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A Review Article On Adhatoda Vasica: Exploring The Ayurvedic Herb

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Abstract: Ancient Indian medical systems, Ayurveda and Unani, revered Adhatoda vasica, a member of the Acanthaceae family, for its potent healing properties. Commercial adhatoda derived from either fresh or dried leaves of the Adhatoda plant. Dried leaves are dull brownish-green, distinctively scented, and bitter. Vasica is a rich source of pyrroloquinazoline alkaloids, including vasicine, vasicol, adhatonine, vasicinone, vasicinol, and vasicinolone, which are the primary components of its various extracts. These compounds have demonstrated various biological and pharmacological activities, including anti-malarial, anti-inflammatory, antioxidant, antidiabetic, anti-bacterial, anti-cancer etc. It is a traditional medicinal herb used traditionally for the relief of cough, asthma, nasal congestion, bronchial inflammation, upper respiratory infections, bleeding disorders, skin diseases, leprosy, tuberculosis, diabetes, allergic conditions, rheumatism, tumor, and many more diseases.

Keywords : Vasaka, Adhatoda Vasaka, Medicinal plant, Natural remedy for asthma,

I. INTRODUCTION

Adhatoda vasica, often referred to as Vasaka or Malabar nut, is a medicinal plant that has been revered in traditional Indian medicine systems like Ayurveda and Unani for centuries. This evergreen shrub, belonging to the Acanthaceae family, is native to the Indian subcontinent but is now cultivated in various parts of the world due to its potent therapeutic properties. The plant's scientific name, Adhatoda vasica, is derived from its unique characteristics. "Adhatoda" is a Greek word meaning "untouched by goats," reflecting the plant's bitter taste that deters herbivores. "Vasica" is a Sanskrit term meaning "healing herb," acknowledging its medicinal value. The leaves and flowers of Adhatoda vasica are the primary parts used in herbal preparations. They are rich in a diverse range of bioactive compounds, including alkaloids, flavonoids, and phenolic compounds. Among the various alkaloids present in the plant, vasicine is the most prominent and is responsible for many of its therapeutic effects. Other significant compounds include vasicinone, deoxyvasicine, maiontone, vasicinolone, and vasicinol [1].

Historically, Adhatoda vasica has been employed to treat a wide array of ailments, particularly respiratory disorders. It is highly valued for its expectorant, bronchodilator, and anti-inflammatory properties. The plant is used to alleviate symptoms of cough, cold, bronchitis, asthma, and other respiratory ailments. Additionally, it has been used to address various other health conditions, including skin diseases, fever, and digestive disorders. Modern scientific research has corroborated the traditional uses of Adhatoda vasica. Studies have demonstrated that the plant possesses antioxidant, antimicrobial, and anticancer properties. The bioactive compounds present in the plant have been shown to exhibit potent pharmacological activities, including the ability to inhibit inflammation, modulate immune responses, and protect cells from oxidative damage. Despite its numerous benefits, it is essential to use Adhatoda vasica under the guidance of a qualified healthcare professional. While it is generally safe when used appropriately, excessive consumption or inappropriate use may lead to adverse effects. As with any herbal remedy, it is crucial to consult with a healthcare provider to determine the appropriate dosage and duration of use. It is important to note that while Adhatoda vasica is generally considered safe when used appropriately, it is advisable to consult with a qualified healthcare professional before using it, especially if you are pregnant, breastfeeding, or taking any prescription or over-the-counter medications. Additionally, it is crucial to use authentic and high-quality Adhatoda vasica products to avoid potential adverse effects [2].

