

ANTIBACTERIAL PLANTS OF INDIA

VOL I



2025



**BHAGWATI PRASHAD SHARMA
EMDAD HOSSAIN
SANDHYA SHARMA
SANJEET KUMAR**



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**AMBIKA PRASAD
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ANTIBACTERIAL PLANTS OF INDIA, VOL. I

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MESSAGE

India possesses a vast and invaluable heritage of medicinal plants that have been traditionally used to combat infectious diseases. In the present era of increasing antibacterial resistance, plant-based remedies offer a promising, eco-friendly and culturally rooted alternative. The book **Antibacterial Plants of India, Volume 1**, is a pictorial compilation highlighting selected antibacterial plant species with clear emphasis on plant morphology, correct botanical identity, common names, scientific names and documented antibacterial properties.

This volume is enriched with original field photographs, enabling accurate identification and practical understanding of plants in their natural habitats. Designed as a reference for students, researchers, academicians and practitioners of botany, pharmacy, microbiology and ethnobotany, the book aims to bridge traditional knowledge with modern scientific perspectives, while promoting awareness, conservation and sustainable utilization of India's antibacterial plant wealth.

Padma Mahanti

(Padma Mahanti, IFS)



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PREFACE

India is one of the world's richest repositories of medicinal plant diversity, owing to its wide range of climatic zones, ecological habitats and long-standing traditions of indigenous healthcare systems. For centuries, plants have served as the primary source of remedies against infectious diseases, long before the advent of modern antibiotics. Even today, traditional medicinal practices such as Ayurveda, Siddha, Unani and folk medicine continue to rely heavily on plant-based therapeutics for managing bacterial infections. The present volume, "Antibacterial Plants of India, Volume 1," has been conceived as a pictorial and field-oriented textbook that brings together botanical authenticity, antibacterial relevance and visual documentation of medicinal plants used across different regions of India. This book documents thirty antibacterial plant species, including *Abrus precatorius*, *Acorus calamus*, *Andrographis paniculata*, *Azadirachta indica*, *Boerhavia diffusa* and *Calotropis* species, among others, each known for its significant role in traditional and scientifically validated antibacterial applications. A distinguishing feature of this textbook is the inclusion of original field photographs, captured in natural habitats, which provide a realistic and practical understanding of plant morphology. Each plant profile presents morphological characteristics, common and scientific names and documented antibacterial properties, making the book especially useful for accurate identification, academic reference and applied research. The emphasis on visual learning enhances comprehension for students, researchers and practitioners, bridging the gap between classical descriptions and real-world observation. This volume is intended to serve as a ready reference for undergraduate and postgraduate students of botany, pharmacy, microbiology, ethnobotany and allied life sciences, as well as research scholars, herbal practitioners and biodiversity workers. Integrating traditional knowledge with contemporary scientific perspectives, this book aims to promote awareness, conservation and rational utilization of India's antibacterial plant wealth. It is hoped that this pictorial compilation will not only support academic learning and research but also inspire further exploration into plant-based antibacterial agents, especially in the context of emerging antimicrobial resistance.



INTRODUCTION

The rapid emergence of antibiotic-resistant bacterial strains poses a serious global health challenge. Overuse and misuse of synthetic antibiotics have led to reduced efficacy of many conventional drugs, prompting an urgent search for novel, safe and sustainable antibacterial agents. Medicinal plants, with their vast array of bioactive secondary metabolites such as alkaloids, flavonoids, terpenoids, phenolics, glycosides and tannins, represent a promising and largely underexplored resource in this context.

India's flora, comprising more than 18,000 plant species, has been extensively utilized in traditional medicine for treating infections of the skin, respiratory tract, gastrointestinal system and wounds. Plants such as *Aegle marmelos*, *Cassia alata*, *Barleria prionitis* and *Bacopa monnieri* have been reported to exhibit significant antibacterial activity against both Gram-positive and Gram-negative bacteria. Scientific validation of these traditional claims has gained momentum in recent decades, reinforcing the relevance of ethnobotanical knowledge in modern drug discovery.

Accurate identification of medicinal plants is fundamental to ensure efficacy, safety and reproducibility of antibacterial studies. Morphological misidentification remains a major challenge in herbal research and practice. In this regard, field-based morphological descriptions supported by original photographs play a crucial role in strengthening taxonomic clarity.

This pictorial textbook emphasizes habit, leaf arrangement, inflorescence, floral characters and other diagnostic features, allowing readers to recognize plants in their natural environments. Visual documentation also supports conservation efforts by familiarizing readers with native and commonly used antibacterial species.

Traditional medicinal systems have long recognized the antibacterial potential of plants such as *Andrographis paniculata* for infections, *Azadirachta indica* for skin and wound ailments and *Acorus calamus* for gastrointestinal disorders. Modern

pharmacological and microbiological studies have begun to substantiate these uses, demonstrating measurable antibacterial activity through *in vitro* and *in vivo* assays.

This book adopts an integrative approach, linking traditional usage, botanical identity and antibacterial properties in a concise and visually rich format. By doing so, it contributes to the growing body of literature that supports the rational development of plant-derived antibacterial agents.

This volume covers thirty antibacterial plant species commonly used in Indian traditional medicine and folk healthcare systems. The selection includes herbs, shrubs, climbers and trees, representing diverse taxonomic groups and ecological habitats. Subsequent volumes are envisioned to expand this compilation, covering additional species and regions of India.

Antibacterial Plants of India





Abrus precatorius

Abrus precatorius L.

Fabaceae

Habit: Climber

Common name: Rosary pea

Vernacular name(s): Gunja, Rati (Hindi, Marathi, Sanskrit and Bengali) and Kaincha (Odia).

Description

It is a perennial, climbing plant with a slender, twining stem. Leaves are even-pinnate, with 5-15 pairs, oblong to elliptic, base and apex obtuse, lower surface sparsely pubescent. Flowers are crowded racemes, ranging from pale purple to light pink, that grow at the end of a stalk. Fruits are short pods containing hard seeds. Seeds are red, black or white in colour.

Antibacterial properties

- ❖ The ethanolic leaf extract has shown strong inhibitory activity against both Gram-positive and Gram-negative bacteria, such as *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas aeruginosa*.
- ❖ The methanolic seed and leaf extracts demonstrate significant inhibition against *E. coli*, *Proteus vulgaris* and *Klebsiella pneumoniae*.
- ❖ The aqueous extracts of the leaves exhibit antibacterial activity, particularly against *Lactobacillus rhamnosus*, *Staphylococcus epidermidis*, *Streptococcus mutans*, *E. coli* and *S. aureus*.
- ❖ Extracts from the stem and seed oil are potent against Gram-positive bacteria and *Candida albicans* but not *Streptococcus anginosus*, *Enterococcus faecalis* and Gram-negative bacteria.

-
- Diwan PD. (2023). Antibacterial activity of different extracts of *Abrus precatorius* leaves against oral microflora to improve oral hygiene. International Research Journal of Science and Engineering. 11(4): 187-190.
- Ramesh S, Muruganantham P, Karpaga Sundari C, Karthikeyan K, Elakkiya R and Chandran C. (2024). Phytochemical screening and antibacterial activity of leaf extracts of *Abrus precatorius* L. Haya: The Saudi Journal of Life Sciences. 9(11): 470-475.
- Prabakaran S and Sowmyapriya R. (2024). *Abrus precatorius*: A deep insight into ethnobotanical, phytochemical and potential application. International Journal of Advanced Biochemistry Research. 8(8): 1339-1345.
- Shende M and Bankar A. (2025). A comprehensive review on *Abrus precatorius* (L.): ethnobotany, phytochemistry, and pharmacological application. International Journal of Pharmaceutical Research and Applications. 10(3): 1672-1677.



Abutilon indicum

Abutilon indicum (L.) Sweet

Malvaceae

Habit: Shrub

Common name: Indian mallow

Vernacular name(s): Kanghi (Hindi), Atibala (Sanskrit) and Pedi pedika (Odia).

Description

Abutilon indicum is an erect, branched shrub covered with soft, velvety hairs, growing up to 1-2 meters tall. The leaves are simple, alternate, heart-shaped and densely pubescent. Flowers are yellow, solitary and axillary with five petals forming a bell-like shape. The fruit is a schizocarp, globose and divided into numerous carpels containing reniform seeds.

Antibacterial properties

- ❖ The ethanolic leaf extract exhibits strong antibacterial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas aeruginosa*. Studies have shown that the plant extracts can exhibit synergistic effects with antibiotics like ampicillin and tetracycline, increasing bacterial susceptibility by weakening the cell wall or inhibiting efflux pumps.
- ❖ Methanolic extracts of leaves and roots have demonstrated significant inhibition zones against *E. coli*, *Klebsiella pneumoniae*, *Proteus vulgaris* and *Salmonella typhi*.
- ❖ The aqueous extracts of leaves and flowers show moderate activity against *S. aureus* and *E. coli*, supporting their use in traditional herbal decoctions for treating infections. Among all plant parts, the leaves generally show the highest antibacterial potency, followed by roots and flowers.

Pattanashetti JI, Kalburgi NB, Patil KA, Sulakod K and Hannahson P. (2023). Antibacterial activity of *Abutilon indicum* leaf extract against periodontal pathogens: An In vitro study. International Journal of Research in Ayurveda and Pharmacy. 14(1): 72-75.

Adhav P, Mali A, Sanap G and Jangle R. (2023). Antioxidant and antibacterial activity of leaf extract of *Abutilon indicum* plant. World Journal of Pharmaceutical Research. 12(5): 1850-1862.

Suresh SN, Sagadevan P, Kumar SR and Rajeshwar V. (2012). Phytochemical analysis and antimicrobial potential of *Abutilon indicum* (Malvaceae). International Journal of Pharmaceutical Research & Development. 4(2): 132-135.



