The Scientific Temper
Vol. 13, No. 2, July-December, 2022:pp 360-364
ISSN 0976-8653, E-ISSN 2231-6396
A Web of Science Journal
DOI: https://doi.org/10.58414/SCIENTIFICTEMPER.13.2.2022.360-364
Doc ID: https://connectjournals.com/03960.2022.13.2.360

Adhatoda vasica: A Critical Review and Assessment of Its Future in Herbal Medicine

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ABSTRACT

Medicinal plants have been used to heal a vast range of human ailments and even to prevent diseases over thousands of years. The contribution of such natural elements also promotes the development of a declining slope in terms of epidemiological records for a particular. *Adhatoda vasica* is a very important medicinal plant that is extensively used in the Ayurvedic medical system. It has been used to treat bronchodilator problems for centuries. The biological properties of this plant are due to the active chemicals produced by it. The observations are quite encouraging, indicating that this plant should be further investigated and revealed in order to acquire some medicinal benefits.

Keywords- *Adhatoda vasica*, phytochemical activity, pharmacological activity.

INTRODUCTION

For ages in all cultures, we use medicinal plants to prepare medicines. Medicinal herbs have been used for the prevention of diseases passed from generation to generation. In people of all age groups, respiratory ailments are one of the important primary causes of illness and death. The respiratory system is extremely vulnerable to a wide range of pathophysiological insults, including inflammatory, viral, and immunological ones. As a result, the emphasis is on adopting disease-relieving treatments that include natural ingredients such as herbal remedies. For thousands of years, plants as protector help in improving human health. Plants have been used as a successful approach to cure many dangerous ailments in medicine streams such as Ayurveda, Unani, Homeopathy, Naturopathy, Sidha, and other alternative medical systems (Prasad et al., 2011). *Adhatoda vasica* belongs to the Acanthaceae family and is an important medicinal herb. For almost 2000 years, the herb has been utilized in India's traditional medical system. Vasaka or Malabar nut are some other names for it. It is an evergreen perennial shrub with a height of 1.2 to 6 meters and has an unpleasant smell and a bitter flavor that is found across India up to an altitude of 1300 meters as said by Chakrabarty and Brantner (2001). Leaves of this plant are elliptic-lanceolate or ovate-lanceolate about 5-30cm in length. Flowers are white, dense spikes with short stalks that are shorter than the leaves (Figure 1). The spikes have leaf-like structures called bracts that are prominently veined. Its leaves have been used as a depressant medicinal drug, spasmolytic and anti-nausea medication, primarily for respiratory problems such as colds, coughs, whooping cough, chronic bronchitis, and asthma. Within the country, there is a high demand for this plant (Shabir, 2013). Dymock et al. (1893) reported in their work that *Adhatoda vasica* is useful in the treatment of respiratory problems. For the intense breathing exercise, the leaf buds of the plant can be chewed with a combination of ginger roots. *Adhatoda vasica* is readily available in the market as cough syrups with tulsi and ginger as a sub-component.

Soft stem cuttings are used to propagate it. Planting should be done with stem cuttings that are 10-15cm long and have 2-4 nodes. Adhatoda is harvested from open fields and purchased from commercial sources. Seeds are

the most common form of propagation, but hardwood cuttings can also be used in the spring and early summer (Bjaj and Williams 1995).

Adhatoda vasica

Root

Flower

Leaf

Stem

Figure 1: Morphological features of *Adhatoda vasica.*

Enzymatic properties

Major bioactive compounds present in the leaves of the plant are vasicine and vasicinone. Adhavasinone is the new alkaloid found with some pyrroloquinoline alkaloids separated from the ethanolic extract of the leaves. A-amirine is triterpene and apigenin, astragalin, and kaempferol are flavonoids extracted from flowers (Kumar et. al., 2005).

Table 1: Chemical constituents of *Adhatoda vasica*

Chemical constituents of *Adhatoda vasica*	Adhatodinine
	Vasicoline
	Vasicine
	Anisotine
	vasicinol
	vasicinone
	Adhavasine
	Adhavasinone
	Vasicinolone
	Deoxypeganine
	Vasicol

Therapeutic properties

Adhatoda vasica is used for the ministrations of many ailments, mainly relevant to the respiratory tract. It is an herb used to treat cough, bronchitis, asthma, and common cold symptoms **(Karthikeyan et al., 2009)**. Spasmolytic, curator, anti-nausea, imbrued, theobid, hypoglycemic, germicide, and animus are some of the medical properties of this plant (Maurya and Singh, 2010). Salalamp et al. (1996) reported in their study that *Adhatoda vasica* has the capability to dissolve saliva. The leaves are primarily used as a bronchial antiseptic and have been reported to be beneficial in TB. In asthma, the leaves are dried and turned into cigarettes. When the leaves are smoked in a pipe, they generate an ammoniacal vapor that helps to relieve asthma symptoms. Various important chemical constituents were found in *Adhatoda vasica*, which is valuable in medicinal properties and human beings (Table 1).

