

Medicinal Importance of *Justicia adhatoda* in Traditional and Modern Medicine

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Abstract: *Justicia adhatoda* (syn. *Adhatoda vasica*), commonly known as *Vasaka* or *Malabar nut*, is an important medicinal plant extensively used in *Ayurveda*, *Siddha*, *Unani*, and traditional folk systems across Asia. For centuries, the plant has been valued for its therapeutic benefits in respiratory ailments, infectious diseases, inflammatory conditions, and various systemic disorders. The presence of unique quinazoline alkaloids such as *vasicine* and *vasicinone*, along with flavonoids, phenols, tannins, and essential oils, contributes to its broad pharmacological profile. Traditional literature describes its effectiveness as an expectorant, bronchodilator, antipyretic, and antimicrobial remedy.

In recent decades, modern pharmacological studies have validated many classical claims and expanded understanding of its therapeutic relevance. *J. adhatoda* exhibits diverse biological activities including anti-inflammatory, antioxidant, antimicrobial, antitussive, antimalarial, anti-ulcer, anti-typhoid, and immunomodulatory effects. Preclinical research also suggests its potential in chronic respiratory disorders such as asthma, chronic bronchitis, and tuberculosis. The plant's bioactive constituents demonstrate mechanisms involving enzyme inhibition, cytokine modulation, free radical scavenging, membrane stabilization, and pathogen suppression. Furthermore, advances in phytochemical analysis and formulation science have led to the development of standardized extracts and novel dosage forms, strengthening its modern therapeutic applications.

This review highlights the journey of *Justicia adhatoda* from traditional medicinal knowledge to contemporary scientific validation, presenting its phytochemistry, ethnomedicinal uses, pharmacological activities, and therapeutic potential. Despite extensive preclinical evidence, further clinical studies are required to establish safety, efficacy, and standardized dosing.

Keywords: *Adhatoda vasica*; Traditional medicine; Phytochemistry; *Vasicine*; Anti-inflammatory; Antimicrobial; Herbal therapeutics

I. INTRODUCTION

The well-known herb *Justicia adhatoda*, also known by various other names such as *vasaka* or *malabar nut*, is commonly used in *Ayurveda* and *Unani* medicine. The plant can be identified by its long opposing branches and huge, pointy leaves. It can reach a height of 2.5 meters and keep its leaves all year long. Traditional medicine uses certain plant components to treat asthma, sprains, colds, coughs, malaria, edema, sexual difficulties, arthritis, rheumatism, and eczema.

With over 600 species spread across tropical and pantropical regions of both hemispheres, the genus *Justicia* is a member of the *Acanthaceae* family. *J. adhatoda*'s secondary metabolites are similar to those found in other species in the same genus, with alkaloids, polyphenols, and saponins being the most prominent elements.



Justicia species can be easily identified by their bilabial flower, which has two stamens, a capsule with four seeds, and an anterior lip with three lobes and a posterior lip that is often two lobes .

The Sub herbaceous plant *Justicia adhatoda* grows between the lower Himalayan ranges and the Indian plains. The plant bears white or purple blooms and small pubescent entire leaves that emerge from enlarged nodes. It is used in treatment of asthma and chronic bronchitis. Vitamin C is present in this plant. The leaves' juice is used for treating dysentery and bloating, while the dried leaves are used to cure malaria .

J. adhatoda leaf extract is a rich source of chiral bioactive chemicals, making it an attractive option for therapeutic development. Additionally, the plant has allelopathic characteristics, which means it can cause phytotoxic effects on other plant. This underlines its importance in both traditional medicine and modern pharmacology. *J. adhatoda* plant extracts are used in popular medications like bisolvon, which reduces mucus production and improves airway clearance .

Botanical Description

Taxonomy

Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Lamiales
Family	Acanthaceae
Genus	<i>Justicia</i>
Species	<i>J. adhatoda</i>
Common name	Adulsa, Vasaka

Morphology

General Description: This evergreen shrub grows to a height of 2.2 to 3.5 meters and is known for its many branches and woody texture. The structure has opposed rising branches with white, pink, or purple blooms. The shrub grows with considerable branching and has a regular root system with secondary and tertiary rootlets. The big lance-shaped leaves are placed oppositely and lack stipules on them. Flowers grow in dense spikes or panicles within leaf axils, supported by short peduncles. Bracts are generally oval and leaf-like. The plant produces a cylindrical fruit with four seeds.



