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Therapeutic Uses of Barleria Acuminata: A review

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Abstract

Medicinal plants continue to play a crucial role in the discovery of safer and cost-effective therapeutic agents. Barleria acuminata, a member of the Acanthaceae family, is traditionally used in various systems of medicine for the management of inflammatory disorders, infections, and neurological conditions. The growing interest in plant-based therapeutics has led to increasing scientific investigations focusing on the pharmacological potential of this species. This review summarizes the available literature on the phytochemical composition and therapeutic activities of Barleria acuminata. Phytochemical studies reveal that the plant contains a wide range of bioactive constituents such as flavonoids, alkaloids, phenolic compounds, glycosides, terpenoids, and tannins. These compounds are known to contribute to its diverse biological properties. Experimental research demonstrates that extracts of Barleria acuminata possess significant anti-inflammatory, antioxidant, antimicrobial, and analgesic activities. The antioxidant potential is primarily attributed to its phenolic and flavonoid content, which helps neutralize free radicals and reduce oxidative stress, a major contributor to chronic diseases.

Furthermore, preliminary investigations indicate promising neuroprotective and anticonvulsant effects, suggesting potential usefulness in the management of central nervous system disorders. The plant has also shown hepatoprotective and antidiabetic activities in experimental models, supporting its traditional use in metabolic and liver-related ailments. Despite these encouraging findings, most studies remain limited to in-vitro and animal models, highlighting the need for well-designed clinical trials to confirm safety and efficacy in humans.

In conclusion, Barleria acuminata represents a valuable medicinal plant with multifaceted therapeutic potential. Future research focusing on standardization, toxicity evaluation, and clinical validation may help transform this traditional remedy into evidence-based herbal formulations.

Keywords:- Barleria acuminata, Acanthaceae, Hepatoprotective, Wound-healing, Nutraceuticals, Nanoformulation etc.

Introduction

Barleria acuminata Nees (local name *Vellaikurunji*) is an erect shrub (up to 3 m tall) native to peninsular India. The whole plant (leaves, stem, roots) has a rich history in Tamil folk medicine. Ethnobotanical surveys report that *B. acuminata* is used as an **antiseptic** and to treat **fever, respiratory ailments, toothache and rheumatic pains.** For example, the Irula tribe of Tamil Nadu uses an infusion of the whole plant for antiseptic purposes and for fever, cough, and joint pain. It has also been cited in traditional medicine against **anemia, asthma, bronchitis, and diabetes.** These uses

align with *B. acuminata*'s reputed roles as an antipyretic, antitussive, anti-asthmatic and general tonic in the region's herbal pharmacopeia. **[1,2]**

- ***Antiseptic, Antipyretic and Respiratory Uses:*** The whole plant is brewed as an infusion for infections, fever, cough and asthma.[3]
- ***Analgesic and Anti-inflammatory Uses:*** Preparations are applied for toothache and joint pain "tooth ache and joint pain" and as a general anti-inflammatory.[3]
- ***Digestive and Metabolic Uses:*** It is reported used for anemia and as an ant diabetic tonic though these uses lack direct experimental validation.[4]

Figure: Plant of Barleria Acuminata

These traditional applications suggest *B. acuminata* contains bioactive constituents with broad pharmacological effects.

Phytochemistry and Bioactive Constituents

Preliminary photochemical screening of *B. acuminata* extracts has revealed a complex profile of secondary metabolites. Leaves and other parts test **positive for alkaloids, flavonoids, tannins, steroids, phenols, terpenoids and saponins.[5]**

These classes are known to contribute antimicrobial, antioxidant and anti-inflammatory activities in many medicinal plants. Detailed analyses by gas chromatography–mass spectrometry (GC–MS) have identified specific compounds in each plant part Key constituents include:

- ✓ **Alpha-linolenic acid (9,12,15-octadecatrienoic acid):** The major compound in leaf extracts (≈34% of GC–MS peak area) This omega-3 fatty acid has known anti-inflammatory and cardioprotective effects.[6]