Acalypha indica

Acalypha indica L.

Euphorbiaceae

Habit: Herb

Common name: Indian copperleaf

Vernacular name(s): Kuppi (Hindi), Harita manjari (Sanskrit) and Indramarisa (Odia).

Description

It is an erect annual herb, 30-60 cm tall, with green, angular stems. The leaves are ovate, serrated and alternate with long petioles. Small greenish flowers occur in axillary spikes, with male flowers at the top and female flowers below. The fruit is a small, three-lobed capsule containing tiny seeds.

Antibacterial properties

- ❖ n-Hexane, chloroform, ethyl acetate and methanol extracts of *A. indica* leaves have been reported to show significant antibacterial activity, exhibiting distinct zones of inhibition against several Gram-positive bacteria like *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Bacillus cereus* and *Streptococcus faecalis* as well as one Gram-negative bacterium, *Pseudomonas aeruginosa*.
- ❖ Acetone and aqueous extract showed antibacterial potential against *S. aureus*, *Bacillus subtilis*, *Escherichia coli* and *Klebsiella* species.
- ❖ Extracts of *A. indica* exhibit variable activity against *Staphylococcus* species, *Pseudomonas* species, *Micrococcus* species and *Klebsiella* species, producing the largest inhibition zones against *Pseudomonas* and *Micrococcus* species and comparatively lower inhibition against *Staphylococcus* and *Klebsiella* species.

-
- Aruna P, Sri JK, Naveena T, Nithi RS and Rengaramanujam J. (2024). Phytochemical analysis, antibacterial activity and formulation of herbal soap using *Acalypha indica* leaf extract. International Journal of Research in Engineering, Science and Management. 7(6): 72-74.
- Manoharan P, Gunasekaran L, Shavi GR, Shanmuagam S and Smith JJ. (2023). Antibacterial activity of *Acalypha indica* extract on *Porphyromonas Gingivalis*: An in vitro study. Journal of Indian Association of Public Health Dentistry. 21(1): 39-43.
- Rajaselvam J, Benila SJM and Meena RA. (2012). Study of antimicrobial activity of *Acalypha indica* against selected microbial species. International Journal of Pharma Sciences and Research. 3(9): 473-476.
- Govindarajani LM, Jenanesan A, Reetha D, Amsath R, Pushpanathan T and Samidurai K. (2008). Antibacterial activity of *Acalypha indica*. European Review for Medical and Pharmacological Sciences. 12: 299-302.



Achyranthes aspera

***Achyranthes aspera* L.**

Amaranthaceae

Habit: Sub-shrub

Common name: Prickly chaff flower

Vernacular name(s): Apamarga (Hindi, Odia, Bengali and Marathi).

Description

It is an erect, perennial herb growing up to 1-1.5 meters tall, with a woody base and hairy stem. The leaves are opposite, simple and ovate with rough surfaces. Flowers are small, greenish-white and arranged in long, stiff spikes that become prickly when mature. The fruit is a dry, one-seeded utricle enclosed by persistent bracts.

Antibacterial properties

- ❖ The chloroform extract of *A. aspera* root showed the highest antibacterial activity against *Staphylococcus aureus*, while the methanol extract of the root exhibited strong inhibition against *Escherichia coli* and *Streptococcus mutans*.
- ❖ Methanolic leaf extract of *A. aspera* possesses notable antimicrobial activity against both Gram-positive bacteria (*S. aureus* and *Bacillus subtilis*) and Gram-negative bacteria (*Klebsiella pneumoniae* and *E. coli*), as well as fungal species such as *Aspergillus niger* and *Candida albicans*.
- ❖ The ethanol root extract is found to be the most effective against *Salmonella typhimurium*, *E. coli*, *B. subtilis*, *Pseudomonas aeruginosa* and *Salmonella abony* strains. Acetone extract indicates the activity against *S. typhimurium*, *E. coli*, *B. subtilis*, *S. aureus* and *P. aeruginosa* strains. Ethyl acetate extract has shown activity against *S. typhimurium*, *E. coli*, *B. subtilis* and *S. aureus* strains.

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- Yadav R, Rai R, Yadav A, Pahuja M, Solanki S and Yadav H. (2016). Evaluation of antibacterial activity of *Achyranthes aspera* extract against *Streptococcus mutans*: An *in vitro* study. Journal of Advanced Pharmaceutical Technology and Research. 7(4): 149-152.
- Londonkar R, Reddy CV and Kumar AK. (2011). Microbiology potential antibacterial and antifungal activity of *Achyranthes aspera* L. Recent Research in Science and Technology. 3(4): 53-57.
- Beaulah AG, Sadiq M and Santhi JR. (2011). Antioxidant and antibacterial activity of *Achyranthes aspera*: An *in vitro* study. Annals of Biological Research. 2(5): 662-670.
- Mishra D. (2018). Antibacterial activity of alkaloids present in plant *Achyranthes aspera*. The Pharma Innovation Journal. 7(6): 147-153.

Acorus calamus



Acorus calamus L.

Acoraceae

Habit: Herb

Common name: Sweet flag

Vernacular name(s): Bach (Hindi) and Bacha (Odia).

Description

It is a perennial, aromatic herb with creeping, branched rhizomes and sword-shaped leaves. The leaves are long, narrow and bright green with a distinct midrib. The flowering stem bears a spadix covered with numerous tiny yellowish-green flowers. The rhizome is thick, spongy and emits a pleasant aromatic odour.

Antibacterial properties

- ❖ The essential oil extracted from *A. calamus* exhibited significant antibacterial activity against both Gram-negative and Gram-positive bacteria, like *Staphylococcus aureus* and *Pseudomonas aeruginosa*.
- ❖ Study revealed that the *A. calamus* rhizome ethyl acetate fraction has strong antibacterial activity against *Escherichia coli*, *S. aureus* and *Candida albicans*.
- ❖ Leaf extract of *A. calamus* also exhibited a significant inhibition zone against the pathogens *Streptococcus mutans* and *P. aeruginosa*.
- ❖ *A. calamus* exhibits antimicrobial activity against a broad spectrum of bacteria, fungi and yeasts, with the activity attributed to various compounds like asarone, methyl isoeugenol and flavonoids. The plant extract can inhibit the growth of pathogens such as *S. aureus*, *P. aeruginosa* and *S. mutans*.

-
- Rita WS, Swantara MD and Utami GAP. (2019). Antimicrobial activity of *Acorus calamus* L. rhizome extract and its total flavonoid and phenolic contents. AIP Conference Proceedings. 2155: 0200054. <https://doi.org/10.1063/1.5125558>
- Haran P, Shanmugam R and Deenadayalan P. (2024). Free radical scavenging, anti-inflammatory and antibacterial activity of *Acorus calamus* leaves extract against *Pseudomonas aeruginosa* and *Staphylococcus aureus*. Cureus. 16(3): e55987. <https://doi.org/10.7759/cureus.55987>
- Al-Mijalli SH, Mrabti HN, Abdallah EM, Assaggaf H, Qasem A, Alenazy R, Bouyahya A, Alshabrimi FM and EL Hachlafi N. (2025). *Acorus calamus* as a promising source of new antibacterial agent against *Pseudomonas aeruginosa* and *Staphylococcus aureus*: Deciphering volatile compounds and mode of action. Microbial Pathogenesis. 200: 107357. <https://doi.org/10.1016/j.micpath.2025.107357>



Aegle marmelos

Aegle marmelos (L.) Corrêa

Rutaceae

Habit: Tree

Common name: Wood apple

Vernacular name(s): Bael (Hindi, Bengali, Marathi) and Bela (Odia).

Description

It is a medium-sized deciduous tree with a crooked trunk and thorny branches. Leaves are trifoliate, aromatic and arranged alternately. Flowers are greenish-white, fragrant and borne in clusters. The fruit is large, woody and spherical with a hard-shell enclosing aromatic, sweet pulp. It commonly grows in dry forests and is widely cultivated for its medicinal and religious importance.

Antibacterial properties

- ❖ Extract of *A. marmelos* produced clear zones of inhibition against Gram-positive and Gram-negative microorganisms. *Raoultella planticola* was the most sensitive to the methanol extract.
- ❖ The aqueous extracts of *A. marmelos* have been shown to have significant activity against *Staphylococcus aureus*. The leaf extract showed antibacterial activity against *Corynebacterium diphtheriae*, *Streptococcus pyrogens*, *Escherichia coli*, *Salmonella typhimurium*, *Proteus vulgaris*, *S. aureus* and *Klebsiella pneumoniae*.
- ❖ Methanol extract showed the maximum zone of inhibition against *Salmonella typhi*, suggesting the highest efficacy against this organism.
- ❖ *A. marmelos* was also found to show maximum zone of inhibition against *Pseudomonas aeruginosa* and *Bacillus subtilis*.

Meena RK, Pareek A and Meena RR. (2016). Antimicrobial activity of *Aegle marmelos* (Rutaceae) plant extracts. International Journal of Medi Pharm Research. 2(1): 1-5.

Kothari S, Mishra V, Bharat S and Tonpay SD. (2011). Antimicrobial activity and phytochemical screening of serial extracts from leaves of *Aegle marmelos* (Linn.). Acta Poloniae Pharmaceutica - Drug Research. 68(5): 687-692.

Karumaran S, Nethaji S and Rajakumar R. (2016). Antimicrobial and antioxidant activity of leaf extracts of *Aegle marmelos*. Advances in Applied Science Research. 7(3): 205-208.

Nandedkar PH, Sonawane PA and Chavan VK. (2017). In vitro antimicrobial activity of fruit extract of *Aegle marmelos* (Bael). International Journal of Pure and Applied Bioscience. 5(5): 595-599.



Aerva lanata

Aerva lanata (L.) Kuntze

Amaranthaceae

Habit: Herb

Common name: Mountain knot grass

Vernacular name(s): Chhaya (Hindi), Paunsia (Odia) and Ashmahabhedah (Sanskrit).