II. PLANT MORPHOLOGY

2.1 Stem

The stem of Adhatoda vasica, often referred to as Vasaka, exhibits the following morphological characteristics:
Erect Growth: The stem typically grows upright, forming a bushy shrub.
Woody Texture: As the plant matures, the stem becomes woody, providing structural support.
Branched Structure: The stem branches profusely, creating a dense network of branches.
Bark: The bark is grayish-brown and rough in texture [3].

fig.2.1 adhatoda: stem

2.2 Leaves

The leaves of Adhatoda vasica, the primary medicinal part of the plant, exhibit the following morphological characteristics:
Simple: Each leaf is composed of a single, undivided blade.
Opposite: Leaves are arranged in pairs, opposite to each other on the stem.
Lanceolate: The leaf shape is lance-shaped, tapering towards both ends.
Margin: The leaf margin is entire, without teeth or lobes.
Venation: The leaves exhibit prominent reticulate venation.
Surface: The upper surface is smooth, while the lower surface may be slightly hairy [3][4].

fig. 2.2 adhatoda: leaves

2.3 Flowers

Adhatoda vasica flowers are a distinctive feature of the plant. They are typically arranged in dense, axillary spikes.
Here are some of their key morphological characteristics:
Inflorescence: The flowers are arranged in dense, spike-like clusters.
Bracts: The flowers are subtended by large, overlapping bracts that can be green or tinged with purple.
Color: The flowers are usually white or purple.

fig. 2.3 adhatoda: flowers

Structure:
Calyx: The calyx is deeply five-lobed.
Corolla: The corolla is bilabiate, meaning it has two distinct lips:
Upper Lip: The upper lip is two-lobed.
Lower Lip: The lower lip is three-lobed.
Stamens: There are four stamens, two of which are longer than the others.
Pistil: The pistil consists of a single ovary with a long style and two-lobed stigma [3].

2.4 Roots

While the leaves and flowers of Adhatoda vasica are more commonly used for medicinal purposes, the roots also possess certain morphological characteristics and potential uses.
Taproot System: The plant typically has a taproot system with a dominant primary root growing vertically downward.
Secondary Roots: Secondary roots branch out from the primary root, forming a network.
Color: The roots are typically brown or grayish-brown in color.
Texture: The roots exhibit a fibrous and woody texture [4].

2.5 Seeds

Adhatoda vasica, commonly known as Vasaka or Malabar nut, does not produce distinct, fleshy fruits like many other plants. Instead, it produces capsules that contain seeds.

Morphological Properties of the Capsules:

Structure: The capsules are dry, dehiscent fruits.

Shape: They are typically oblong or ovoid.

Size: Relatively small in size.

Dehiscence: The capsules split open at maturity to release the seeds [5].

III. CLASSIFICATION

Table 3.1: Morphological classification of Adhatoda vasika [6]

kingdom	plantae
division	angiosperms
class	eudicots
order	lamiales
family	acanthaceae
genus	justicia
species	j adhatoda
common name	adulasa (vasaka)

IV. CHEMICAL COMPOSITION

While specific quantitative data on the exact chemical composition of Adhatoda vasica can vary depending on factors like geographical location, cultivation conditions, and harvest time, here's a general overview of the major compounds and their approximate ranges:

Alkaloids:

Vasicine: The primary alkaloid, typically found in concentrations ranging from 0.5% to 1.1% of the dry weight of the plant.

Other Alkaloids: Vasicinone, Deoxyvasicine, Deoxyvasicinone, 6-Hydroxyl pegamine, maiontone, vasicinolone, and vasicol are present in lower concentrations.

Flavonoids:

These polyphenolic compounds possess strong antioxidant and anti-inflammatory properties. They play a crucial role in safeguarding cells from oxidative damage and mitigating inflammation.

Tannins:

Tannins contribute to the astringent properties of Adhatoda vasica. These compounds contribute to wound healing and exhibit antimicrobial effects.

Saponins:

These compounds exhibit hemolytic and expectorant properties, making them beneficial in the treatment of respiratory ailments [7].

4.1 Active constituents of Adhatoda Vasica

Adhatoda vasica leaves contain two primary alkaloids, vasicine and vasicinone, renowned for their pharmacological properties. Re cent studies reveal that vasicine exhibits bronchodilatory activity akin to theophylline, both in vitro and in vivo, and both alkaloids togethe r demonstrate marked bronchodilatory effects. Moreover, vasicine shows strong respiratory stimulant activity and thrombopoietic activity, which increases platelet production. It also possesses uterine stimulant and moderate hypotensive Activities.