✓ **Sterols:** The leaf and stem extracts contain high levels of phytosterols – notably **β-sitosterol** (~19.3% in leaves) and **stigmasterol** (~9.8% in leaves). These sterols have documented antimicrobial, anti-inflammatory, hepatoprotective and analgesic properties. **Campesterol** (3.5% in leaves; 0.28% in stems) and **friedelan-3-one** (a pentacyclic triterpene in stems) are also present.[7]

✓ **Tocopherols:** α-Tocopherol (vitamin E) is detected (~4.4% in leaves, contributing potent antioxidant activity.[7]

✓ **Fatty acids and esters:** *B. acuminata* is rich in saturated and unsaturated fatty acids (e.g. hexadecanoic acid, linoleic acid esters) identified in GC–MS profiling. Some of these have anti-inflammatory and skin-healing effects.[8]

✓ **Other phenolics:** Minor components include catechol, benzofuran derivatives (e.g. 4, 7-dimethylbenzofuran), and various alkylamine derivatives. These are known antioxidant and antimicrobial agents.[8,9]

Phytochemical constituents	Petroleum ether	Chloroform	Ethyl acetate	Ethanol	Aqueous
Alkaloid	_	+	+	+	+
Flavonoid	_	+	+	+	_
Phenol	+	_	_	++	_
Tannin	_	++	_	+++	+
Glycoside	+	+	++	+	-
Saponin	_	_	+	+	+
Resin	+	++	_	++	_
Steroids	_	+	++	_	+
Terpenoids	_	_	+	++	_
Cardiac glycosides	+	+++	++	+++	++
Triterpenoids	+	_	_	+	_
Reducing sugar	_	+	+	++	+

(+) → Present (-) → Absent

Taken together, *B. acuminata* extracts contain multiple bioactives (ω-3 fatty acids, sterols, flavonoids and phenolics) that plausibly underlie its therapeutic effects. [7]

Pharmacological Activities

Several in vitro pharmacological studies have begun to validate *B. acuminata*'s traditional uses. In particular, **antimicrobial** efficacy has been documented, while other activities remain to be fully explored.

Antimicrobial Activity

Multiple studies report that *B. acuminata* extracts inhibit bacterial and fungal pathogens. In agar-diffusion assays, ethanol extracts of leaves, stems and roots showed dose-dependent inhibition of **Gram-positive** and **Gram-negative** bacteria as well as fungi.

Notably, leaf ethanol extract produced a **28 mm zone of inhibition against *Staphylococcus aureus*** (Gram+) and an 8 mm zone against *Klebsiella aerogenes* (Gram–). Fungal pathogens (*Candida albicans*, *Aspergillus flavus*) were also inhibited (zones ≈20–28 mm). [10]

These levels of activity were comparable to some standard antibiotics. The antimicrobial effects are attributed to the extract's alkaloids, phenolic and other actives. In summary, *B. acuminata* leaf and stem extracts exhibit broad-spectrum bactericidal and fungicidal effects, supporting its traditional use against infections. [2, 4]