Description

It is an erect or slightly spreading herb, usually 50-100 cm tall, covered with soft, woolly white hairs. Leaves are opposite, ovate to elliptic, and densely pubescent, giving them a greyish appearance. Flowers are small, greenish-white, and arranged in long, slender spikes. The spike bracts become stiff and slightly prickly in fruit.

Antibacterial properties

- ❖ The extracts of *A. lanata* exhibited varying levels of antibacterial activity against the selected microorganisms. Ethyl acetate leaf extract showed the highest activity, particularly against *Staphylococcus saprophyticus* and *Proteus vulgaris*, while benzene and acetone leaf extracts were effective against *Streptococcus agalactiae* and *Acinetobacter baumannii*. Aqueous extracts showed minimal or no activity.
- ❖ It was reported that *A. lanata* contains highly effective antimicrobial constituents. The extract showed the maximum zone of inhibition against *Salmonella typhi*, suggesting the highest efficacy against this organism.
- ❖ *A. lanata* extract was reported to be effective against Gram-positive bacteria (*Staphylococcus aureus* and *Bacillus subtilis*) and Gram-negative bacteria (*Escherichia coli* and *Klebsiella pneumoniae*).

Ramalingam V and Rajangam U. (2015). Antibacterial potential of different parts of *Aerva Lanata* (L.) against some selected clinical isolates from urinary tract infections. *Microbiology Research Journal International*. 7(1): 35-47.

Srujana M, Hariprasad P, Manogna JH, Sravani P, Raju V, Bramhachary N, Ramu N, Reddy GR, Nagulu M and Nath KVS. (2012). In Vitro antibacterial activities of stem extracts of *Aerva lanata*. *International Journal of Pharmaceutical Sciences Review and Research*. 14(1): 21-23.

Subramanian A, Raman N and Dhasarathan P. (2019). Study on antibacterial activity of phytochemicals obtained from *Aerva lanata*. *Asian Journal of Pharmacy and Pharmacology*. 5(4): 721-727.



Ageratum conyzoides

Ageratum conyzoides L.

Asteraceae

Habit: Herb

Common name: Billygoat weed

Vernacular name(s): Visadoori (Hindi) and Pokasunga (Odia).

Description

It is an erect, annual herb, 30-80 cm tall, with softly hairy stems and leaves. The leaves are opposite, ovate, and serrated with a characteristic strong odour. The plant bears fluffy, bluish-purple to white flower heads arranged in terminal clusters. The fruits are small, black achenes topped with a bristly pappus for wind dispersal. It commonly grows as a weed in fields, roadsides and disturbed habitats.

Antibacterial properties

- ❖ n-Hexane, chloroform, and methanol extracts of *A. conyzoides* showed strong antibacterial activity against *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Streptococcus pneumoniae* and *Pseudomonas aeruginosa*.
- ❖ Aqueous, methanolic and hexane leaf extracts of *A. conyzoides* showed different levels of antibacterial activity on the tested bacteria. The aqueous extract inhibited *S. aureus*, *Yersinia enterocolitica* and *Escherichia coli*, but showed no activity against *Staphylococcus gallinarum*. The methanolic extract inhibited *S. aureus* and *E. coli*, but not *S. gallinarum* or *Y. enterocolitica*.
- ❖ *A. conyzoides* leaves showing pronounced effects against *S. aureus* and *E. coli*. Methanolic extracts, especially using high-purity methanol, exhibit the highest activity; strong against resistant *S. aureus*, weak against *E. coli* and inactive against *P. aeruginosa*.

Okwori A, Dina C, Junaid S, Okeke I, Adetunji J and Olabode A. (2006). Antibacterial activities of *Ageratum conyzoides* extracts on selected bacterial pathogens. The Internet Journal of Microbiology. 4(1): 1-8.

Rajput D, Saikai LR, Borkatak M and Agarwalla S. (2022). *Ageratum conyzoides* L.: In vitro antimicrobial, antioxidant and phytochemical study. Ecology, Environment and Conservation. 28: S255-S261.

Kumar S, Kumar VJ and Singh R. (2020). Antibacterial Activity of Medicinal Plant Extracts of *Ageratum conyzoides*. Indo American Journal of Pharmaceutical Research. 10(6): 865-871.



Alstonia scholaris

Alstonia scholaris (L.) R.Br.

Apocynaceae

Habit: Tree

Common name: Blackboard tree

Vernacular name(s): Saptaparni (Hindi, Sanskrit), Chatim (Bengali) and Chhatian (Odia).

Description

It is a large evergreen tree with a straight bole and whorled branches. Leaves are arranged in distinct whorls, elliptic to obovate and leathery in texture. Flowers are small, greenish-white, fragrant, and borne in terminal cymes. The fruit consists of long paired follicles. Seeds are numerous and provided with silky hairs.

Antibacterial properties

- ❖ The methanolic leaf or bark extract of *A. scholaris* demonstrates broad-spectrum antibacterial activity, effectively inhibiting both Gram-positive bacteria, such as *Staphylococcus aureus* and *Bacillus cereus*, and Gram-negative bacteria, including *Escherichia coli* and *Enterobacter* species. This wide activity range is attributed to the presence of diverse phytochemicals like alkaloids, phenolics, flavonoids and triterpenoids.
- ❖ The fractionated extracts, particularly ethyl acetate and n-butanol fractions derived from stem bark or leaf/bark extracts, exhibit active secondary metabolites such as indole alkaloids, terpenoids and phenolic compounds, which enhance potency against challenging Gram-negative pathogens (*E. coli*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*) as well as Gram-positive organisms.
- ❖ Pure isolated compounds, such as pentacyclic triterpenoids (oleanolic and ursolic acid), are tested individually; their antibacterial action becomes mostly restricted to Gram-positive bacteria.

Altaf IUK, Hussain MM and Rahim A. (2019). Phytochemical and antimicrobial study of *Alstonia scholaris* leaf extracts against multidrug-resistant bacterial and fungal strains. *Pakistan Journal of Pharmaceutical Sciences*. 32(4):1655-1662.

Wang CM, Chen HT, Wu ZY, Jhan YL, Shyu CL and Chou CH. (2016). Antibacterial and synergistic activity of pentacyclic triterpenoids isolated from *Alstonia scholaris*. *Molecules*. 21(2): 139. <https://doi.org/10.3390/molecules21020139>

Saxena N, Shrivastava PN and Saxena RC. (2013). Antibacterial efficacy of *Alstonia Scholaris* (L.) R. Br. stem bark extracts. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*. 4(1): 964-970.



Alternanthera sessilis

***Alternanthera sessilis* (L.) R.Br. ex DC.**

Amaranthaceae

Habit: Herb

Common name: Sessile joyweed

Vernacular name(s): Gudrisag (Hindi), Matsyakshi (Sanskrit) and Madaranga (Odia).

Description

It is a perennial creeping or ascending herb with prostrate stems. Stems root at nodes and are glabrous. Leaves are simple, opposite, ovate to oblong with entire margins. Flowers are small, white, and axillary. Perianth segments are dry and papery. Fruit is a small utricle containing a single seed.

Antibacterial properties

- ❖ The ethanolic extract of *A. sessilis* aerial parts shows antibacterial activity against multiple Gram-positive and Gram-negative bacteria, including *Staphylococcus aureus*, *Bacillus subtilis*, *Bacillus polymyxa*, *Streptococcus faecalis*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Shigella dysenteriae* and *Escherichia coli*.
- ❖ *A. sessilis* leaf extract used to synthesise silver nanoparticles (AgNPs) produces particles that show antibacterial activity. These biosynthesized AgNPs inhibited both Gram-negative (*Klebsiella pneumoniae*, *E. coli*, *P. aeruginosa*) and Gram-positive bacteria (*S. aureus*) in agar diffusion tests, often with zones of inhibition in the ~11-12 mm range at 60 µg/mL.
- ❖ The aqueous extract of *A. sessilis* exhibits antibacterial activity with a low MIC (<100 µg/mL) against *E. coli*, and a moderate MIC (~252.5 µg/mL) against *S. aureus*.

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- Kumar DA, Das M, Mohanraj P and Das A. (2014). Antimicrobial activity study of ethanolic extract of *Alternanthera sessilis* Linn. aerial parts. Journal of Applied Pharmaceutical Research. 2(3): 01-04.
- Kabeerdass N, Murugesan K, Arumugam N, Almansour AI, Kumar RS, Djearamane S, Kumaravel AK, Velmurugan P, Mohanavel V, Kumar SS, Gulyas B and Mathamohun M. (2022). Biomedical and textile applications of *Alternanthera sessilis* leaf extract mediated synthesis of colloidal silver nanoparticle. Nanomaterials. 12(16): 2759. <https://doi.org/10.3390/nano12162759>
- Monroy AE and Limsiac CL. (2016). Phytochemical and antimicrobial analysis of “Lupo” (*Alternanthera sessilis* L. R. BR.). WVSU Research Journal. 5(2): 21-34.



Andrographis paniculata

Andrographis paniculata (Burm.f.) Wall. ex Nees

Acanthaceae

Habit: Herb

Common name: King of bitters

Vernacular name(s): Kalmegh (Hindi) and Bhuinimba (Odia and Sanskrit).

Description

It is an erect annual herb with a slender, quadrangular stem. The stem is glabrous and profusely branched. Leaves are opposite, lanceolate with an acuminate apex. Flowers are small, white, with purple markings. Inflorescence is terminal and axillary panicles. Fruit is a narrow capsule with numerous seeds.