Figure 1: *Justicia adhatoda*



Stem

Justicia adhatoda has a strong, erect, and bushy stem. The plant usually grows up to 1–3 meters in height, so the stem supports a medium-sized shrub. Young stems are green, soft, and slightly hairy, which makes them flexible. As the plant becomes older, the stem turns light brown to greyish and becomes hard, woody, and thick. The stem shows clear nodes and internodes, where each node gives rise to opposite leaves. Branching is abundant, making the whole plant look dense. The cross-section of the stem is almost quadrangular (four-angled) in young stages but becomes more cylindrical when mature .

Leaves

Leaves are the most characteristic part of *Justicia adhatoda*. They are simple, opposite, and decussate, meaning each pair of leaves is arranged at 90° to the next pair. Leaves are large, generally 10–20 cm long and 3–7 cm wide. Lanceolate to elliptic, with a pointed tip and a broad base. Both surfaces of the leaf are smooth, but the underside may have very fine hairs. The upper surface is dark green and shiny, while the lower surface is pale green. The leaf has a very prominent midrib with visible lateral veins that run towards the margin. The margin is entire (not toothed or serrated). When the leaf is crushed, it gives a strong medicinal smell, indicating the presence of active alkaloids like vasicine and vasicinone. Leaves are slightly bitter in taste and are the main part used in medicine .

Flowers

Flowers of *Justicia adhatoda* are very attractive, despite being small. They occur in dense clusters (spikes or panicles) usually at the end of branches or in leaf axils. Each flower is tubular, bilabiate (two-lipped), typical of the Acanthaceae family.

Colour: Primarily white, with purple, pink, or maroon streaks on the lower lip. The upper lip of the flower is smaller, while the lower lip is larger and spreads out. The corolla is about 2–3 cm long, slightly curved, and looks delicate. Bracts (small leaf-like structures) are present beneath each flower and are green and prominent. The plant mostly flowers during winter and early spring (December–arch) in India. Flowers contain nectar, which attracts bees and helps in pollination .

Fruit and Seeds

The fruit is a capsule, narrow and elongated, measuring 1.5–2.5 cm in length. The capsule has a smooth surface and is green when young but turns brown as it matures. A very special character of *Justicia adhatoda* is that the capsule opens explosively when dry — a common feature in the Acanthaceae family. This explosive opening helps in seed dispersal, spreading seeds away from the parent plant. Inside each fruit, there are usually 4 seeds, arranged in two pairs. Seeds are small, roundish to oval, flat, and light brown in colour. The seeds have a hard outer coat, which protects them until germination .





Figure 2 : *Justicia adhatoda*

Geographical Distribution

The plant is indigenous to China, India, and other tropical and subtropical regions of Southeast Asia. The plant is typically found in the lower Himalayan region or Sivalik hills in India, where it has a subtropical climate that ranges from Morni hills, Hamirpur in Himachal Pradesh, Chandigarh and the Kalesar National Park of Haryana state.

Preferred Habitat

Moist areas, forest borders, scrub forests and lower Himalayan foothills (up to 1300 m).

Native Range

India (widely found in plains, foothills, and lower Himalayas up to 1300–1500 m altitude)
Nepal, Pakistan, Bangladesh and Sri Lanka

Extended Distribution

Due to its extensive medicinal value and ease of cultivation, the plant has spread beyond South Asia

Southeast Asia: Myanmar, Thailand, Indonesia, Malaysia

East Asia: Southern China

Middle East: Afghanistan, Iran

Africa: Madagascar, Tanzania, Kenya.

Caribbean & South America: Cultivated in some herbal gardens .

Chemical Constituents

J. adhatoda contains macro and micro minerals such as calcium (Ca), copper (Cu), potassium (K), iron (Fe), zinc (Zn), manganese (Mn), vanadium (V), and chromium .