Ethnomedicinal uses

Adhatoda vasica pieces have been employed for their therapeutic properties since antiquity (Atal, 1980). It has aided in the treatment of many gasping tract illnesses in people of all age groups in the Ayurvedic line of medicine. Various plant components are used in Unani medicine to treat gasping, arthritis, muscle sprains, and cough (Jain, 1991). European practitioners have also recognized the precious herb. It was claimed to help with typhus, diphtheria, and intermittent fevers (Wren, 1932). Its leaves are employed as an antispasmodic in Germany (Madaus, 1938). It is regarded as a natural treatment in Sweden, and various cough medications containing an Adhatoda extract are available (Farnlof, 1998). It can also be used to treat bleeding piles, impotence, and sexual problems (Ahmad et al., 2009). Its purge of the root is used to treat phthisis, contagion, and sharp fever in Southeast Asia (Dymock et al., 1890). Leaves of the plant are used to treat hematoma and droppings in India. Nether people use a paste of the leaves to relieve labor pain (Jain et al., 1994). Boiling the

leaf powder in sesame oil stops bleeding, earaches, and ear pus, as well as jaundice. Various components of *Adhatoda vasica* are used ethnomedical in this way (Table 2).

Table 2: Parts of the plant with its curable disease

S.No	Plant Part	Curative Disease
1	Whole plant	Phlegm, menorrhagia, bleeding pile
2	Leaves	Hematoma, scabies, lesion, migraine, Hansen's disease, effective in snakebite, asthma, urinary trouble, induce abortion, insecticidal effects
3	Root	Diabetes, cough, liver disorders, phthisis, contagion, sharp fever, leucorrhoea, eye disease, parturition, gonorrhea
4	Flower	Ophthalmia, cold, phthisis, asthma, bronchitis, cough, antispasmodic, fever, gonorrhea, antiseptic, blood circulation
5	Fruit	Cold, bronchitis, jaundice, diarrhea, dysentery, fever, as a laxative

PHYTOCHEMISTRY

Adhatoda vasica is an Indian medicinal plant that is widely recognized for treating respiratory disorders owing to its quinazoline alkaloids (Herrmann et al., 2006). In Germany, however, the use of Adhatoda extracts in the nasal cavity for allergic rhinitis is on the rise. Spectrum data and chemical analyses proved two novel aliphatic hydroxy ketones isolated from the shooting part of *Adhatoda vasica* identified as 37-hydroxyhexatetracont-1-en-15-one and 37-hydroxyhexatetracont-an-19-one, respectively (Singh et al., 1991). Its flowers have been shown to contain 2, 4-dihydroxychalcone 4-glucoside (Bhartiya and Gupta; 1982). Chemical and spectroscopic studies identified a new bioactive compound and a galactoside extracted from the roots as 9-acetamido-3,4-dihydropyrido-(3,4-b)-indole and O-ethyl—D-galactoside, respectively. In addition, the roots of *Adhatoda vasica* have yielded sitosterol, -D-glucoside, D-galactose, and deoxyvasicine (Jain et al., 1994).

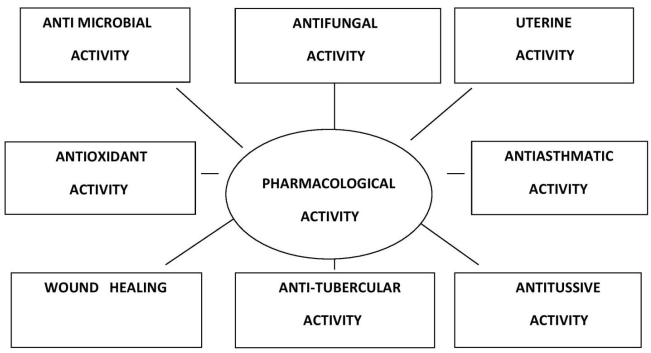

Figure 2: Biological properties of *Adhatoda vasica*

Pharmacological activity

Although a lot of pharmacological investigations have been carried out based on the ingredients present in it but many more are there to explore. Vasicine, vasicinone, and other active chief are responsible for this plant's pharmacological actions. The major bioactive compound is called Vasicine which when extracted becomes a racemic molecule. Different compounds including Bisolvon/ Bromhexine and ambroxol have been created and are used as Robitussin in commercial cough formulations. A summary of the findings of these studies is presented in Figure 2.

Antioxidant activity

Adhatoda vasica leaf extract when given somatologically at 800mg/kg showed controlled hemorrhage conditions in post-irradiated animals. The plant treated with 100 and 200mg/kg improvised superoxide dismutase catalase and glutathione levels in carbon tetrachloride-induced hepatotoxicity (Pandit et al., 2004).