Antibacterial properties

- ❖ Ethanol extract of aerial parts (leaves/stem) shows broad-spectrum antibacterial activity against both Gram-positive and Gram-negative bacteria. This includes *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis*, *Klebsiella pneumoniae* and *Proteus vulgaris*.
- ❖ In some studies, methanolic stem extracts produce large inhibition zones against *Pseudomonas aeruginosa*; Gram-positive pathogens like *S. aureus*, *Enterococcus faecalis* and *Bacillus cereus* are also strongly inhibited.
- ❖ Aqueous leaf extracts display significant antimicrobial activity against both Gram-positive and Gram-negative bacteria, including *B. subtilis*, *E. coli* and *P. aeruginosa*. Pure andrographolide (a major di-terpenoid) shows selective activity mainly against Gram-positive organisms.

Mishra US, Mishra A, Kumari R, Murthy PN and Naik BS. (2009). Antibacterial activity of ethanol extract of *Andrographis paniculata*. Indian Journal of Pharmaceutical Sciences. 71(4): 436-438.

Awoyinka EO, Ogundare AO and Adebolu TT. (2019). Evaluation of antibacterial properties of stem extract of *Andrographis Paniculata*- Nees on Some Antibiotic Resistant Bacterial Isolates. Journal of Advances in Microbiology. 19(2): 1-7.

Malahubban M, Alimon AR, Sazili AQ, Fakurazi S and Zakry FA. (2013). Phytochemical analysis of *Andrographis paniculata* and *Orthosiphon stamineus* leaf extracts for their antibacterial and antioxidant potential. Tropical Biomedicine. 30(3): 467-480.



Anisomeles indica

Anisomeles indica (L.) Kuntze

Lamiaceae

Habit: Shrub

Common name: Indian catmint

Vernacular name(s): Kala bhangra (Hindi) and Gopali (Marathi and Bengali).

Description

It is an erect aromatic herb with a quadrangular, pubescent stem. Leaves are opposite, ovate and serrate. Inflorescence consists of axillary and terminal whorls. Flowers are bluish-purple and bilabiate. Calyx is tubular and persistent. Fruit is a schizocarp, forming four nutlets.

Antibacterial properties

- ❖ Studies report that *A. indica* leaf extracts exhibit antimicrobial activity against both Gram-negative and Gram-positive bacteria, including *Pseudomonas aeruginosa* (Gram-negative) and *Staphylococcus aureus* (Gram-positive), with inhibition zones around 10 mm and 9 mm, respectively, in disc-diffusion assays. This activity is associated with the presence of flavonoids, phenolics, terpenoids and other bioactive compounds detected by GC-MS.
- ❖ Ethanol extracts of *A. indica* containing the bioactive component ovatodiolide demonstrate bactericidal activity against *Helicobacter pylori*, including multidrug-resistant strains.
- ❖ *A. indica* leaf extract was found effective against *S. aureus*, *Bacillus cereus*, *Proteus vulgaris* and *Salmonella typhimurium*.

Fasale SB, Nimbalkar MS, Mane MP, Waghmare MB and Khot SS. (2024). Phytochemical characterization of *Anisomeles indica* (L.) Kuntze Extract Using GC-MS: Evaluation of Antioxidant and Antimicrobial Properties. International Journal of Plant and Environment. 10(1): 132-137.

Lien HM, Wu HY, Hung CL, Chen CJ, Wu CL, Chen KW, Huang CL, Chang SJ, Chen CC, Lin HJ and Lai CH. (2019). Antibacterial activity of ovatodiolide isolated from *Anisomeles indica* against *Helicobacter pylori*. Scientific Reports. 9(1): 4205. <https://doi.org/10.1038/s41598-019-40735-y>

Pandit N, Kadam A, Survase A, Ashara P, Patil A, Bagade C, Patil S and Kamble S. (2025). Phyto-engineered Pd-doped WO₃ nanocomposite via *Anisomeles indica* leaf extract: a recyclable heterogeneous catalyst for aqueous Petasis reaction, photocatalytic dye degradation, and antibacterial applications. RSC Advance. 15: 41995-42008.



Asparagus racemosus

***Asparagus racemosus* Willd.**

Asparagaceae

Habit: Climber

Common name: Satavari

Vernacular name(s): Satavari (Hindi, Odia, Bengali and Marathi).

Description

It is a thorny climbing undershrub with a woody, twining stem. Roots are tuberous, fleshy and arranged in clusters. True leaves are reduced to scales. Photosynthesis is carried out by needle-like cladodes. Flowers are small, white and fragrant. Fruit is a globose red berry containing black seeds.

Antibacterial properties

- ❖ The methanol extract of *A. racemosus* roots shows significant *in vitro* antibacterial activity against a wide panel of both Gram-positive and Gram-negative bacteria, including *Escherichia coli*, *Shigella dysenteriae*, *Shigella sonnei*, *Shigella flexneri*, *Vibrio cholerae*, *Salmonella typhi*, *Salmonella typhimurium*, *Pseudomonas putida*, *Bacillus subtilis* and *Staphylococcus aureus*.
- ❖ The ethanolic extract of *A. racemosus* roots exhibits antibacterial activity against both Gram-negative and Gram-positive organisms such as *Proteus mirabilis*, *E. coli*, *Klebsiella pneumoniae* and *P. putida*.
- ❖ Ethanol extracts of *A. racemosus* leaf tissue possess antibacterial activity against *Bacillus pumilis*, *B. subtilis*, *E. coli*, *Pseudomonas aeruginosa*, *Proteus vulgaris* and *S. aureus*.
- ❖ *A. racemosus* aqueous extracts have also been reported to show antibacterial effects against *E. coli*, *P. aeruginosa*, and *Vibrio parahaemolyticus*. These effects are attributed to phytochemicals such as tannins, saponins and flavonoids with known antimicrobial properties.

Mandal SC, Nandy A, Pal M and Saha BP. (2000). Evaluation of antibacterial activity of *Asparagus racemosus* Willd. root. *Phytotherapy Research*. 14(2): 118-119.

Battu GR, Kumar BM and Battu GR. (2010). Phytochemical and antimicrobial activity of leaf extract of *Asparagus racemosus* Willd. *Pharmacognosy Journal*. 2(12): 456-463.

Kumaran T, Geethu S and Citarasu T. (2019). Pharmacological investigation, medicinal uses and antibacterial studies of the root extract *Asparagus racemosus*. *International Journal of Chemical Science*. 3(2): 29-32.

Azadirachta indica



***Azadirachta indica* A. Juss.**

Meliaceae

Habit: Tree

Common name: Neem

Vernacular name(s): Neem (Hindi) and Nimba (Sanskrit and Odia).

Description

It is a medium to large evergreen tree with a stout trunk. Bark is rough and fissured. Leaves are imparipinnate with serrate leaflets. Flowers are small, white and arranged in axillary panicles. Fruits are smooth, ovoid drupes. Seeds are single, enclosed in a hard endocarp.

Antibacterial properties

- ❖ Methanolic leaf extracts of *A. indica* have demonstrated *in vitro* antibacterial activity against multiple pathogenic bacteria, including both Gram-positive and Gram-negative strains. Zones of inhibition (>10 mm) have been recorded against *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Escherichia coli*, *Proteus* species, *Enterococcus faecalis*, *Staphylococcus aureus*, *Staphylococcus epidermidis* and others at tested concentrations, indicating broad-spectrum efficacy.
- ❖ Crude bark extracts of *A. indica* also shows antibacterial activity. Agar diffusion and broth microdilution assays reveal inhibition of *E. faecalis*, *P. aeruginosa* and *Proteus mirabilis* across tested concentrations, and zones of inhibition against *S. aureus* at higher extract concentrations (>500 µg/mL).
- ❖ Ethanol extracts of neem leaves have been shown to inhibit both Gram-positive (*S. aureus*, *Bacillus cereus*) and Gram-negative bacteria (*E. coli*, *Salmonella* species) in agar diffusion assays, with significant zones of inhibition noted at higher extract concentrations.

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- Khan S and Junaid A. (2023). Evaluating the antibacterial activity of *Azadirachta indica* extracts on *Escherichia coli* and *Salmonella* spp. Interdisciplinary Journal of Agriculture and Environmental Sciences. 9(2): 19-25.
- Singaravelu S, Sankarapillai J, Sasidharn Chandrakumari A and Sinha P. (2019). Effect of *Azadirachta indica* crude bark extracts concentrations against Gram-Positive and Gram-Negative bacterial pathogens. Journal of Pharmacy and Bioallied Sciences. 11(1): 33-37.
- Altayb HN, Yassin NF, Hosawi S and Kazmi I. (2022). *In-vitro* and *in-silico* antibacterial activity of *Azadirachta indica* (Neem), methanolic extract, and identification of Beta. d-Mannofuranoside as a promising antibacterial agent. BMC Plant Biology. 22(1): 262. <https://doi.org/10.1186/s12870-022-03650-5>

Bacopa monnieri



***Bacopa monnieri* (L.) Pennell. Plantaginaceae**

Habit: Herb

Common name: Brahmi

Vernacular name(s): Brahmi (Hindi, Odia, Marathi and Bengali).

Description

It is a perennial creeping herb with soft stems. Stems are prostrate and root at nodes. Leaves are opposite, obovate, fleshy and glabrous. Flowers are solitary, axillary and pale blue to white. Calyx and corolla are five-lobed. Fruit is an ovoid capsule with numerous seeds.

Antibacterial properties

- ❖ The methanol extract of *B. monnieri* leaf exhibits antibacterial activity against a wide range of both Gram-positive and Gram-negative bacteria, like *Klebsiella pneumoniae*, *Escherichia coli*, *Proteus vulgaris*, *Bacillus subtilis*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Salmonella typhi* and *Shigella* species.
- ❖ Methanolic and ethanolic leaf extracts demonstrated antibacterial activity against uropathogenic bacteria such as *K. pneumoniae* and *Proteus mirabilis* in agar well diffusion assays. Activity was concentration-dependent, and the aqueous extract was the least active among the tested solvents.
- ❖ In another susceptibility study, methanol extracts exhibited a zone of inhibition (~ 9-14 mm) against *Bacillus* species (Gram positive) and *E. coli* (Gram-negative), while ethanol and aqueous extracts showed weaker activity. This indicates that methanol extracts are generally more effective than ethanol or aqueous extracts against both types of bacteria.

