A REVIEW ON BIOLOGICAL ACTIVITIES OF ADATHODA VASICA L. Nees

1Xavier Kuncheria
Department of Botany, K.E College,
Mannanam P.O., Kottayam, Kerala, India

2Sebastian A.
Post graduate and Research Department of Botany,
St.Berchmans College, Changanacherry , Kottayam, Kerala, India -686101

3Tojo Jose
Research and Development center,
Bharathiar University, Coimbatore, Tamilnadu, India.

ABSTRACT
Adhatoda vasica Nees (Acanthaceae) is a well known medicinal plant with numerous traditional applications. Its diverse medicinal activities include anti-inflammatory, anti-oxidant, antibacterial, hepatoprotective, antispasmodic, anti-helminthic, antidiabetic, wound healing effect and anti-ulcer activities. It is commonly used in indigenous and traditional folk medicine system globally. A review on phytochemical compositions and pharmacological properties of different parts of Adhatoda vasica are adumbrated in this article.

INTRODUCTION
Adhatoda vasica (L.) Nees (Synonym - Adhatoda zeylanica; Justicia adhatoda) popularly known as Malabar Nut belonging to family Acanthaceae is a biologically active plant with a deluge of medicinal applications. The plant is distributed throughout India which is cropped as a hedgerow plant (Mehta, 2016). Generally, the plant is immune to grazing by goats and other animals due to its malodorous aroma. The plant is ethnopharmacologically important with multitudinous biological effects which is used traditionally to cure various diseases from time immemorial (Kumar et al., 2013). Due to its cosmopolitan distribution, the plant has the following local names in different geographic entities,

Assamese : Titabahak, Bahak, Vachaka
Bengali : Basak
English : Vasaka
Gujrati : Aduso, Ardsui, Adulso
Hindi : Adosa, adalsa, vasaka
Kannada : Adsale, Adusoge, Atarusha, Adsole, Adasale
Kashmiri : Vasa
Malayalam : Ata-lotakam
The plant is perennial, evergreen and branched highly with vexing odour and bitter taste. It is a shrub 1.0 m to 2.5 m in height, with opposite ascending branches with leaves retained throughout the year. The leaves are cauline, opposite, decussate, petiolate, lanceolate or ovate-lanceolate, entire, leathery with acute apex (Sharma and Kumar, 2016). The stomata are elongated-oval in shape and surrounded by crescent shaped cells, the long axis of which is at right angles to the ostiole. The epidermis bears simple one to three celled warty hairs and small glandular hairs with a Quadricellular secreting gland. Inflorescence is dense, short pedunculate spike, bracteates with long bracts and spike axial and terminal. The corolla is large and white with lower lip streaked purple or pink. Fruits are 4 seeded non fleshy, dehiscent, a capsule which is longitudinally channelled with hook like outgrowths, called “retinacula” (GoI, 1990; Ghosh and Karmakar, 2012).

Systematic position of *Adhatoda vasica*

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<tr>
<th>Kingdom</th>
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<tr>
<td>Subkingdom</td>
<td>Tracheobionta</td>
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<td>Division</td>
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<td>Lamiales</td>
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<td>Species</td>
<td><em>vasica</em></td>
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The plant is widely used in the treatment of bronchitis, leprosy, various disorders in blood, cardiac troubles, respiratory illness, fever, vomiting, loss of memory, liver infections, mouth troubles, sore-eye, and gonorrhea in Ayurvedic system of medicine (Khare, 2007). Likewise, it is a well-known plant drug in Ayurvedic and Unani system of medicines (Claeson *et al*., 2000). *Adhatoda vasica* exhibits mainly anti-inflammatory, anti-oxidant (Muruganantham, *et al*., 2015); antibacterial (Sheeba and Mohan, 2012); hepatoprotective (Kumar *et al*., 2015); antispasmodic and expectorant (Gangwar and Ghosh, 2014); anti-helminthic (Bhinge *et al*., 2015); antidiabetic (Gulfraz *et al*., 2011); wound healing effect (Subhashini and Arunachalam, 2011) and anti-ulcer (Vinothapooshan and Sundar, 2011) activities.

**Phytochemistry**

The plant is rich in essential oils, fats, resins, sugar, gum, amino acids, proteins and vitamin C (Dymock, 1972). The presence of pyrroquinazoline alkaloids *viz*. Vasicine and Vasicinone (Chihara, 1997); adhatonine, vasicinol and vasicinolone (minor alkaloids); vasicoline, adhatodine, casicolinone and anisotine (quinazoline alkaloids); Sitosterol, β-glucoside-galactose and deoxyvasicine (from roots) (Jain *et al*., 1980) and 2’-4’- dihydroxychalcone- 4-glucoside (from flowers) (Bhartiya and Gupta, 1982) was also well established (Lone *et al*., 2013). Moreover, the presence of l-vasicinone, deoxyvasicine, maiontone, vasicinolone and vasicinol, 1, 2, 3, 9-tetrahydro-5-methoxypyrrolo[2, 1-b]quinazoline-3-ol (Chowdhury and Bhattacharyya, 1985); kaempferol and quercetin (Rawat *et al*., 1994); 3-hydroxy-D-friedoolean-5-ene, epitaraxerol and peganidine (Atta-Ur-Rahman *et al*., 1997) was also reported.
Experimental Pharmacology

Various extracts of *A. vasica* exerts commendable pharmacological activities which is tested not only in *vivo* but also in *vitro* by many experimental studies. The plant represents a promising herb with very strong conceptual or traditional base as well as a strong experimental base for its employment.