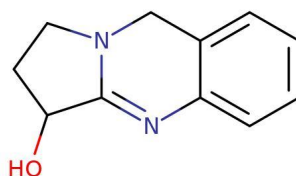
The chemical composition of *Justicia adhatoda* reveals that it comprises the majority of chemicals, including alkaloids, polyphenolics, glycosides, and phytosterols. Its main ingredients are quinazoline alkaloids, with vasicine serving as its



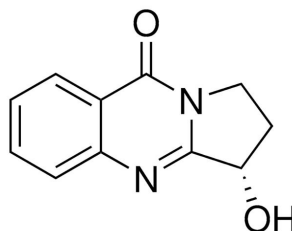
primary alkaloid. The leaves contain two main alkaloids: vasicinone and vasicine. Additionally, adhatodine and anisotine have been reported to be present in leaves. Vasicol and vasicinone were extracted from the inflorescence. Alkaloids have also been observed to exhibit moderate hypotensive and uterine triggering action. The leaves produce an essential oil that is high in carotene and vitamin C. It has also been observed that essential oils (at appropriate concentrations) can suppress Mycobacterium TB. This plant's roots and leaves contain a variety of chemical compounds, including essential oils, sugar, gum, resins, proteins, vitamin C, and amino acids. Its leaves also contain very minute amounts of crystalline acid and essential oil. Elemental analysis revealed that Ca, Na, Mg, and K are the main elements in *Justicia adhatoda* with Ni, Co, Cd, Cr, Mn, Fe, Zn, Pb, and Cu present as trace elements.

Chemical Structures

Vasicine



Vasicinone



Medicinal Values

Traditional Uses

Green matured leaves were used as traditional medicine to treat cough, fever, asthma, and dysentery .

Vasaka leaves are used to treat coughs, asthma, fevers, tuberculosis, piles, jaundice, and bleeding gums. It also serves as an expectorant. It can act as a bronchodilator. Its decoction has potential to treat colds and rheumatism. The leaves, bark, and flower extracts are used to treat bronchial, asthmatic, and pulmonary diseases .

Flower: Vasaka flowers are able to treat tuberculosis. They reduce burning sensations, urinary frequency, and urinary redness. Massaging with a blend of flower and oil eliminates the firmness of feet .

Root: Grinding root bark with cow's ghee produces a paste that is effective for treating syphilis. The Bark of root is useful for renal calculus . It can treat cough, asthma, bilious and phlegmous tuberculosis, hemorrhage, jaundice, nausea and vomiting, and leprosy .

Leaves: leaves are useful for healthy menstrual bleeding, toothache, ascites, and bronchial asthma. Symptoms may include phthisis cough, vermifugal bloody diarrhea, and whooping cough. meningitis, intestinal worms Symptoms may include nausea, vomiting, jaundice, scabies, pruritus, leprosy, urethritis, and good teeth .



Anti-asthmatic and bronchodilator activity

J. adhatoda major alkaloids, vasicine and vasicinone, are proven to be effective respiratory treatments. Leaf and root preparations can treat coughs, colds, and bronchitis, among other lung and bronchial problems. Herbal tea made from fresh *J. adhatoda* leaves is an expectorant since it contains vasicine is an alkaloid with several variants. *J. adhatoda* extract was tested for antitussive efficacy in both anaesthetized rabbits and guinea pigs, as well as unanaesthetized ones. The findings revealed effective antitussive action. *J. adhatoda* leaf ethanolic extract effectively reduces acetylcholine and histamine-induced bronchoconstriction in guinea pigs, comparable to ketotifen treatment .

Antioxidant activity

The antioxidant activity of *J. adhatoda* leaf extracts in hexane, chloroform, and methanol was evaluated against α -tocopherol (standard). The methanol extract had the strongest inhibitory efficacy, followed by chloroform and hexane extracts. Thus, the findings support the antioxidant activity of *J. adhatoda* leaves. The Radical scavenging activity of Vasicine acetate, produced from Vasicine using Butylated hydroxytoluene (BHT) as a reference, improved with increasing extract concentration .