Mehta J, Utkarsh K, Fuloria S, Singh T, Sekar M, Salaria D, Rolta R, Begum MY, Gan SH, Rani NNIM, Chidambaram K, Subramaniyan V, Sathasivam KV, Lum PT, Uthirapathy S, Fadare OA, Awofisayo O and Fuloria NK. (2022). Antibacterial potential of *Bacopa monnieri* (L.) Wettst. and its bioactive molecules against uropathogens-an in silico study to identify potential lead molecule(s) for the development of new drugs to treat urinary tract infections. *Molecules*. 27(15): 4971. <https://doi.org/10.3390/molecules27154971>

Fazlul MKK, Deepthi SP, Mohammed I, Farzana Y, Munira B and Nazmul MHM. (2019). Antibacterial and antifungal activity of various extracts of *Bacopa monnieri*. *International Journal of Pharmaceutical Research*. 11(1): 1698-1702.

Verma M. (2016). Antimicrobial screening of the leaf extracts of *Bacopa monnieri* (L) Pennell. *International Journal of Current Pharmaceutical Research*. 8(2): 21-23.

Begonia picta



***Begonia picta* Sm.**

Begoniaceae

Habit: Herb

Common name: Painted leaf begonia

Vernacular name(s): Patharchatta (Odia).

Description

It is a perennial herb with erect flowering shoots. Leaves are simple, alternate, broadly ovate to orbicular. Flowers are showy, pink to white, borne in axillary cymes. Fruit is a three-winged capsule containing numerous minute seeds.

Antibacterial properties

- ❖ The ethyl acetate extract of *B. picta* demonstrated antibacterial activity specifically against *Salmonella typhi*, while the n-hexane and methanol extracts did not show significant activity against common test bacteria such as *Staphylococcus aureus* or *Escherichia coli*. This suggests a solvent-dependent spectrum of antibacterial activity with potential specificity toward certain Gram-negative pathogens.
- ❖ Broader work on *Begonia* species shows that various solvent extracts exhibit antimicrobial effects against *Staphylococcus epidermidis*, *E. coli*, *Bacillus subtilis* and other bacteria. This general pattern across *Begonia* species suggests that *B. picta* may possess understudied antibacterial potential beyond the one reported result.

Borah D, Dutta R, Majumdar S and Mili C. (2025). *Begonia* species: a review on its ethnobotany, phytochemicals, and biological activities. Discover Plants. 2: 182. <https://doi.org/10.1007/s44372-025-00272-7>

Shrestha N, Itani R and Khanal DP. (2016). Pharmacognostic, phytochemical, antioxidant and antibacterial activity studies on *Begonia picta*. World Journal of Pharmaceutical Research. 5(1): 979-997.

Barleria prionitis



***Barleria prionitis* L.**

Acanthaceae

Habit: Shrub

Common name: Porcupine flower

Vernacular name(s): Vajradanti (Hindi/Sanskrit) and Daskeranta (Odia).

Description

It is an erect spiny shrub with quadrangular branches. Leaves are opposite, ovate and glabrous. Spines are modified bracts and calyx lobes. Flowers are large, bright yellow and axillary. Calyx is rigid and spiny. Fruit is a two-seeded capsule.

Antibacterial properties

- ❖ Methanolic extract of *B. prionitis* leaves demonstrates inhibitory activity against both Gram-positive and Gram-negative bacteria, such as *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis* and *Salmonella enterica*, as well as antifungal activity against *Candida albicans* and *Aspergillus niger* in agar diffusion assays. The methanol extract was the most potent among solvents tested (Ethyl acetate, acetone, petroleum ether and chloroform).
- ❖ Ethanolic leaf extract of *B. prionitis* exhibited significant antimicrobial activity against a panel of pathogenic bacteria with minimum inhibitory concentrations (MIC) typically between ~53.1-106.2 µg/mL for bacterial strains, indicating relatively strong antibacterial potency.
- ❖ In a separate study using aqueous, petroleum ether, chloroform and acetone extracts of *B. prionitis* leaves, all extracts were found to inhibit the growth of oral disease-associated bacteria such as *Lactobacillus rhamnosus*, *Staphylococcus aureus*, *B. subtilis*, *Actinomyces viscosus*, *Staphylococcus epidermidis*, *E. coli* and *Streptococcus mutans* in disc diffusion assays, with chloroform extract showing particularly notable inhibition.

Khare A. (2016). Phytochemical and antimicrobial activity of *Barleria prionitis* leaves. International Journal of Applied Research. 2(10): 95-97.

Bawake SS, Lamrood PY and Gaykar BM. (2024). Broad-spectrum antimicrobial activity of *Barleria Prionitis* Linn.: A focus on solvent specific efficacy. African Journal of Biomedical Research. 27(3S): 974-984.

Sawarkar HA, Kashyap PP, Pandey AK, Singh MK and Kaur CD. (2016). Antimicrobial and cytotoxic activities of *Barleria prionitis* and *Barleria grandiflora*: A comparative study. Bangladesh Journal of Pharmacology. 11: 802-809.



Biophytum sensitivum

***Biophytum sensitivum* (L.) DC. Oxalidaceae**

Habit: Herb

Common name: Tropical little tree plant

Vernacular name(s): Jharasi (Hindi) and Lokachana (Odia).

Description

It is a small erect herb with a short unbranched stem. Leaves are pinnate and sensitive to touch. Leaflets fold on mechanical stimulation. Flowers are yellow and borne on long peduncles. Calyx and corolla are five-lobed. Fruit is a small capsule with numerous seeds.

Antibacterial properties

- ❖ Multiple solvent extracts (except n-hexane) of *B. sensitivum* callus exhibited antimicrobial activity against both Gram-positive and Gram-negative bacteria, with inhibition zones ranging from ~4.5-22.9 mm at 100 ppm in agar well diffusion assays.
- ❖ Ethanolic extracts of *B. sensitivum* whole plant have been shown to inhibit pathogenic bacteria with MIC values indicating antibacterial effectiveness against *Escherichia coli* (~456 µg/mL), *Pseudomonas aeruginosa* (~419 µg/mL), *Klebsiella pneumoniae* (~419 µg/mL) and *Staphylococcus aureus* (~398 µg/mL). This demonstrates broad antimicrobial potential across both Gram-negative and Gram-positive bacteria, with various phytochemicals (flavonoids, tannins, saponins, terpenes and steroids) present in the extract.
- ❖ Aqueous and ethanolic leaf extracts of *B. sensitivum* were tested against *E. coli*, *P. aeruginosa*, *Acinetobacter baumannii*, *Bacillus megaterium*, *Bacillus subtilis* and *Brevibacillus choshinensis*. Both aqueous and ethanol extracts showed measurable antibacterial effects against several of these pathogens, although specific inhibition values depend on the extract and strain.

Asha S and Radhakrishnan RD. (2023). Analysis of the antibacterial potentials of the leaf extracts of selected medicinal plants against pathogenic bacterial strains. *Notulae Scientia Biologicae*. 15(3): 11575. <https://doi.org/10.55779/nsb15311575>

Kala SC, Vijayalakshmi M, Khalivulla SI and Mallikarjuna K. (2014). Phytochemical and antimicrobial analysis of callus extracts of *Biophytum Sensitivum* (Linn) DC. *Microbiology Research Journal International*. 4(8): 869-884.

Christabel HPR, Dhanaraj TS and Ramamurthy V. (2025). Phytochemical analysis and antibacterial activity of *Biophytum sensitivum*. *International Journal of Biosciences*. 27(2): 300-305.



Boerhavia diffusa

***Boerhavia diffusa* L.**

Nyctaginaceae

Habit: Herb

Common name: Punarnava

Vernacular name(s): Punarnava (Hindi/ Sanskrit) and Puruni saga (Odia).

Description

It is a perennial prostrate herb with thickened rootstock. Stems are spreading and succulent. Leaves are ovate and unequal at the base. Flowers are small, pink and arranged in umbels. Perianth is petaloid. Fruit is an anthocarp enclosing a single seed.

Antibacterial properties

- ❖ Ethanol extract of *B. diffusa* leaves exhibits strong antibacterial activity against both Gram-positive (*Staphylococcus aureus*) and Gram-negative (*Escherichia coli*) bacteria in agar diffusion assays. The ethanol extract produced zones of inhibition up to $\sim 17.8 \pm 0.3$ mm against *S. aureus* and $\sim 14.2 \pm 0.2$ mm against *E. coli*. MIC values for ethanol extract ranged from 0.0625 to 0.125 mg/ μ L, indicating potent antimicrobial effects at relatively low concentrations. The acetone extract also showed inhibitory activity, whereas aqueous extracts were generally less active.
- ❖ Methanolic extracts also show antibacterial action against *Pseudomonas aeruginosa* and *S. aureus* with zones of inhibition ranging ~ 25 -30 mm at concentrations of 100-200 mg/mL.
- ❖ Crude extracts (methanol, ethanol, chloroform, ethyl acetate and aqueous) from *B. diffusa* leaves and roots have demonstrated activity against a wide range of Gram-positive and Gram-negative bacteria, including *S. aureus*, *Bacillus subtilis*, *Streptococcus faecalis*, *Shigella flexneri*, *Proteus vulgaris*, *Salmonella typhi*, *Klebsiella pneumoniae*, *Vibrio cholerae* and *P. aeruginosa*.