Antiasthmatic and bronchodilator property

Dorsch and Wagner (1991) showed in their study that the known therapeutical respiratory agents are vasicine and vasicinone which are the major alkaloids of *Adhatoda vasica.* Problems such as emphysema, pulmonary disorders, and chest cold can be treated with plant leaf and root extracts. An imbue of leaves calms vexation in the throat and acts as a Robitussin, loosening mucus in the gasping passages.

Wound healing activity

Many investigations have been conducted to confirm *Adhatoda vasica* effectiveness in wound healing. The percentage termination of the abscission wound model and analyzing the different parameters of the ointment prepared from the methanolic extract of *Adhatoda vasica* reveal a meaningful impact in the abscission wound model as a contrast to standard medicine (Vinothapooshan and Sundar, 2010). Lesions were produced through the backbone of buffalo calves for the aim of the investigation, and a decoction of alcohol to chloroform ratio in a powdered form is applied. For better recovery, the calves were treated with *Adhatoda vasica*. Vasaka increased the wound-healing tissue's durability, immersion, and docility. The mice treated with *Adhatoda vasica* shows high levels of proteins and amino acids. Its alcoholic extract was shown to be quite efficient (Bhargava et al., 1988).

Antitubercular activity

Vasicine creates bromhexine and ambroxol, two extensively used mucolytics, due to the chemical components of Adhatoda alkaloids. Vaskas tremendous potential as an antitussive and beneficial for treating upper respiratory

tract infections is well recognized and confirmed by numerous trials. On Mycobacterium tuberculosis, both of them show a pH-dependent growth inhibitory effect. Their effects indicate that it has the potential to play a substantial role in TB therapy as a supplement (Grange and snell, 1996). Antitubercular activity is present in the water extracts of some medicinal plants such as Harita-Manjari, Vasaka, Shallots, and Garlic (Gupta et al., 2010).

Antitussive activity

When handled endovenously, the extract was 1/20-1/40 as effective as codeine in treating rabbits and guinea pigs' mechanically and electrically generated coughs. The antitussive effect of a plant extract administered orally to guinea pigs against irritant-induced aerosols was equivalent to that of codeine (Dhuley, 1999). In antropinized rats, Adhatodavasica petroleum ether extract stimulated respiratory tract fluid greater than ammonium chloride or eucalyptol. We found a reduction in respiratory secretions in the sequence of 78%, 47%, and 36% respectively.

Uterine activity

The uteri of several animal species under various hormonal effects were used in both in vitro and in vivo approaches to study the uterotonic action of vasicine in de It appeared that the uterotonic action resembled that of oxytocin and methyl ergometrine. Under the priming impact of estrogens, vaccines abortifacient action was more pronounced than its uterotonic effect (Gupta et al., 1978). Research on vasicine-induced abortion has been done on rats, guinea pigs, hamsters, and rabbits. It was revealed in the study that vasicine released PGs, and in in vitro tests, vasicine and its derivatives were proven to exhibit oxytocic action at doses over 1 mg/ml. (Rao et al., 1982).

Antifungal activity

It has been demonstrated that plants are reliable sources of physiologically active natural compounds with greater effectiveness in therapeutic applications. Recent years have seen a growth in the use of natural goods and active plant extracts, and new pharmaceuticals are being developed with the aid of cutting-edge technology and advanced research. The current clarifies plant's phytochemical components and their effective agent, a human pathogenic fungus. The phytochemical extract's lowest level of inhibitory activity is determined. The extract is used in additional research for partial characterization by TLC, antifungal determination by agar disc diffusion, and activity to suppress the development of germ tubes. The current investigation on *Adhatoda vasica* impact on the pathogenic fungi Aspergillusruber and Trichophytonrubrum was conducted to assess the drug's antifungal properties (Ramachandran and Sankaranarayanan, 2013).

Antimicrobial activity

Using solvents of various polarities, preliminary phytochemical and antibacterial studies were conducted on crude extract derived from the leaf of *Adhatoda vasica.* The results of the testing showed that phenols, tannins, alkaloids, saponins, amino acids, and reducing sugars were present. Staphylococcus aureus, Bacillus subtilis, Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa were examined for their response to methanol, petroleum ether, and water extracts. Different species' minimal inhibitory concentrations of crude extracts were calculated.

Antiulcer activity

An experiment was done on rats with *Adhatoda vasica* leaf powder which manifest positive results. According to Srivastava et al. (2006), the ethanol-induced ulceration model gave 80% of the activity which shows an elevated performance.

Declaration: *We also declare that all ethical guidelines have been followed during this work and there is no conflict of interest among authors.*

CONCLUSION

Adhatoda vasica Nees has been extensively investigated for its pharmacological properties, according to a review of the literature. It is a good source of several essential compounds for medicine, including vasicine, vasicinone, and some other alkaloids. Some pharmacological actions, such as antioxidant, anti-asthmatic, wound healing, anti-tubercular, antitussive, uterine, antifungal, and antimicrobial, have been discussed in this study. The development of therapeutically effective compounds from *Adhatoda vasica* should be prioritized as researchers adopt on the global scenario for drug discovery from plant sources.

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