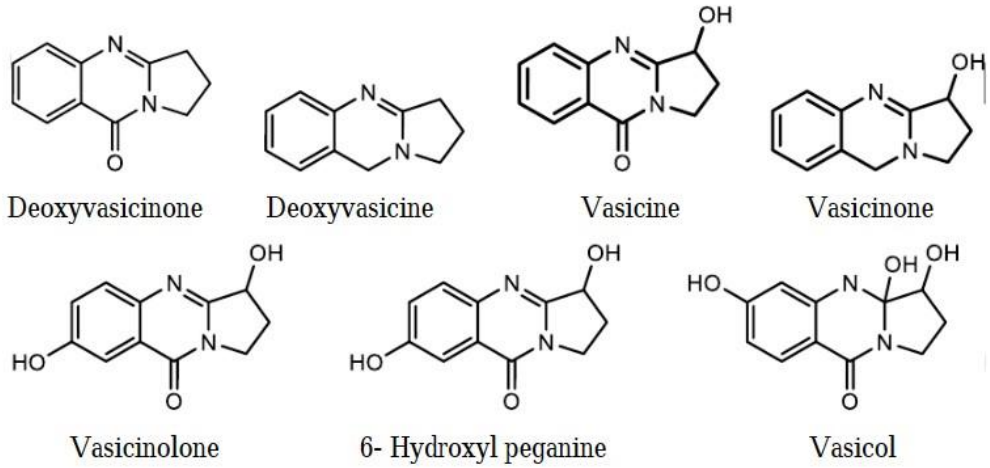

fig. 4.1 adhatoda: active constituents

Vasicine metabolizes to vasicinone. Leaf extracts contain 0.85% vasicine and 0.027% vasicinone. Roots yield sitosterol, β-glucoside-galactose, and deoxyvasicine. Flowers contain 2'-4-dihydroxychalcone-4-glucoside, kaempferol, and quercetin. Aerial parts contain 3-hydroxy-D-friedoolean-5-ene,epitaraxerol,and,peganidine.

The leaves also possess a small amount of essential oil and a crystalline acid. A 1956 Indian analysis showed that the seeds contain 25.8% deep yellow oil with glycerides of arachidic acid (3.1%), behenic acid (11.2%), lignoceric acid (10.7%), cerotic acid (5%), oleic acid (49. 9%), and linoleic acid (12.3%). β-Sitosterol makes up about 2.6% of the composition.

Elemental analysis through atomic absorption spectrophotometry has revealed the presence of major elements such as potassium, s odium, calcium, and magnesium, as well as trace elements including zinc, copper, chromium, nickel, cobalt, cadmium, lead, manganese, a nd iron [6][8].

V. CULTIVATION

Agro-Ecological Requirements:

Vasica is adaptable to diverse climates and soils. It thrives best in alluvial soils. It can also be intercropped with coconut or rubber during the initial 3-4 years of plantation.

Propagation:

Vasica is mainly propagated through vegetative means, using terminal or lateral stem cuttings that are 15-20 cm long and have 3-4 nodes. Pre-rooted cuttings tend to perform better in the field. Nursery preparation, usually done in March-April, involves planting cuttings in poly bags filled with a mix of farmyard manure or vermicompost, topsoil, and sand. Rooted cuttings are ready for transplantation in the field after about two months.

Cultivation:

Rooted Vasica cuttings can be planted on mounds or ridges. The field should be thoroughly ploughed and levelled, with ridges or mounds prepared at 60 cm intervals. During the monsoon season, cuttings are planted on the prepared ridges, maintaining a spacing of 30 cm between each cutting. Up to 5 cuttings can be planted on a single mound. In sloping areas, cuttings can be directly planted in holes made with a sharp pole. Adequate drainage is essential to mitigate the risk of waterlogging.

Fertilization:

Apply organic manure, such as FYM, compost, or green leaf manure, at a rate of 10 tons per hectare as a basal dressing. Regular weeding and earthing up are essential, followed by topdressing with fertilizers.