Abhayarathna AHYG and Mahendranathan C. (2024). *In-vitro* antibacterial activity of *Boerhavia diffusa* leaf extract against *Staphylococcus aureus* and *Escherichia coli*. Ceylon Journal of Science. 53(1): 45-49.

Umamaheswari A, Nuni A and Shreevidya R. (2010). Evaluation of antibacterial activity of *Boerhaavia diffusa* L. leaves. International Journal of Green Pharmacy. 4(2): 75-78.

Reshawn MI, Priyadharshini R, Kumar SR and Sinduja P. (2021). Analysis of antimicrobial activity of aqua alcoholic extract of *Boerhaavia diffusa* against oral pathogens - an in vitro study. Journal of Pharmaceutical Research International. 33(60B): 3921-3928.



Bombax ceiba

***Bombax ceiba* L.**

Malvaceae

Habit: Tree

Common name: Silk cotton tree

Vernacular name(s): Semal (Hindi), Shimul (Bengali) and Simili (Odia).

Description

It is a tall deciduous tree with a stout, spiny trunk. Branches are horizontal in young trees. Leaves are palmately compound. Flowers are large, red and appear before leaves. Fruits are woody capsules. Seeds are embedded in silky cotton fibres.

Antibacterial properties

- ❖ Methanolic extract of the stem bark of *B. ceiba* exhibited inhibitory effects against both Gram-positive and Gram-negative bacteria in agar diffusion assays. The extract inhibited *Staphylococcus aureus* with a zone of inhibition up to ~24 mm and also significantly reduced the growth of *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis* and *Salmonella typhi* in a dose-dependent manner, indicating broad-spectrum activity.
- ❖ In stem bark phytochemical and antimicrobial studies, both methanol and ethanol extracts inhibited *P. aeruginosa* (~21.8 mm and ~21.3 mm zones, respectively). Methanol extract also inhibited *B. subtilis* (~17.1 mm) and ethanol extract showed good activity against *Xanthomonas maltophilia* (up to ~20.6 mm). Aqueous extracts showed moderate activity against *E. coli* (~16 mm).
- ❖ Ethanol extract of *B. ceiba* leaves exhibited antibacterial activity with notable inhibition against *P. aeruginosa* (~25.3 mm zone of inhibition).

Shah SS, Iqbal A, Ahmed S, Khan WM, Hussain S and Li Z. (2018). Report: Phytochemical screening and antimicrobial activities of red silk cotton tree (*Bombax ceiba* L.). Pakistan Journal of Pharmaceutical Sciences. 31(3): 947-952.

Ur-Rehman M, Akhtar N and Mustafa R. (2017). Antibacterial and antioxidant potential of stem bark extract of *Bombax ceiba* collected locally from South Punjab area of Pakistan. African Journal of Traditional, Complementary and Alternative Medicines. 14(2): 9-15.

Kumari S, Ambastha S, Kumari A, Patnaik A and Sharan L. (2023). Phytochemical screening and antimicrobial activities of leaves of *Bombax ceiba* L. South Asian Journal of Experimental Biology. 13(5): 381-385.

Butea monosperma



***Butea monosperma* (Lam.) Taub.**

Fabaceae

Habit: Tree

Common name: Flame of the forest

Vernacular name(s): Palash (Hindi, Odia, Marathi and Bengali).

Description

It is a medium-sized deciduous tree with a crooked trunk. Leaves are trifoliate with a large terminal leaflet. Flowers are bright orange-red. Inflorescence is dense axillary racemes. Fruit is a flat pod. Pod usually contains a single seed.

Antibacterial properties

- ❖ Ethanolic extracts of flowers and stems of *B. monosperma* demonstrate significant antibacterial activity against both Gram-positive and Gram-negative bacteria, including *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas aeruginosa*.
- ❖ Methanolic extracts of *B. monosperma* (leaves, twigs, bark) are found to be more active than aqueous extracts in inhibiting *S. aureus*, *Bacillus cereus*, *B. subtilis*, *E. coli* and *P. aeruginosa* when tested by agar diffusion. This is attributed to phenols, flavonoids, and tannins extracted in methanol, which are known antimicrobial phytochemicals.
- ❖ Leaf extracts obtained with petroleum ether show antibacterial effects in agar well diffusion assays, with activity increasing with concentration against *B. subtilis*, *S. aureus*, *E. coli* and *P. aeruginosa*.
- ❖ Some studies have shown that aqueous extracts of flowers can inhibit several human pathogenic bacteria (*Pseudomonas* species, *Vibrio cholerae*, *Salmonella* species, *Staphylococcus aureus*, *Micrococcus luteus*).

Desmukh MM and Gurme MK. (2022). Antimicrobial activity of *Butea monosperma* extracts against human pathogenic bacteria. International Journal of Research Publication and Reviews. 3(1): 647-650.

Puri ES, Rani AS and Sulakshana G. (2021). Evaluation of antibacterial potential of *Butea Monosperma* leaf extract. International Journal of Scientific Research in Biological Sciences. 8(5): 59-61.

Munawar M, Aruna K and Rao RSV. (2018). Evaluation of antibacterial and antioxidant activity of ethanolic extracts of *Butea monosperma*. World Journal of Pharmaceutical Research. 7(3): 730-740.

Yaduvanshi PS, Yadav R, Jain G, Sawle JR and Sharma S. (2021). Anti-microbial evaluation of twigs of *Butea monosperma* Lam. Natural Volatiles and Essential Oils. 8(5): 2883-2894.

Byttneria herbacea



***Byttneria herbacea* Roxb.**

Malvaceae

Habit: Herb

Common name: Herbaceous ayenia

Vernacular name(s): Sanalaliya and Makra phula (Odia).

Description

It is a slender twining climber with an elongated stem. Leaves are cordate with long petioles. Stems and leaves are softly pubescent. Flowers are small and yellowish. Inflorescence is an axillary cyme. Fruit is a spiny capsule with several seeds.

Antibacterial properties

- ❖ Methanolic and other extracts from the root and whole plant of *B. herbacea* exhibit antibacterial activity against both Gram-positive and Gram-negative bacteria. These extracts produced measurable zones of inhibition against *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*, which are commonly implicated in wound infections.
- ❖ In agar well diffusion testing with a broad range of solvents (n-hexane, petroleum ether, ethyl acetate, chloroform, acetone, methanol, ethanol and water), *B. herbacea* extracts showed strong antibacterial activity against a panel of bacteria, including Gram-positive: *Streptococcus epidermidis*, *S. aureus*, *Bacillus cereus*; and Gram-negative: *Escherichia coli*, *Salmonella typhi*, *K. pneumoniae* and *Serratia marcescens*.
- ❖ *B. herbacea* leaf extract shows exceptional antimicrobial activity in vitro, attributed to plant-derived reducing agents stabilising the nanoparticles. These BH-AgNPs demonstrate strong antibacterial effects, likely against both Gram-negative and Gram-positive bacteria.

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- Subramanyam GK, Gaddam SA, Kotakadi VS, Gunti H, Palithya S, Penchalaneni J and Challagundla VN. (2023). Green fabrication of silver nanoparticles by leaf extract of *Byttneria Herbacea* Roxb. and their promising therapeutic applications and its interesting insightful observations in oral cancer. *Artificial Cells, Nanomedicine, and Biotechnology*. 51(1): 83-94.
- Revathy M, Sundararajan PN and Kasturi M. (2019). Error detection and correction method for timing errors in registers. *Indian Journal of Natural Sciences*. 10(57): 17763-17953.
- Sharma T, Kumar V, Nariya M and Acharya R. (2023). Evaluation of wound healing and antimicrobial activity of root and whole plant of *Byttneria herbacea* Roxb. (Samarakhadyam). *Indian Journal of Natural Products and Resources*. 14(4): 564-572.

Caesalpinia bonduc



***Caesalpinia bonduc* (L.) Roxb.**

Fabaceae

Habit: Shrub

Common name: Fever nut

Vernacular name(s): Karanjwa (Hindi) and Gila lata (Odia).

Description

It is a prickly climbing shrub with rigid branches. Stems and leaf rachis bear sharp, recurved prickles. Leaves are bipinnate. Flowers are yellow and arranged in racemes. Fruit is an inflated, spiny pod. Seeds are hard, globose and grey.

Antibacterial properties

- ❖ Crude methanol extract of *C. bonduc* leaves and its ethyl acetate, chloroform and petroleum ether fractions demonstrate antibacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa*, which were particularly sensitive to chloroform and ethyl acetate fractions, while the methanol extract also showed detectable inhibition, indicating broad-spectrum action.
- ❖ Soxhlet extracts of *C. bonduc* seeds prepared in a sequence of solvents exhibited antibacterial inhibition against pathogens like *P. aeruginosa*, *Proteus mirabilis*, *Shigella dysenteriae*, *S. aureus* and *Enterococcus faecalis*. In particular, chloroform extracts demonstrated effective antibacterial activity in these assays.
- ❖ Multiple solvent extracts from leaves, bark and seeds (e.g., dichloromethane, ethyl acetate, methanol) showed strong antimicrobial effects against *Staphylococcus epidermidis*, *Escherichia coli*, *Salmonella paratyphi*, *Candida albicans* and other microbes in broad screening studies, with methanol extracts often showing the highest activity.

Elango VP, Irulandi K, Suresh M and Mehalingam P. (2016). Evaluation of phytochemical analysis and antimicrobial activity of different solvent seed extracts of *Caesalpinia bonduc* (L.) Roxb. International Journal of Botany Studies. 1(4): 19-21.

Savaji P, Navanit S and Nayeem A. (2014). Phytochemical extraction and antibacterial studies of *Caesalpinia bonduc* seed extracts. Mapana Journal of Sciences. 13(4): 47-54.