Antimicrobial activity of *Justicia adhatoda*

Justicia adhatoda (also known as *Adhatoda vasica* or Malabar nut) has been widely studied for its antibacterial and antifungal effects, chiefly due to bioactive substances such as alkaloids (e.g., vasicine) and flavonoids in its leaves and extracts .

Anti-Diabetic Activity

Diabetes, or diabetes mellitus, is a metabolic condition that has increased in prevalence in recent years. Researchers worldwide have investigated *J. adhatoda's* possible anti-diabetic properties. Two quinazoline alkaloids, vasicine and vasicinol, exhibited strong sucrase inhibitory action .

Anti-Ulcer Activity

The plant contains quinazoline alkaloids such as vasicine, vasicinone, essential oils, flavonoids, and phenolic compounds. These components exhibit strong free radical scavenging and mucosal protective properties, allowing the gastric lining to resist acid and oxidative damage .

Anti-Inflammatory Activity

Inflammation is mediated by pathways involving prostaglandins, cytokines, nitric oxide (NO), and oxidative stress. Studies show that extracts of *J. adhatoda* significantly inhibit these pro-inflammatory mediators, making it beneficial in the management of both acute and chronic inflammatory conditions.

The key constituents contributing to anti-inflammatory effects include:

Vasicine and vasicinone – Quinazoline alkaloids with strong inhibitory action on inflammatory mediators.

Flavonoids – Quercetin, luteolin derivatives that suppress ROS and free radicals.

Phenolics and tannins – Contribute to antioxidant defense and membrane stabilization.

Mechanistic importance: These compounds suppress inflammation by reducing oxidative stress, inhibiting mediators such as TNF- α and IL-6, and blocking COX/LOX pathways .

Malarial Fever Relieving Activity

Malarial fever results from the proliferation of Plasmodium parasites in blood, leading to inflammatory reactions, oxidative stress, cytokine release, and high fever. Extracts of *J. adhatoda* help relieve fever and reduce parasite-induced symptoms through direct antiparasitic action, modulation of inflammatory mediators, and antioxidant effects.

The main components contributing to malarial fever relief include:



Vasicine and Vasicinone – Potent quinazoline alkaloids with reported antimalarial and antipyretic actions.
Flavonoids (quercetin derivatives, luteolin) – Inhibit parasite growth and reduce oxidative tissue damage.
Tannins and phenolic acids – Immunomodulatory and antipyretic effects.
These compounds collectively contribute to lowering fever and improving systemic recovery .

Anti-Typhoid Activity

Typhoid fever is caused by *Salmonella typhi*, a Gram-negative pathogen that invades the intestinal mucosa, enters the bloodstream, and produces systemic fever, abdominal pain, and inflammation. The rise of multidrug-resistant *Salmonella* strains has encouraged the search for plant-based antimicrobials, making *J. adhatoda* a promising natural candidate.

The major constituents contributing to antimicrobial activity include:

Vasicine and Vasicinone – Potent quinazoline alkaloids

Flavonoids (quercetin, luteolin)

Tannins and phenolic compounds

Essential oils and saponins

These constituents act synergistically to inhibit bacterial growth, suppress toxin production, and strengthen host immunity .

II. CONCLUSION

Justicia adhatoda, also known as Vasaka or Malabar nut, is a well-known medicinal plant used for centuries in Ayurveda, Unani, and other traditional healing systems. It is mainly valued for its natural compounds like vasicine and vasicinone, which help treat coughs, colds, asthma, and other respiratory problems. The plant also shows strong antibacterial, anti-inflammatory, and antioxidant activities, making it useful for many health conditions. *Justicia adhatoda* grows easily in tropical and subtropical regions and can be recognized by its distinct leaves and flowers. Because of its powerful healing properties, it continues to attract interest from researchers and herbal medicine experts. However, more detailed studies are needed to confirm its effects and create standardized herbal medicines. Overall, *Justicia adhatoda* is an important and promising medicinal plant that connects traditional wisdom with modern scientific research for better healthcare in the future.

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