Irrigation:

Irrigation is generally not required during the monsoon. However, in drought conditions, irrigation may be necessary at intervals of 4 days [9].

VI. COLLECTION

6.1 Collection

The leaves, roots, and stems of Adhatoda possess medicinal properties. Leaves can be harvested as early as the first year of planting, while roots require a two-year waiting period. The prime period for harvesting Adhatoda spans from December to January. By the second year of cultivation, the entire plant, including its root system, is harvested. Roots are carefully dug out to avoid damage, cleaned, and then marketed either fresh or dried. A one-hectare Adhatoda plantation typically yields 10-11 tonnes of roots, stems, and leaves.

6.2 Leaf collection

Timing: Leaves can be harvested year-round, but the best time is during the growing season when they are fully mature.
Method: Harvest the leaves by hand, avoiding damage to the plant.
Root Collection:
Timing: Roots are usually harvested after two years of growth. The ideal time is during the winter months when the plant is dormant.
Method: Dig up the roots carefully, ensuring they are clean and free of soil.
Drying:
Shade Drying: The harvested leaves and roots should be dried in shade to preserve their medicinal properties.
Sun Drying: While faster, sun drying can reduce the potency of the plant material.
Storage:
Store the dried plant material in airtight containers in a cool, dry place, away from direct sunlight and moisture [10].

VII. PREPARATION METHODS

Adhatoda vasica, also known as Vasaka, is an important Ayurvedic drug that can be prepared in various ways, including:

Juice: To prepare Adhatoda Vasica juice, start by harvesting fresh, clean leaves. Thoroughly rinse the leaves under clean water to remove any dirt or impurities. Next, using a mortar and pestle, crush the leaves into a fine paste. Form the paste into a bolus, heat it, and then squeeze it through four layers of muslin cloth to extract the juice. If the juice is too concentrated, dilute it with water to your desired taste. To improve the taste, especially for children, you can add honey or sugar [10].

Extract: To prepare Adhatoda Vasica extract, start by collecting fresh or dried leaves. If using fresh leaves, wash them thoroughly to remove impurities. For dried leaves, grind them into a fine powder. Solvents were selected based on their polarity for the extraction process. Hexane, toluene, ethyl acetate, acetone, and methanol were used. In this method, 4 grams of powdered substance was extracted with 600 ml of solvent. The extraction was carried out at the boiling point of the solvent for approximately 6-8 hours, and this process was repeated for 6 cycles as a preliminary extraction step. After extraction, the solvent is evaporated, leaving behind a crude extract. For further purification, techniques like column chromatography or recrystallization can be used [11].

Dried leaf powder: A remedy for bronchitis can be made by powdering the dried leaves [6].

VIII. THERAPEUTIC USES OF ADHATODA VASICA

8.1 Anti-asthmatic and bronchodilator activity

Anti-asthmatic Activity:

Mast Cell Stabilization: Vasaka extract has been shown to stabilize mast cells, preventing the release of inflammatory mediators that contribute to asthma symptoms.
Anti-inflammatory Effects: Vasaka exhibits anti-inflammatory properties by inhibiting the production of inflammatory cytokines and chemokines.
Asthma: Vasaka is used in combination with other medications for the treatment of asthma, providing relief from lung and bronchiole disorders and inflammation [12].

Bronchodilator Activity:
Relaxation of Smooth Muscle: Vasaka alkaloids directly relax the smooth muscle of the bronchi, leading to bronchodilation.
Enhanced Mucociliary Clearance: Vasaka promotes the clearance of mucus from the airways, further improving respiratory function.
Chronic Bronchitis: Vasaka is helpful in reducing cough, expectorating mucus, and improving lung function in chronic bronchitis [13][14][15][16].

8.2 Anti-ulcer activity

Adhatoda leaf powder demonstrated significant anti-ulcer activity in experimental rats compared to the control group.