Billah MM, Islam R, Khatun H, Parvin S, Islam E, Islam SA and Mia AA. (2013). Antibacterial, antidiarrhoeal, and cytotoxic activities of methanol extract and its fractions of *Caesalpinia bonduc* (L.) Roxb leaves. BMC Complementary and Alternative Medicine. 13: 101. <https://doi.org/10.1186/1472-6882-13-101>

Calotropis gigantea



***Calotropis gigantea* (L.) Dryand. Apocynaceae**

Habit: Shrub

Common name: Crown flower

Vernacular name(s): Arakha (Hindi, Odia and Bengali).

Description

It is an erect perennial shrub with a thick woody stem. All parts exude milky latex. Leaves are large, ovate and greyish-green. Flowers are showy, bluish-purple in umbels. Fruit is a large follicle. Seeds are flat with silky tufts.

Antibacterial properties

- ❖ Crude methanol and ethanol extracts of *C. gigantea* (leaves and roots) display antibacterial activity against both Gram-positive and Gram-negative bacteria. In agar diffusion assays, these extracts inhibited *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Salmonella typhimurium* with measurable zones of inhibition.
- ❖ Aqueous and ethanolic extracts of root and leaf showed varying inhibition zones against *E. coli*, *S. aureus*, *P. aeruginosa*, *Bacillus cereus* and *Klebsiella aerogenes*, with both extract types confirming the presence of antibacterial phytochemicals.
- ❖ Root bark methanol extract and chloroform fraction showed inhibition of *Sarcina lutea*, *Bacillus megaterium* and *P. aeruginosa* in disc diffusion assays.
- ❖ Some studies also report that latex extracts possess antimicrobial effects, with significant inhibition of *E. coli* and *S. aureus* and quantifiable MIC values, supporting traditional use against bacterial infections.

Hussain A, Bano S, Rehman Z, Waheed F, Bashir T, Alam S and Nawaz U. (2024). Phytochemical screening, antimicrobial and antioxidant activities of *Salvadora Persica* and *Calotropis gigantea* extracts against selected pathogens. Biological and Clinical Sciences Research Journal. 2024: 1241. <https://doi.org/10.54112/bcsrj.v2024il.1241>

Julius OO, Oluwasusi VO, Ibiyemi MF and Oluwatobi FB. (2021). Antibacterial activities and phytochemical screening of crude extracts of *Calotropis Gigantea* (Giant Milkweed). South Asian Journal of Research in Microbiology. 9(3): 24-31.

Nasir K and Khan MA. (2020). Antimicrobial activity of latex of *Calotropis gigantea* against some bacteria. Advances in Agriculture and Biology. 3(1): 32-37.

Alam MA, Habib MR, Nikkon R, Rahman M and Karim MR. (2008). Antimicrobial activity of Akanda (*Calotropis gigantea* L.) on some pathogenic bacteria. Bangladesh Journal of Scientific and Industrial Research. 43(3): 397-404.

Calotropis procera



Calotropis procera (Aiton) Dryand.

Apocynaceae

Habit: Shrub

Common name: Apple of sodom

Vernacular name(s): Arakha (Hindi, Odia and Bengali).

Description

It is a robust perennial shrub with spreading branches. Leaves are obovate and leathery. Flowers are white with a purplish tinge. Inflorescence is an umbellate cyme. Fruit is a large, inflated follicle with silky-haired seeds.

Antibacterial properties

- ❖ Ethanolic extracts of *C. procera* leaves demonstrate significant antibacterial effects against both Gram-positive and Gram-negative bacteria. In agar diffusion assays, the ethanolic leaf extract showed inhibition zones against *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Bacillus subtilis* and *Escherichia coli*.
- ❖ Leaf extracts of *C. procera* prepared in ethanol showed antibacterial activity against methicillin- and vancomycin-resistant clinical isolates, including *S. aureus*, *E. coli*, *Pseudomonas aeruginosa*, *K. pneumoniae*, *Proteus mirabilis*, and *Streptococcus pyogenes*.
- ❖ Aqueous extracts of *C. procera* leaves also possess antibacterial activity against *S. aureus* and *Staphylococcus epidermidis*; they had lower MICs (~16 mg/mL; more sensitive), while *E. coli* and *Salmonella typhimurium* were more resistant (MIC ~128 mg/mL). *C. procera* aqueous extract exhibited pronounced inhibition of Gram-positive bacteria relative to Gram-negative bacteria.

Nejhad AA, Behbahani AB, Hojjati M, Vasiee A and Mehrnia MA. (2023). Identification of phytochemical, antioxidant, anticancer and antimicrobial potential of *Calotropis procera* leaf aqueous extract. Scientific Reports. 13(1): 14716. <https://doi.org/10.1038/s41598-023-42086-1>

Akindele PO, Fatunla OA, Ibrahim KA and Afolayan CO. (2017). Antibacterial and phytochemical screening of *Calotropis Procera* leaf extracts against vancomycin and methicillin resistant bacteria isolated from wound samples in hospital patients. Journal of Complementary and Alternative Medical Research. 2(1): 1-14.

Saddiq AA, Tag HM, Doleib NM, Salman AS and Hagagy N. (2022). Antimicrobial, antigenotoxicity, and characterization of *Calotropis procera* and its rhizosphere-inhabiting Actinobacteria: In Vitro and In Vivo Studies. Molecules. 27(10): 3123. <https://doi.org/10.3390/molecules27103123>

Carissa spinarum



Carissa spinarum L.

Apocynaceae

Habit: Shrub

Common name: Conkerberry

Vernacular name(s): Karaunda (Hindi) and Khira koli (Odia).

Description

It is a rigid, spiny shrub with woody branches. Spines are modified branches. Leaves are opposite, elliptic and glossy. Flowers are white and fragrant. Fruits are ovoid berries. Seeds are few and embedded in soft pulp.

Antibacterial properties

- ❖ Ethanolic and methanolic extracts of *C. spinarum* exhibit significant antibacterial activity against both Gram-positive and Gram-negative pathogens. Reported inhibition includes *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas aeruginosa*.
- ❖ Fractionated extracts, especially ethyl acetate and n-butanol fractions, display stronger and broader antibacterial activity than crude extracts. These enriched fractions were highly active against *S. aureus*, *Streptococcus pyogenes*, *Proteus vulgaris* and *E. coli*.
- ❖ Chloroform, methanol, and aqueous extracts of *C. spinarum* fruit and bark exhibit antibacterial activity against multiple clinical strains like *E. coli*, *Enterobacter aerogenes*, *Klebsiella pneumoniae*, *S. aureus* and *Bacillus cereus*. Ethanol and chloroform extracts showed maximum inhibition, while the aqueous extract demonstrated moderate effects.
- ❖ Aqueous extracts of leaf and root show dose-dependent antibacterial activity, particularly against *S. aureus*, *Staphylococcus epidermidis*, and *Streptococcus mutans*. Gram-negative bacteria such as *E. coli* and *K. pneumoniae* show reduced susceptibility, consistent with lower permeability to polar compounds.

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- Ayalew TT, Ayalew TG, Chekol AE and Mengie AT. (2022). Phytochemical investigation and determination of antibacterial activity of solvent leave extracts of *Carissa spinarum*. Infection and Drug Resistance. 15: 807-819.
- Sharma N, Kumar V, Gupta N, Shekhar P and Kaur PS. (2023). Traditional importance, phytochemistry, pharmacology, and toxicological attributes of the promising medicinal herb *Carissa spinarum* L. Separations. 10(3): 158. <https://doi.org/10.3390/separations10030158>
- Rubaka C, Ndakidemi P, Malebo H and Shahada F. (2014). Analysis of phytochemical and antibacterial activity of *Carissa spinarum* Linn crude extracts. European Journal of Medicinal Plants. 4(8): 937-945.



Cassia alata

***Cassia alata* L.**

Fabaceae

Habit: Shrub

Common name: Ringworm bush

Vernacular name(s): Dadmardan (Hindi), Dadrughna (Sanskrit) and Sana chakunda (Odia).

Description

It is a stout, erect shrub growing in open areas. Leaves are large and pinnate with broad leaflets. Flowers are bright yellow, arranged in erect candle-like spikes. Pods are long, winged and flat.

Antibacterial properties

- ❖ Crude ethanol and aqueous extracts of *C. alata* leaves and bark demonstrated antibacterial effects against *Staphylococcus aureus* in agar diffusion assays, with inhibition zones in the range of ~9-14 mm (aqueous extracts sometimes more active than ethanol extracts). *E. coli* often showed resistance to the extracts tested.
- ❖ Crude ether and methanol extracts of *C. alata* leaves and root showed concentration-dependent inhibition of *Neisseria gonorrhoeae* (a clinically resistant bacterial pathogen), with ether extracts more potent than methanol.
- ❖ Crude aqueous-polar extracts of *C. alata* inhibited Gram-positive organisms such as *S. aureus*, *Staphylococcus epidermidis* and *Bacillus subtilis*, also reduced biofilm formation, supporting potential use against biofilm-forming skin pathogens.

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- Saito ST, Trentin Dda S, Macedo AJ, Pungartnik C, Gosmann G, Silveira Jde D, Guecheva TN, Henriques JA and Brendel M. (2012). Bioguided fractionation shows *Cassia alata* extract to inhibit *Staphylococcus epidermidis* and *Pseudomonas aeruginosa* growth and biofilm formation. Evidence-Based Complementary and Alternative Medicine. 2012: 867103. <https://doi.org/10.1155/2012/867103>
- Somchit MN, Reezal I, Nur IE and Mutalib AR. (2003). In vitro antimicrobial activity of ethanol and water extracts of *Cassia alata*. Journal of Ethnopharmacology. 84(1): 1-4.
- Otto RB, Ameso S and Onegi B. (2014). Assessment of antibacterial activity of crude leaf and root extracts of *Cassia alata* against *Neisseria gonorrhoea*. African Health Sciences. 14(4): 840-848.



Cassia fistula

Cassia fistula L.

