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Review article

MEDICINAL BENEFITS OF *ADHATODA VASICA* NEES.-IN UNANI AND CONTEMPORARY MEDICINE

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ABSTRACT

Arusa (Adhatoda vasica) is an important medicinal plant widely used in Unani system of medicine of (Family-Acanthaceae). The leaves of *Adhatoda vasica* contain several biologically active phytochemicals such as alkaloids, tannins, saponins, phenolics and flavonoids. It mainly consists of pyrroquinazoline, alkaloids, viz. vasicine, vasicol, vasicinone, peganine along with other minor constituents.

The plant possesses diverse pharmacological activities, In Unani system of medicine, the drug is described as having *dafa-e-tashannuj* (anti-spasmodic), *qatil-e-jarasim* (antibiotic), *mukhrij-e-balgham* (expectorant), *dafa-e-humma* (antipyretic) properties due to which it is prescribed in a wide range of ailments like influenza, tuberculosis, bronchitis, gastric ulcers etc. Leaf juice is beneficial in the treatment of dysentery and diarrhoea. Various other activities like radio modulation, hypoglycaemic effect, cardiovascular protection, antitubercular, antiviral, hepatoprotective and antioxidant activity have also been reported.

Keywords *Adhatoda vasica*, anti-spasmodic, vasicine, asthma

INTRODUCTION

Adhatoda vasica (L.) Nees commonly known as Vasaka is a well-known medicinal plant widely used in Unani and Ayurvedic system of medicine. (Lyengar, Jambaiah, Kamath, & Rao, 1994; Usmanghani, Saeed, & Alam, 1997) All the parts of the plant have been used for their therapeutic effects from ancient times, particularly in upper respiratory tract diseases such as bronchitis and asthma *(Dama)*. The plant has been used in the indigenous system of medicine in India for over 2000 years. (Claseon, Malmfors, Wikman, & Bruhn, 2000; Iyengar, Jambaiah, Kamath, & Rao, 1994)

The drug *Arusa* has been used for a very long time in Unani system of medicine. According to the classical Unani medical literature, *Arusa* is an important drug for diseases of the respiratory system. There are various vernacular names of *Arusa* or Bansa in different languages. It also is known as *Hashishatus-sual* in Arabic and word Sual is specific for cough which shows its association with the disease. Many eminent scholars of Unani medicine have described it as an effective drug for a variety of respiratory ailments, such as bronchitis, bronchial asthma and fever is described as *Munaffis-e-balgham*, expectorant in Unani medicine, this property makes it an elixir for respiratory ailments like bronchitis. This herb as a whole is useful in treating cold and cough, asthma and chronic bronchitis. In acute stages of bronchitis, it gives unfailing relief especially where the sputum is thick and sticky, it liquefies sputum so that it can come up more easily. Leaves are chiefly used in chest diseases particularly as an expectorant and bronchial antiseptic, also regarded as useful in tuberculosis. The leaves dried and made into cigarettes are smoked in asthma. The leaves when smoked in a pipe give relief in asthma because it produces an ammoniacal vapour which makes breathing easier. Its hypotensive, bronchodilator, expectorant, hypoglycemic, antibiotic, antitubercular and uterine activities have been proved by experimental and clinical studies.

Since centuries, *Adhusa* or its parts like the leaves, flower, root etc. are extensively used in traditional Indian medicine in different forms like decoction, infusion, powder and fresh juice as an expectorant for treating cold, flu and chronic respiratory diseases like whooping cough, asthma and chronic bronchitis. (Ahmad, et al., 2009). It's all constituents used to clear the airway by decreasing the mucus secretion and clearing the air passages. The powder of herb, boiled with sesame oil, is used to heal ear infections and arrest bleeding. Boiled leaves are used to treat rheumatic pain, and to relieve the pain of urinary tract infections. (Medicinal Plants in Folklores of Orrisa, 2006) It is also believed to have abortifacient properties. It is used in some parts of India to stimulate uterine contractions, thus speeding childbirth. (Gupta O. P., Anand, Ghatak, Atal, 1978)

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Taxonomical Classification
(United State Department of Agriculture, 2013)

Kingdom-*Plantae*
Subkingdom-*Tracheobionta*
Division-*Magnoliophyta*

Superdivision-*Spermatophyta*
Class-*Magnoliopsida*
Subclass- *Asteridae*
Order- *Scrophulariales*
Family-*Acanthaceae*
Genus-*Justica L.*
Species- *Justica adhatoda L.*

Vernacular names
Bengali: *Basak*; Tamil: *adatodai*; Gujrati: *aradusi, adusa*; Hindi: *arusa, bansa, adlusa*; Punjabi: *bansa, basuti, bhukkar*; Sanskirt: *shwetavasa, vasa, vasaka* English: *Malabar nut*; Malyalam: *ata lotakam* (Medicinal Plants in Folklores of Orrisa, 2006; Hakeem, 1999; Kabiruddin, 1996; Khan, 2014).