Inhibition of Acid Secretion:
Vasaka extracts have been shown to reduce gastric acid secretion, a key factor in the development of ulcers.
This inhibition may be due to the presence of compounds that interfere with the production of gastric acid.
Mucosal Protection:
Vasaka extracts can enhance the production of mucus in the stomach lining, which acts as a protective barrier against acid and other harmful substances.
This increased mucus production helps to maintain the integrity of the gastric mucosa and prevent ulcer formation [16].

8.3 Antioxidant Activity

A phytochemical investigation of Adhatoda vasica leaf extracts revealed the presence of several bioactive compounds, including alkaloids, tannins, saponins, phenolics, and flavonoids. Subsequent antioxidant assays demonstrated the potent antioxidant and reducing power of the methanolic extracts.
These results underscore the herb's potential as a natural antioxidant supplement to prevent oxidative stress-related diseases, such as typhoid, cardiovascular diseases, neurodegenerative disorders, and age-related conditions [17].

8.4 A Natural Wound Healer

Adhatoda vasica, a versatile medicinal plant, has been recognized for its wound-healing properties. This herb contains various bioactive compounds, including alkaloids, flavonoids, and phenolic compounds, which contribute to its wound-healing potential.
Promotion of Collagen Synthesis:
Adhatoda vasica promotes collagen synthesis, a vital protein for wound healing, which enhances the formation of new tissue and fortifies the wound site. Additionally, animals treated with Adhatoda showed significant increases in the levels of elastin, collagen, hydroxyproline, hexosamine, and zinc. The alcoholic extract of this herb was identified as the most effective [18].

8.5 Antitussive Activity

Adhatoda vasica effectiveness as an antitussive agent is attributed to the presence of several bioactive compounds.
Direct Inhibition of Cough Reflex:
Certain compounds in Adhatoda vasica can directly inhibit the cough reflex by acting on the cough center in the brain.
Expectorant Properties:
Vasaka has expectorant properties that assist in loosening and expelling mucus from the respiratory tract. By reducing mucus congestion, it helps to relieve cough [19].

8.6 Anti-bacterial activity

Adhatoda Vasica herb contains various bioactive compounds, including alkaloids, flavonoids, and phenolic compounds, which contribute to its antimicrobial activity.
Inhibition of Bacterial Growth:
Adhatoda vasica extracts can inhibit the growth of a wide range of bacteria, including both Gram-positive and Gram-negative strains.
Cell Membrane Disruption:
Certain compounds in Adhatoda vasica can disrupt the bacterial cell membrane, leading to cell death.
Inhibition of Enzyme Activity:
Adhatoda vasica can inhibit the activity of essential enzymes required for bacterial growth and survival.[20]

8.7 Hepatoprotective

Recent scientific studies have confirmed its hepatoprotective properties.
Promotion of Liver Cell Regeneration:
Adhatoda vasica may stimulate the regeneration of damaged liver cells, aiding in the repair process.
Protection Against Liver Toxins:
The herb can protect the liver from the damaging effects of various toxins and pollutants.[21]

8.8 Anti-inflammatory Activity

Vasicine, the primary alkaloid found in Adhatoda vasica, exhibited anti-inflammatory properties.
Inhibition of Inflammatory Mediators:
Adhatoda vasica can inhibit the production of inflammatory mediators such as cytokines, chemokines, and prostaglandins.
Suppression of Inflammatory Enzymes:
This herb can suppress the activity of inflammatory enzymes like cyclooxygenase (COX) and lipoxygenase (LOX), which play a key role in inflammation.[22]

8.9 Antiallergic Activity

Adhatoda vasica treats various allergic symptoms. Its antihistamine properties are attributed to the presence of several bioactive compounds, including alkaloids, flavonoids, and phenolic compounds.
Histamine Receptor Antagonism:
Adhatoda vasica can block histamine receptors, preventing histamine from binding and triggering allergic reactions.

Inhibition of Histamine Release:
This herb can inhibit the release of histamine from mast cells, reducing the overall allergic response [23].