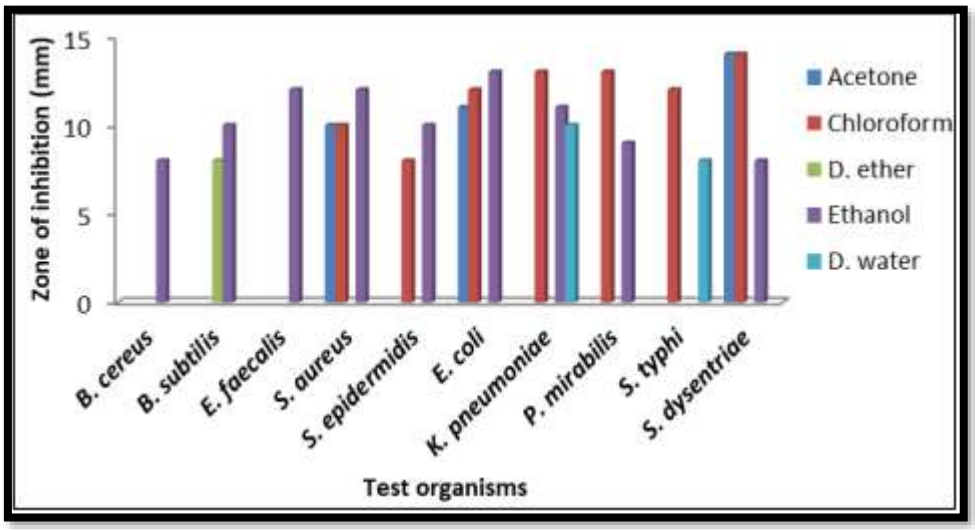

Figure: Antimicrobial activity of B. acuminata leaf extracts

Experimental studies have demonstrated that extracts of Barleria acuminata exhibit significant antimicrobial activity against a range of Gram-positive and Gram-negative bacteria, as well as pathogenic fungi. Ethanolic extracts, particularly from the leaves, have shown strong inhibitory effects against Staphylococcus aureus, Escherichia coli, Klebsiella species, and Candida albicans. These findings support the traditional use of the plant as an antiseptic and for treating infectious conditions.

Anti-inflammatory and Analgesic Potential

Specific anti-inflammatory or analgesic assays on *B. acuminata* have not been published. However, it's Phytochemistry and uses imply such effects. The plant's traditional use for **fever and pain (toothache, joint pain)** suggests anti-inflammatory/analgesic activity. Biochemically, the high content of **α-linolenic acid** (an omega-3 fatty acid) and **β-sitosterol** (phytosterol) in the leaves provides a mechanistic basis: both are known to inhibit pro-inflammatory mediators and modulate pain pathways. [11]

For example, β-sitosterol has documented **anti-inflammatory, analgesic and hepatoprotective** effects. Similarly, catechol and flavonoids (present in extracts) are general COX/enzyme inhibitors.

Thus, while direct in vivo data are lacking, the combination of phytochemicals and folk indications strongly suggest *B. acuminata* has anti-inflammatory and pain-relieving properties worthy of future study.

Antioxidant Capacity

Although no targeted antioxidant assay on *B. acuminata* is reported, its extract composition implies substantial radical-scavenging potential. Qualitative tests show *B. acuminata* contains flavonoids, phenolics and tannins. GC–MS has identified **catechol**, **α-tocopherol (vitamin E)** and various phenolic esters in the leaves. These are potent antioxidants. In related Barleria species, strong DPPH/FRAP antioxidant activity correlates with similar phytochemicals. Therefore, it is reasonable to infer that *B. acuminata* extracts neutralize free radicals and reduce oxidative stress (which may underpin some of its anti-inflammatory and hepatoprotective effects). Direct antioxidant assays (DPPH, ABTS, etc.) on *B. acuminata* remain to be done.[7,8]

Hepatoprotective Actions

No in vivo liver-protection studies of *B. acuminata* were found. However, several extract constituents are individually hepatoprotective. As noted, **β-sitosterol and stigmasterol** (abundant in leaves and stems) are reported to protect the liver from toxins. Likewise, triterpenoids like **friedelan-3-one** (identified in stems) belong to a class known for liver-healing effects. Traditional use against **jaundice and spleen ailments** (reported for other Acanthaceae members) hints at possible activity. Taken together, the phytosterols and terpenes in *B. acuminata* suggest it may support liver function, although formal hepatoprotective assays (e.g. CCl_4-induced liver injury models) are needed to confirm this.[12]

Wound Healing and Tissue Repair

Ethnobotanically, *B. acuminata* is often applied as an antiseptic and for sores on mucous membranes. These uses imply wound-healing potential. Some *Barleria* species (e.g. *B. prionitis*, *B. lupulina*) have shown wound-contracting and skin-repair properties, likely due to enhanced collagen synthesis by phytosterols. By analogy, *B. acuminata* extracts (rich in fatty acids, sterols and tannins) may promote tissue repair and prevent infection. However, no direct wound-healing studies on *B. acuminata* have been published, so this remains speculative and warrants investigation.[13]