Fabaceae

Habit: Tree

Common name: Golden shower tree

Vernacular name(s): Amaltas (Hindi) and Sunari (Odia).

Description

It is a medium-sized deciduous tree with a spreading crown. Leaves are pinnate with several pairs of leaflets. Flowers are bright yellow, arranged in long, pendulous racemes. Pods are cylindrical and black when mature. Seeds are embedded in sweet pulp.

Antibacterial properties

- ❖ Methanolic and ethanolic extracts of *C. fistula* leaves have been shown to inhibit both Gram-positive and Gram-negative bacteria, including *Bacillus cereus*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli* and *Klebsiella pneumoniae* when tested by disc diffusion.
- ❖ Petroleum ether, chloroform, ethanol, methanol and aqueous leaf extracts exhibited antibacterial activity, particularly against Gram-positive bacteria, with ethanol extract showing the highest activity. MIC values for polar extracts ranged from 94 to 1500 µg/mL.
- ❖ Ethanol extracts of *C. fistula* bark and their ethyl acetate fractions inhibited *Salmonella typhi* and *Shigella dysenteriae* with MICs of 0.3125% and 0.625% *in vitro* and also significantly reduced *S. typhi* colony counts in animal infection models.
- ❖ Some studies reported that methanolic leaf extract of *C. fistula* inhibited *S. aureus*, though it showed little activity against *E. coli*, *Proteus* and *Pseudomonas aeruginosa* in that particular isolated test.

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- Kamath BR and Kizhedath S. (2019). In vitro antibacterial activity of *Cassia fistula* Linn methanolic leaf extracts. International Journal of Basic and Clinical Pharmacology. 8(2): 270-274.
- Chaerunisaa AY, Susilawati Y, Muhaimin M, Milanda T, Hendriani R and Subarnas A. (2020). Antibacterial activity and subchronic toxicity of *Cassia fistula* L. barks in rats. Toxicology Reports. 7: 649-657.
- Panda SK, Padhi LP and Mohanty G. (2011). Antibacterial activities and phytochemical analysis of *Cassia fistula* (Linn.) leaf. Journal of Advanced Pharmaceutical Technology and Research. 2(1): 62-67.
- Seyyednejad SM, Motamedi H, Vafei M and Bakhtiari A. (2014). The antibacterial activity of *Cassia fistula* organic extracts. Jundishapur Journal of Microbiology. 7(1): e8921. <https://doi.org/10.5812/jjm.8921>

Celastrus paniculatus



***Celastrus paniculatus* Willd.**

Celastraceae

Habit: Climber

Common name: Black oil plant

Vernacular name(s): Jyotishmati (Sanskrit), Malkangani (Hindi) and Kujuri & Pengu (Odia).

Description

It is a large woody climber commonly found in deciduous forests. Leaves are ovate, serrate and glabrous. Flowers are small, greenish-white, in terminal panicles. Fruits are yellow capsules splitting open at maturity. Seeds are enclosed in bright red arils.

Antibacterial properties

- ❖ Leaf extracts of *C. paniculatus* prepared with solvents such as n-butanol, acetone and methanol demonstrated antibacterial activity against both Gram-positive and Gram-negative bacteria in agar well diffusion and micro-broth assays. The n-butanol extract exhibited the highest antibacterial activity, while aqueous extracts showed negligible antibacterial effects.
- ❖ *C. paniculatus* mediated copper nanoparticles (CuNPs) were tested for antimicrobial activity using the agar well diffusion method and showed a dose-dependent increase in inhibition against *Streptococcus mutans*, *Candida albicans* and *Lactobacillus* species indicating potential antibacterial and antifungal efficacy.

Naik PK, Dubey D, Cheruvanachari P, Pattnaik A and Babu SK. (2020). In vitro evaluation of antibacterial and antioxidant properties of an Indian medicinal plant: *Celastrus paniculatus* Willd. Journal of Biomedical and Pharmaceutical Research. 9(1). <https://doi.org/10.32553/jbpr.v9i1.726>

Priyadharshini KSK, Arivarasu L and Rajeshkumar S. (2020). Antioxidant and antimicrobial activity of *Celastrus paniculatus* mediated copper nanoparticles. Plant Cell Biotechnology and Molecular Biology. 21(29-30): 38-43.

Celosia argentea



Celosia argentea L.

Amaranthaceae

Habit: Herb

Common name: Cockscomb

Vernacular name(s): Kurdu (Hindi, Marathi) and Ganja chulia (Odia).

Description

It is an erect annual herb with a simple or branched stem. Leaves are alternate, lanceolate to ovate, with entire margins and tapering apex. Inflorescence is a dense terminal or axillary spike or plume. Flowers are small, bisexual, silvery white to pink or purple. Fruit is a small utricle containing numerous minute black seeds.

Antibacterial properties

- ❖ Historical and literature reviews report that *C. argentea* extracts, especially alcohol extracts of whole plant, leaves, or inflorescences, exhibit inhibition of both Gram-positive and Gram-negative bacteria, including *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Proteus vulgaris* with measurable zones of inhibition in agar diffusion assays.
- ❖ A recent phytopharmacological study evaluating *C. argentea* inflorescence extracts (ethanolic and aqueous) reported significant antibacterial action in disc diffusion assays, with ~20 mm inhibition against *S. aureus* and ~18 mm against *E. coli* for ethanolic extracts at 200 mg/mL; aqueous extracts also showed measurable zones.
- ❖ In a clinical antibacterial evaluation of leaf extracts tested against eight burn wound bacterial pathogens, *C. argentea* alcoholic leaf extract exhibited disc diffusion inhibition, demonstrating antibacterial effects comparable to conventional antimicrobial cream *in vitro*.

Gnanamani A, Priya KS, Radhakrishnan N and Babu M. (2003). Antibacterial activity of two plant extracts on eight burn pathogens. *Journal of Ethnopharmacology*. 86(1): 59-61.

Ruqsar A, Tejaswi G, Sravanthi A, Nikhitha B and Goud EP. (2025). Assessment of in-vitro anti-bacterial activity of *Celosia argentea* young inflorescence. *International Journal of Scientific Development and Research*. 10(7): a851-a855.

Tang Y, Xin Hl and Guo Ml. (2016). Review on research of the phytochemistry and pharmacological activities of *Celosia argentea*. *Revista Brasileira de Farmacognosia*. 26(6): 787-796.



DISTINCTIVE INSIGHTS AND PRACTICAL SIGNIFICANCE OF THE BOOK

Antibacterial Plants of India, Volume 1, presents a visually rich and scientifically grounded documentation of thirty selected antibacterial plant species from India, emphasising accurate botanical identification through detailed morphological descriptions supported by original field photographs. A distinctive feature of this pictorial volume is its strong taxonomic foundation, which minimizes misidentification, a common limitation in herbal and antibacterial research. Integrating growth habit, diagnostic morphological traits, vernacular names, and authenticated antibacterial evidence for each species, the book establishes a reliable bridge between classical plant taxonomy and contemporary microbiological validation. The compilation highlights India's immense floristic wealth and demonstrates that common herbs, shrubs, climbers and trees possess broad-spectrum antibacterial potential against both Gram-positive and Gram-negative pathogens, as documented through published scientific studies.

One of the peculiar findings emerging from this volume is the recurring pattern of solvent-dependent antibacterial efficacy across diverse plant taxa, with methanolic and ethanolic extracts consistently showing higher inhibitory activity than aqueous preparations. Several plants documented in the book, such as *Andrographis paniculata*, *Azadirachta indica*, *Acorus calamus*, *Boerhavia diffusa* and *Barleria prionitis* exhibit antibacterial activity against multi-pathogen, reinforcing their traditional reputation as broad-spectrum remedies. The book also reveals that different plant parts (leaves, roots, bark, rhizomes, flowers) vary markedly in antibacterial potency, highlighting the importance of precise plant-part selection in pharmacological research. Importantly, the visual correlation between morphology and bioactivity enhances interpretative clarity and encourages field-based learning and validation.

The book serves as a practical reference and teaching tool for students, researchers, academicians and practitioners in botany, pharmacy, microbiology, ethnobotany and allied life sciences. Its pictorial format makes it especially useful for plant identification during field surveys, biodiversity assessments and ethnobotanical documentation, while the compiled antibacterial data support hypothesis generation for drug discovery and research on antimicrobial resistance. Beyond academia, the volume has applied value for herbal practitioners, conservationists and policy planners by promoting awareness, sustainable utilization and conservation of medicinal plant resources. *Antibacterial Plants of India, Volume 1* functions not only as a visual catalogue but also as a scientific foundation for future experimental studies, translational research and subsequent volumes expanding the antibacterial plant repertoire of India.



ABBREVIATIONS

µg/mL - Microgram per millilitre

AgNPs - Silver Nanoparticles

AWD - Agar Well Diffusion

CuNPs- Copper Nanoparticles

DD - Disc diffusion

g - Gram

GC-MS - Gas chromatography–mass spectrometry

h - Hour

mg/mL - Milligram per millilitre

MIC - Minimum Inhibitory Concentration

mm - Millimetre

PPM - Parts Per Million

AUTHOR'S PROFILE

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He is working in the department of Higher Education, Government of Himachal Pradesh, India and presently posted as Associate Professor and Head, Department of Botany, Sidharth Government College, Nadaun, Himachal Pradesh, India. He has 24 years of academic experience. His field of specialization is Orchid Tissue Culture. His current research is focused on ethnobotany, biodiversity conservation, RET plants and pollination biology. He has published more than 45 research articles in reputed national and international journals. He has published 16 books, 92 book chapters in edited books, including Taylor and Francis, Apple Academic Press, and many popular articles. He has presented his research work in more than 64 international and national conferences, symposia and seminars. He has delivered invited lectures on several occasions. He has been awarded by the Himachal Pradesh Government for AIDS Awareness Campaign in 2023.



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