8.10 Anti-tubercular activity

While Adhatoda vasica has shown various capability in pharmacological activities, there isn't substantial scientific evidence to definitively claim its anti-tubercular activity.
Adhatoda vasica utilized to treat respiratory infections, including tuberculosis. This traditional use suggests potential anti-tubercular properties.
Antimicrobial Properties: The herb contains Bromohexine and ambroxol- two widely-used mucolytics, semi-synthetic derivatives bioactive compounds with antimicrobial properties, which may inhibit the growth of Mycobacterium tuberculosis. (Grange et al., 1996).
Immune-Modulatory Effects: It might modulate the immune response, enhancing the body's ability to fight the tuberculosis infection.
Reducing inflammation can help mitigate the damage caused by the tuberculosis infection.[24]

8.11 A Natural Insecticide

Historical Use: Adhatoda vasica has been used in India for centuries as an insecticide.
Pest Control: Its leaves control insect pests in oil seeds in both lab and warehouse settings [25].
Alkaloid Effect: Vasicinol, an alkaloid in Adhatoda, causes antifertility by blocking the oviduct in several insect species.
Insect Repellent: Proven effective as an insect repellent (Saxena et al., 1986) [26].

8.12 A Potential Anti-Diabetic Agent

Adhatoda vasica has shown promise as a potential anti-diabetic agent due to its ability to regulate blood glucose levels.
Treatment Use: A. vasica root and leaf are commonly used in rural areas for liver diseases and diabetes.
Anti-Diabetic Properties: Studies show significant anti-diabetic effects.
Rat Studies: Effective against Streptozotocin-induced hyperglycemia at doses of 100, 200, and 400 mg/kg/day.
Methanolic Leaf Extract: Found highly effective in managing diabetes.
Alkaloids: Vasicine and vasicinol with IC50 values of 125 and 250 µM respectively.
Ethanolic Extract: Experimental research confirms anti-diabetic properties in rats.
Rabbit Study: Leaf suspension given orally at 25 mg/kg temporarily lowers blood sugar levels [27][28][29][30][31].

8.13 A Potential Antimutagenic Agent

Adhatoda vasica has shown promise as a potential antimutagenic agent. This means it may help prevent genetic mutations that can lead to various diseases, including cancer.
Inhibition of Mutagens:
Certain compounds in Adhatoda vasica may directly inhibit the activity of mutagens, substances that can cause genetic mutations.
DNA Repair:
The herb may stimulate DNA repair mechanisms, helping to correct any damage caused by mutagens [32].

IX. SIDE EFFECTS

While Adhatoda vasica is generally safe when used appropriately, it can cause some side effects in certain individuals. Here are some potential side effects:
Gastrointestinal Issues: Some people may experience digestive issues like nausea, vomiting, and diarrhea.
Allergic Reactions: In rare cases, allergic reactions can occur, including skin rashes, itching, and difficulty breathing.
Nervous System Effects: High doses or prolonged use may lead to nervous system symptoms like dizziness, headache, and tremors [33].

X. PRECAUTIONS

Pregnancy and Breastfeeding: Pregnant and breastfeeding women should avoid using Adhatoda vasica, as it may not be safe for the developing baby.
Children: The safety of Adhatoda vasica in children has not been fully established. It's best to consult with a pediatrician before using it in children.
Drug Interactions: Adhatoda vasica may interact with certain medications, so it's important to inform your healthcare provider about all medications you are taking [34].

XI. CONCLUSION

Adhatoda vasica, a valuable medicinal herb, has been used for centuries in traditional Indian medicine. Its diverse pharmacological activities, including anti-asthmatic, anti-inflammatory, antioxidant, and antimicrobial properties, are attributed to its bioactive compounds, primarily alkaloids like vasicine and vasicinone. Proper cultivation, collection, and preparation methods are crucial to maintain the herb's potency. While generally safe, it's essential to use Adhatoda vasica under medical supervision, especially for pregnant and breastfeeding women, as well as children.

Scientific research continues to validate its traditional uses and explore its potential in modern medicine. However, further studies are needed to fully understand its mechanisms of action and optimize its therapeutic applications.

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