future phytochemical studies. Such an approach would allow researchers to compare metabolite profiles under more controlled conditions while reducing dependence on wild populations.

Future phytochemical investigations should focus on more comprehensive chemical characterization using appropriate analytical methods, potentially including HPLC-DAD, LC-MS/MS and NMR spectroscopy. GC-MS may be useful for suitable volatile or derivatized constituents but should not be treated as a substitute for methods appropriate to non-volatile phenolics. Metabolomic approaches may also assist in comparing chemical variation between populations. Bioassay-guided fractionation could help determine whether particular constituents are associated with the reported biological activities. In addition, validated pharmacological assays, toxicity evaluation, dose-response studies and mechanistic investigations would be needed to assess the biological significance and safety of promising extracts or isolated compounds. Integrating ethnobotany, phytochemistry, pharmacology and conservation biology would provide a more rigorous and sustainable framework for investigating the medicinal potential of this threatened tree fern.

Pharmacological Significance and Research Gaps

The available literature provides preliminary but relevant evidence of the medicinal and phytochemical significance of *Alsophila nilgirensis*. Ethnomedicinal documentation has associated the species with traditional diabetes management (Sathiyaraj *et al*., 2015) [8], while experimental research has reported antidiabetic and antihyperlipidemic effects of an ethanolic pith extract in streptozotocin-induced diabetic rats (Elavarasi *et al*., 2020). Phytochemical investigations have

also reported quercetin, catechin and additional phenolic, flavonoid and tannin-related constituents, together with other metabolite classes identified through preliminary screening (Narayanan & Marimuthu, 2016; Sahaya Mary & Mahesh, 2015) [4, 5].

Despite these findings, important gaps remain. The chemical identities and concentrations of many chromatographic constituents have not been established, the contribution of individual compounds to reported pharmacological effects remains unclear, and the available evidence does not establish clinical efficacy or safety in humans. Antioxidant, antimicrobial and other biological activities also require careful evaluation using appropriate experimental methods and clearly characterized material. The reported Critically Endangered status of the species further emphasizes the need to integrate conservation with future research. Sustainable cultivation, authenticated ex situ material and suitable propagation methods could support more reproducible investigations while reducing pressure on wild populations.

Overall, *A. nilgirensis* warrants further study as a medicinal pteridophyte with documented ethnobotanical relevance and preliminary phytochemical and preclinical evidence. Progress will depend on rigorous chemical characterization, reproducible pharmacological investigations, cautious interpretation of experimental findings and research strategies that respect the conservation requirements of the species.

References

1. Benniamin A, Pandey S, Mondal R. Alsophila nilgirensis. The IUCN Red List of Threatened Species, 2025.
2. Dudani SN, Mahesh MK, Subash Chandran MD, Ramachandra TV. Cyathea nilgirensis Holttum (Cyatheaceae: Pteridophyta): A threatened tree fern from central Western Ghats, India. Journal of Threatened Taxa,2014:6(1):5413–5416. https://doi.org/10.11609/JoTT.o3343.5413-5416
3. Elavarasi S, Revathi G, Saravanan K, Averal HI. Antidiabetic and antihyperlipidemic activities of Cyathea nilgiriensis (Holttum) on STZ-induced diabetic rats. Drug Development for Cancer and Diabetes: A Path to 2030,2020:233–248. https://doi.org/10.1201/9780429330490-20
4. Narayanan J, Marimuthu alias Antonysamy J. HPTLC fingerprint profile (phenolics) of selected Cyathea species from Western Ghats, South India. Chinese Journal of Biology,2016:2016:6420371. https://doi.org/10.1155/2016/6420371
5. Sahaya Mary, Mahesh MK. Determination of antibacterial and antifungal activities of endemic tree fern Cyathea nilgirensis plant extract. International Journal of Current Research,2015:7(7):18276–18279.
6. Sahaya Mary R. Evaluation of antimicrobial and anti-inflammatory activities of n-hexane fraction of Cyathea nilgirensis Holttum. International Journal of Pharma and Bio Sciences,2016:7(3):B:748–755.
7. Sankara Rao K, Swamy RK, Kumar D, Singh AR, Bhat KG. Cyathea nilgirensis Holttum. Flora of Peninsular India, 2019. http://peninsula.ces.iisc.ac.in/plants.php?name=Cyathea%20nilgirensis
8. Sathiyaraj G, Muthukumar T, Ravindran KC. Ethnomedicinal importance of fern and fern allies traditionally used by tribal people of Palani Hills (Kodaikanal), Western Ghats, South India. Journal of Medicinal Herbs and Ethnomedicine,2015:1(1):4–9. https://doi.org/10.5455/jmhe.2015-07-08
9. Sureshkumar J, Silambarasan R, Bharati KA, Krupa J, Amalraj S, Ayyanar M. A review on ethnomedicinally important pteridophytes of India. Journal of Ethnopharmacology,2018:219:269–287. https://doi.org/10.1016/j.jep.2018.03.024