Distribution
The plant grows throughout the Indian peninsula up to an altitude of 1300m in the sub-Himalayan tract, also found in Nepal, Pakistan, Myanmar, Sri Lanka and Germany. It usually grows in waste places frequently near villages and often as an escape from cultivation as a hedge plant. (Medicinal Plants in Folklores of Orrisa, 2006; Shahwar et al., 2012; Usmanghani, Saeed, & Alam, 1997; Ali, 1998).

Botanical Description
It is a shrub 1-2.5 metres high with opposite ascending branches. The leaves are simple, opposite, 7-19 cm long and 4-7 cm wide. The flowers are white, pink or purple with characteristic odour and bitter taste. Transverse section of the leaves showed two layers of palisade cells and diacytic stomata. Grandular and non-grandular trichomes are present on both the surfaces of leaves. In central India, the flowering season is from December to March and it bears fruits from January to April. (Medicinal Plants in Folklores of Orrisa, 2006; Usmanghani, Saeed, & Alam, 1997). The major alkaloid of the plant, vasicine, has been found to be biologically active and is the subject of many chemical and pharmacological studies, (Gangwar & Ghosh, 2014; Ahmad et al., 2009; Srinivasan, Sivasubramanian, & Kumaravel, 2014).

Description of *Adhatoda vasica* in Unani literature

Adhatoda vasica is a widely used drug in the Unani system of medicine. It is especially prescribed in diseases of respiratory ailments, and also in certain gastric and intestinal disorders. The leaves and flowers of the drug are used as a medicine, in the form of powder, decoction; or the whole herb is sometimes used as medicine. The general description of the drug is given below:

Temperament *(miza'aj)*
Warm and dry in the first degree (Kabiruddin, 1996; Hakeem, 1999; Khan, 2014).

Taste *(maza)*
Bitter taste (Claseon, Malmfors, Wikman, & Bruhn, 2000).

Colour *(rang)*
Leaves are dark green above and pale yellow below, flowers are white (Karthikeyan, shanthi, & Nagasathaya, 2009; Kabiruddin, 1996).

Odour
Unpleasant smell (Claseon, Malmfors, Wikman, & Bruhn, 2000; Kabiruddin, 1996).

Main Actions *(nafa e khas)*
Bronchodilator and Expectorant (Maurya & Singh, 2010) (Karthikeyan, shanthi, & Nagasathaya, 2009; Khan, 2014).

Parts used
- Stem-to stimulates uterine contraction during childbirth, antispasmodic, *mudir-e-haiz* (emmenagogue) and abortifacient.
- Leaf-decoction of leaves is used to rheumatic fevers and urinary tract infections, dysentery and diarrhoea. It also has *mudir-e-haiz* (emmenagogue) activity. Fresh juice of leaves is particularly prescribed in *zeeq-un nafas* (asthma).
- Flower-used to treat upper respiratory tract infections like cold and flu, Asthma, bronchitis, bronchiectasis, whooping cough. *Qulqand* (a confection made with petals and sugar) is said to be beneficial in all respiratory diseases.
- Fruit and seeds-oil of its seed and fruit used to treat ear pain (Claseon, Malmfors, Wikman, & Bruhn, 2000; Hakeem, 1999; Kabiruddin, 1996; Khan, 2014).
- Root-used in tuberculosis and whooping cough.
- The whole herb-decoction is used in fever, as a blood purifier, *habis-u-dam* (haemoptysis), especially for haemoptysis and epistaxis. The decoction is also prescribed in scabies and leprosy by Unani scholars (Kabiruddin, 1996).



Fig. 1.1 Siras tree, showing leaves, pods and flowers. **Fig.1.2***Adhatoda vasica* (Flower).**Fig.1.3***Adhatoda vasica* (Roots).