Other Pharmacological Effects

Traditional medicine attributes **antidiabetic** benefits to *B. acuminata* (used for "diabetes"), but no in vitro or animal studies on its glucose-lowering effects were found. Likewise, potential **antioxidant, immunomodulatory, or anticancer** activities have not been explored for this species, though related Barleria contain cytotoxic and anti-inflammatory compounds. In general, the demonstrated antimicrobial, anti-inflammatory and antioxidant constituent profile of *B. acuminata* suggests it could have multiple therapeutic effects, but evidence beyond folklore is still emerging.[14]

Novel Perspectives and Emerging Research Areas

The complex phytochemical makeup of *Barleria acuminata* makes it well suited for modern multi-target and systems-level investigations. Network pharmacology, which embraces the polypharmacological nature of plant extracts, has emerged as a powerful approach for decoding the complex bioactivities of natural product. In this framework, the dozens of compounds in *B. acuminata* (fatty acids, terpenoids, flavonoids, phenols, and sterols) can be mapped to biological pathways to identify synergistic mechanisms. For example, GC–MS profiling found that the leaves of *B. acuminata* are rich in α-linolenic acid (an omega-3 fatty acid) and contain significant amounts of β-sitosterol and stigmasterol. These diverse bioactives may simultaneously modulate multiple targets, fitting the systems-pharmacology paradigm where whole-plant extracts achieve therapeutic effects via networked interactions.

An important emerging application is using *B. acuminata* compounds to combat antimicrobial resistance. Several phytosterols and terpenes from medicinal plants act as antibiotic adjuvants. In Barleria, for example, the plant sterol stigmasterol markedly potentiated the effect of ampicillin against β-lactamase–producing bacteria. In the cited study, combining stigmasterol with ampicillin reduced bacterial colony counts by >98%, suggesting true synergism. Since *B. acuminata* extracts contain stigmasterol and β-sitosterol, they could similarly enhance conventional antibiotics or overcome resistance mechanisms. This adjuvant strategy is an exciting avenue for future research in *B. acuminata* phytochemistry.

Another frontier is green nanotechnology using *Barleria* extracts. Plant phenolics and terpenoids readily reduce metal ions and cap the resulting nanoparticle. Indeed, *Barleria* extracts have been used to synthesize silver nanoparticles (AgNPs). For instance, methanolic extracts of *B. albostellata* leaf and stem were shown by FTIR to contain abundant phenolic and terpenoid groups that both reduce Ag^+ and stabilize the AgNP surfaces. The resulting biogenic NPs inherit both the metal's properties and the plant's bioactivity. Such phyto-synthesized nanoparticles are being explored as antimicrobial or anticancer agents and could offer nano-formulations of *B. acuminata* bioactives with improved delivery and potency.

Finally, *B. acuminata*'s nutritional components suggest a role as a functional food or nutraceutical. GC–MS analysis revealed that its leaves are unusually high (~34%) in 9,12,15-octadecatrienoic acid (α-linolenic acid, an ω-3 fatty acid). This ALA is known for antioxidant, anti-inflammatory and cardioprotective effects. The plant also contains significant phytosterols (β-sitosterol and stigmasterol), which are documented to reduce cholesterol absorption and improve metabolic health. These findings imply that *B. acuminata* could be developed into a dietary supplement or ingredient that delivers heart-healthy fatty acids and plant sterols.

In summary, emerging research on *B. acuminata* is moving beyond single-target assays toward integrated approaches. Network pharmacology can help decode synergistic actions of its compound, while studies on antibiotic potentiation, green nanoparticle synthesis, and nutritional profiling open new translational opportunities. Together, these novel perspectives highlight *B. acuminata* as a versatile source of bioactive molecules for multi-target therapeutics, antimicrobial adjuvants, and nutraceuticals.