1. **Anti-asthmatic and bronchodilator activity**: The use of Adhatoda to treat respiratory illnesses is time tested in traditional medicine. Both vasicine and vasicinone are the primary alkaloid constituents of Adhatoda with well esteemed therapeutical respiratory potentials (Dorsch and Wagner, 1991). Decoction of the tender leaves of Adhatoda has an un laxing effect on throat irritation during cold and cough which also acts as an expectorant. Further Adhatoda extracts in animal models showed commendable antitussive effects (Dhuley, 1999; Gairola *et al*., 2010). *Adhatoda vasica* reduced ovalbumin and PAF-induced allergic reaction. Alkaloid vasicinol and about 20% Vasicine inhibited ovalbumin-induced allergic reactions by about 37% at a concentration of 5 mg (Mullar *et al*., 1993).

2. **Anti-ulcer activity**: *Adhatoda vasica* leaf powder showed appreciable degree of anti-ulcer activity in experimental rats with Aspirin, Alcohol and pyloric ligation models. The action is mainly due to the modulation of defensive factors through an improvement of gastric cytoprotection and partly due to acid inhibition by the extracts (Vinothapooshan and Sundar, 2011).
3. **Anti tubercular activity:** Gupta *et al.* (2010) evaluated the *in vitro* anti-tubercular activity of *Adhatoda vasica* with appreciable results. Alkaloids such as visicine, produces bromhexine and ambroxol – two widely-used mucolytics. Both of these have pH-dependent growth inhibitory against *Mycobacterium tuberculosis*. Moreover, the use of the plant results in increased lysozyme and rifampicin levels in bronchial secretions, lung tissue and sputum suggesting that it a prominent role in tuberculosis treatment (Grange and Snell, 1996).

4. **Insecticidal activity:** *Adhatoda vasica* has been used as an insecticide even from prehistoric times. Haifa and Ali (2016) scrutinized the insecticidal effect of acetone and methanol crude leaf extract of *A. vasica* with high mortality percentage in (nymphs and adults) of *Brevicoryne brassicae*, and recommended that the plant can be used as insecticide. Several studies have shown the plant has an antifertility effect against several insect species by causing blockage of the oviduct.

5. **Anti-inflammatory & analgesic activity:** The anti-inflammatory and analgesic activity of *Adhatoda vasica* was well reported by many researchers worldwide. Mulla *et al.* (2010) demonstrated the remarkable anti-inflammatory and analgesic activities of ethanolic extract of roots of *Adhatoda vasica*.

6. **Abortifacient and uterotonie activity:** The plant has abortifacient and uterotonie activity, making it useful for inducing abortion and for stimulating uterine contractions for speedy childbirth (Kirtikar and Basu, 1975; Claeson *et al.*, 2000). The plant is traditionally used by midwives at the time of delivery because of its uterotonie activity. Due to its anti-implantation activity, it should not be used in pregnancy.

7. **Thrombolytic activity:** Shahriar (2013) concluded that the extracts of the *Adhatoda vasica* can be used as a thrombolytic agent and demonstrated in *vitro*.

8. **Enzyme activity:** The decoction of the leaves of the plant activated the trypsin (Vijaya and Vasudevan, 1994) an enzyme found in the digestive system of many vertebrates, where it hydrolyses proteins.

9. **Hypoglycaemic activity:** *Adhatoda vasica* ethanolic extract and fractions showed dose dependent inhibition of α-glucosidase and α -amylase enzyme and exhibited lower inhibitory activity (Vadivelan *et al.*, 2015). Numerous ethnomedical/tribal informations regarding the use of the plant for diabetes is well documented.

10. **Hepatoprotective activity:** Pandit *et al.* (2004) provide conclusive evidence for the hepatoprotective effect of *A. vasica* against carbon tetrachloride induced hepatotoxicity. The plausible mechanism of the hepatoprotective action might be due to its antioxidant effect.

11. **Antibacterial activity:** The findings of Sheeba and Mohan (2012) revealed that *Adhatoda vasica* plant extract exhibited antibacterial activity against pathogens like *Staphylococcus aureus*, *Streptococcus pyogens*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus vulgaris* and *Klebsiella pneumoniae*. The broad spectrum of antimicrobial activity of the plant was also reported by Rashmi and Linu (2012).

12. **Antifungal activity:** Antifungal activity and the mode of action of alkaloid extract from the leaves of *Adhatoda vasica* was well studied (Ramachandran and Sankaranarayanan, 2013). The antifungal effect of the plant against *Fusarium oxysporum* Schlechtthe causal agent of Fusarium wilt disease in tomato was also reported (Neela *et al.*, 2014).

13. **Antiviral activity:** Chavan and Chowdhary (2014) enumerated that the extracts of *A. vasica* have strong anti-influenza virus activity that can inhibit viral attachment and/or viral replication, and recommended the plant for viral prophylaxis. The inhibitory activity of HIV-protease by the plant extract was also noted (Singh *et al.*, 2010).

14. **Antiparasitic activity:** The ovicidal and larvicidal properties of *Adhatoda vasica* extracts against gastrointestinal nematodes of sheep was reported *in vitro* (Al-Shaibani *et al.*, 2008). The nematicidal efficacy of *A. vasica* extracts was also reported by Singh *et al.* (2015).

**CONCLUSION**

It can be resolved that *A. vasica* is considered as a wonder plant with innumerable medicinal potencies. The plant is rich in an array of phytochemicals which is the sole basis of the biological activities. This is why the plant is included in the list of prime drugs for the management of Raktapitta (haemorrhagic diseases), Kasa (Bronchitis) and Rajayakshma (phthisis) in Ayurvedic materia medica. No doubt, the plant represents a classical herbal drug with very strong conceptual or traditional base as well as a strong experimental base. However, clinical trials, clinical utility studies coupled with molecular level interpretations are also needed.

**REFERENCES**