Research Gaps and Future Directions for *Barleria acuminata*

Phytochemical Profile: Existing studies on *Barleria acuminata* are limited to preliminary screening. Qualitative analysis of leaf extracts confirmed the presence of major classes such as alkaloids, flavonoids,

tannins, steroids, phenols, terpenoids and saponins.[15] A GC–MS study identified dozens of compounds in ethanolic leaf, stem and root extracts – for example, α-linolenic acid (9,12,15-octadecatrienoic acid) was the dominant peak (34.13% area) in leaves, and 2,2,6,6-tetramethylpiperidine dominated stems and roots. However, *B. acuminata* has **no reported isolation of pure bioactive constituents** (e.g. iridoids, phenylethanoid glycosides or unique terpenes) that are known from other Barleria species. In short, **comprehensive chemical profiling and compound isolation are lacking**. Future research should employ modern metabolomic techniques (LC–MS/MS, NMR) and bioassay-guided fractionation to identify and characterize novel metabolites from *B. acuminata*.

- Investigate *B. acuminata* leaves, stems and roots with advanced analytical methods to quantify and structurally characterize its secondary metabolites (beyond the generic classes reported).
- Compare the phytochemical fingerprint of *B. acuminata* with related species (e.g. *B. tomentosa*, *B. cristata*) to find unique markers or chemotypes.

Pharmacological Potential: The only pharmacological study on *B. acuminata* to date examined antibacterial activity. Crude leaf extracts (especially ethanol extracts) showed broad-spectrum antibacterial effects in vitro, with Gram-negative bacteria being more inhibited than Gram-positive. No MIC values were provided, but the tested concentrations were relatively high. Apart from this, **no other bioactivity assays** (e.g. anti-inflammatory, analgesic, antioxidant, antitumor, antidiabetic) have been conducted on *B. acuminata*. In contrast, congeners such as *B. cristata*, *B. prionitis* and *B. noctiflora* are reported to have diverse effects (anti-inflammatory, anticancer, etc.). This highlights a major gap: the **therapeutic spectrum of *B. acuminata* is essentially unknown**. Future work should systematically screen *B. acuminata* extracts and isolated compounds in relevant in vitro and in vivo models (e.g. anti-inflammatory assays, cytotoxicity against cancer cell lines, enzyme inhibition panels) to evaluate its pharmacological potential.[16]

- **Expand bioactivity screening** beyond antibacterial: test *B. acuminata* extracts (and fractions) in assays for anti-inflammatory (e.g. COX-1/2, LOX), antioxidant (e.g. DPPH, FRAP), cytotoxic (cancer cell lines), antidiabetic (α-glucosidase inhibition), and other activities.
- Use standardized extract preparations (defined by solvent, concentration) to enable reproducible comparisons.

Mechanistic Insights: To date, **no mechanism-of-action studies** have been performed on *B. acuminata*. The molecular targets or pathways underlying any observed activity are unknown. Given the classes of compounds present, plausible mechanisms might mirror those of related species (e.g. phenolics inhibiting COX enzymes, alkaloids affecting neurotransmission, terpenoids modulating signaling). For example, iridoid glycosides and phenylethanoids in other Barleria species have known antioxidant and anti-inflammatory effects. Modern approaches such as enzyme inhibition assays, cell signaling studies, and transcriptomics could elucidate bioactivity pathways. In addition, **in silico techniques** (molecular docking and dynamics) offer a promising avenue: recent work on *Barleria buxifolia* used LC–MS profiling plus docking against a malarial kinase (PI4KIIIβ), identifying a potent lead compound. Similar computational screening of *B. acuminata* metabolites (e.g. those identified by GC-MS) against relevant drug targets could guide mechanism hypotheses and prioritise compounds for testing.

- **Elucidate targets:** Perform biochemical assays (e.g. enzyme inhibition, receptor binding) to identify molecular targets of active *B. acuminata* extracts or constituents.
- **Computational modeling:** Apply molecular docking and molecular dynamics to *B. acuminata* phytochemicals against disease-related proteins (e.g. bacterial enzymes, inflammatory mediators). This can prioritize leads for experimental validation.[17]

Toxicity and Safety: No toxicity or safety studies have been reported specifically for *B. acuminata*. This is a critical gap, as natural products can have harmful effects if not properly tested. Limited data from other Barleria species suggest generally low acute toxicity. For instance, *B. cristata* and *B. prionitis* ethanol extracts showed

no mortality or acute toxicity in rodents at doses up to 2000–3000 mg/kg. Nonetheless, *B. acuminata* extracts could differ in composition and safety profile. Systematic toxicological evaluation (acute, sub-chronic, and genotoxic studies in appropriate animal models) is needed before any therapeutic claims. In particular, the safety of individual isolated compounds (if found) should be assessed.

- **Preclinical toxicity studies:** Conduct standard acute and sub-acute toxicity assays in rodents to determine LD50, target-organ effects and safety margins of *B. acuminata* extracts. Use WHO or OECD guidelines for herbal drugs.
- **In vitro safety profiling:** Evaluate cytotoxicity on human cell lines (e.g. hepatocytes, kidney cells) and test for common toxic liabilities (hERG inhibition, etc.) if compounds are isolated.
- **Herb–drug interactions:** If *B. acuminata* is consumed traditionally, assess effects on cytochrome P450 enzymes and common drug targets.[18]

Clinical and Ethnobotanical Evidence: There is **no clinical or epidemiological data** on *B. acuminata*. It is known by local name "Vellaikurunji" and reportedly used in traditional medicine, but detailed ethnopharmacological records are lacking. A genus-level review notes that *Barleria* species have significant traditional use potential but almost no scientific documentation of clinical efficacy. Bridging this gap would require ethnobotanical surveys to document how *B. acuminata* is used (doses, preparations, indications), followed by well-designed clinical studies to test efficacy and safety in humans. However, clinical work should only proceed after thorough preclinical validation.

- **Ethnobotanical documentation:** Record traditional uses, preparation methods and local knowledge of *B. acuminata* in native regions (e.g. Andhra, Karnataka, Tamil Nadu).
- **Clinical research:** Plan exploratory clinical or observational studies (e.g. for wound healing or anti-infective use) once active constituents are identified and toxicology cleared.[19]

Comparative Studies within *Barleria*: Very few studies compare *B. acuminata* with its congeners. Genus-wide reviews emphasize that **most Barleria species remain uncharacterized** chemically and pharmacologically. Comparative research (chemometric or biological) could determine if *B. acuminata* offers unique advantages. For example, analyzing profiles of verbascoside and other phenylethanoids across *B. acuminata*, *B. cristata* and *B. prionitis* could reveal species-specific markers. Similarly, parallel bioassays could show whether *B. acuminata* has stronger activity in certain assays. Such comparative data would contextualize *B. acuminata* within the genus and help prioritize species for drug discovery.

- **Chemotaxonomic analyses:** Profile and compare key metabolites (e.g. iridoids, flavonoids, phenylethanoids) across several Barleria species to highlight distinctive compounds in *B. acuminata*.
- **Phylogenetic context:** Relate phytochemistry and bioactivity data to Barleria phylogeny; this may suggest evolutionary patterns of metabolite distribution.[20]

Standardization and Quality Control: As with many medicinal plants, *B. acuminata* extracts lack standardization. No pharmacopeial monograph exists. Quality control challenges include species authentication (it has been treated as a variety of *B. tomentosa* in the past) and variability of active content. Future work should establish reliable markers and analytical methods for extract standardization. This could involve:

- Developing botanical authentication protocols (morphological keys, DNA barcoding) to ensure correct identification of *B. acuminata*.
- Quantifying putative marker compounds (e.g. total phenolics or specific glycosides like verbascoside) by HPLC or spectrophotometry to define batch-to-batch consistency.
- Setting quality specifications (moisture, ash, microbial limits) if the plant is to be used medicinally.[21]

Drug Development Prospects: No drug leads have emerged from *B. acuminata*, but the **genus is known for drug-like natural products**. Isolated Barleria compounds (e.g. labdane diterpenoids, flavonoids,

phenylethanoid glycosides) often show bioactivity. The chemical scaffolds tentatively identified in *B. acuminata* (fatty acids, alkaloids, sterols) are common and modifiable. Future drug discovery efforts could focus on:

- **Lead identification:** Screen purified *B. acuminata* compounds (or enriched fractions) against drug targets or disease models to find leads. For example, any novel piperidine derivative or terpenoid could be tested for specific activities.
- **Synthetic modification:** If bioactive molecules are found, analog synthesis (e.g. acetylation, esterification) may improve potency or pharmacokinetics.
- **Formulation development:** Evaluate delivery strategies (liposomes, phytosomes, etc.) for *B. acuminata* extracts to enhance bioavailability.[22]

Importantly, any drug development pathway should integrate early ADMET (absorption/distribution/metabolism/toxicity) profiling to avoid late failures.

Advanced Computational and Nanotechnology Approaches: Cutting-edge methods offer new avenues for research. For example, **molecular docking and in silico screening** have already been applied to other Barleria species: one study used LC–MS metabolite profiling of *B. buxifolia* root and docked compounds against a malaria enzyme, finding a lead with higher predicted potency than artemisinin. No such in silico work has been done for *B. acuminata*, but it is a logical next step given the GC–MS data available. Researchers could dock predicted or known *B. acuminata* compounds against relevant targets (bacterial enzymes, cancer proteins, etc.) to prioritize candidates.

Likewise, **nanoformulation** is an emerging field. In the Barleria genus, leaf extracts of *B. cristata* have been used to biosynthesize silver nanoparticles (AgNPs) that showed potent antimicrobial and insecticidal activity. *B. acuminata* extracts could similarly be explored for green nanoparticle synthesis. These biogenic nanoparticles often have enhanced bioavailability and efficacy. Screening *B. acuminata*–derived nanoparticles against pathogens or cancer cells is an innovative research direction.

- Perform in silico docking of *B. acuminata* phytochemicals against disease targets (e.g. COX-2, microbial enzymes) to generate hypotheses for activity.
- Attempt green synthesis of metal nanoparticles (Ag, Au, Cu) using *B. acuminata* leaf/stem extracts, and evaluate their biological activities. The success of *B. cristata*-derived AgNPs suggests this could yield potent nano-antimicrobials

Conclusion

Phytochemical and Pharmacological Insights

Scientific studies show that *Barleria acuminata* contains various **phytochemicals** including **alkaloids, flavonoids, tannins, steroids, phenols, terpenoids, and saponins** compounds known to have medicinal properties. These constituents likely contribute to its biological effects.

Research specifically on *B. acuminata* extracts has demonstrated **antibacterial and antifungal activity**, with significant inhibition of both bacterial pathogens (with higher activity against Gram-negative bacteria in some extracts) and fungal species like *Candida albicans* and *Aspergillus flavus*.

A broader review of the *Barleria* genus (Acanthaceae) to which *B. acuminata* belongs reports a wide range of **biological activities** across species, including **antioxidant, anti-inflammatory, antimicrobial, anticancer, antidiabetic, antiulcer, hepatoprotective, analgesic, anti-amoebic, anti-helminthic, anti-arthritic,**

antihypertensive, and antiviral effects. These effects are attributed to bioactive compounds such as flavonoids, phenolics, iridoids, phenylethanoid glycosides, and immunomodulatory proteins.

Additionally, studies in other *Barleria* species validate **anti-inflammatory** and **antimicrobial potentials** through in-vitro assays that showed inhibition of bacterial growth and suppression of enzymes like COX-1 and COX-2 involved in inflammation.

Therapeutic Relevance

While specific clinical studies on *B. acuminata* are limited, its **traditional uses for treating infection-related ailments**, combined with experimental evidence for antimicrobial and biochemical activity, provide scientific support for its **therapeutic potential**.

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