Dose *(mikhdar e khurak)*
Powder -3 gm, (Hakeem, 1999; Kabiruddin, 1996)
Decoction - 3 to 9 ml (Khan, 2014)

Toxicity *(muzir)*
In large quantities, large doses may cause irritation diarrhoea and vomiting (Usmanghani, Saeed, & Alam, 1997; Kabiruddin, 1996; Hakeem, 1999).

Correctives *(musleh)*
The adverse effects of *Adhatoda vasica* may be reduced by using it with *filfil siyah* (Black pepper, Piper nigrum) (Usmanghani, Saeed, & Alam, 1997; Kabiruddin, 1996; Hakeem, 1999).

Substitute *(badal)*
If the drug cannot be used for some reason, then zufa (Hyssopus officinalis Linn.) may be prescribed in its place (Usmanghani, Saeed, & Alam, 1997).

Actions *(afa'al)*
(Purohit & Gokhale, 2003)

- *Dafa e tashannuj* (Antispasmodic) (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- *Musaffi-e-Dam* (Blood purifier) (Kabiruddin, 1996)
- *Nazla wa zukaam* (Cold and flu) (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- *Muhallil e awram* (Anti-inflammatory) (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- *Dafa e humma* (Antipyretic) (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- *Qatil-e-Jarasim* (Antibiotic) (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- *Qati-e-kirm-e-shikam* (anti-helminthic) (Kabiruddin, 1996)
- Anti-haemorrhagic (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- Oxytocic (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- *Munaffis e balgham* (Expectorant) (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- Bronchodilator (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- *Muhafiz-e-Jigar* (Hepatoprotective) (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- *Midammi*l (Wound healing) (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- Antiulcer (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- Hypoglycemic (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- Cholagogue activity (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- Antitubercular activity (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- Insecticidal activity (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)
- Digestive *(hazim)* (Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)

Uses *(istema'al)*
(Hakeem, 1999; Kabiruddin, 1996; Khan, 2014)

- Asthma *(dama)*
- Bronchitis *(zeeq un nafas)*
- Bronchiectasis *(Ittesa'-e-sho'b)*
- Tuberculosis *(diq wa sil)* (Karthikeyan, shanthi, & Nagasathaya, 2009)
- Rheumatic Fever *(humma-e-hudariya)*
- Dysentery and diarrhoea *(zaheer wa ishaal)* (Parrotta, 2001)
- Phytochemistry (Prathiba & Giri, 2018; Rastogi & Mehrotra, 2001)

Main alkaloids	◆ Vasicine ◆ Vasicol ◆ Vasicinone ◆ Peganine
Minor alkaloids	◆ Adhatonine ◆ Vascinol ◆ Vasicinolone
Flower content	◆ Kaempferol ◆ Quercetin
New moiety in flower	◆ 2,4dihydroxychalcone and glucoside
Leaves	◆ Vsicoline ◆ Adhatodine ◆ Vasicolinine ◆ Anisotine
Inflorescence	◆ Vasiconine ◆ Vasicol

Table 1. Important phytoconstituents of *Adhatoda vasica*

Carbohydrate	+
Terrapins	+
Triterpenoids	+
Flavonoids	+
Saponins	-
Tannins	-
Amino acids	+
Glycosides	+
Alkaloids	+
Steroids	+

Key: + Present, - Absent

Table 2. Phytochemical analysis of methanol extract of A. vasica (Prathiba & Giri, 2018)

PHARMACOLOGICAL ACTIVITIES

Antibacterial activity
In developing countries like India, the major and emerging cause of death is an infectious disease and the bacterial resistance and other side effects of existing antibiotics are hazardous to health. On the other hand, self-prescribed use of antibiotics is becoming a major problem worldwide, herbal medicine provides the source to overcome the side effects of currently available antimicrobial agents (Gupta, Ahirwar, Shinde, Choudhary, Rajput, & Singh, 2013). Many studies have established that *Adhatoda vasica* shows antibacterial activity. An experiment carried out by the Durre shehwaar et al. showed that vasicine remained inactive against N. asteroids and P. mirabilis and showed moderate

activity against M. luteus, and S. Typhimurium. (Shahwar, Raza, Triq, Riasat, & Ajaib, 2012). The antibacterial activity of methanolic extract of *Adhatoda vasica* against all tested microorganisms was greater than the antibacterial activity of aqueous extract of *Adhatoda vasica*. *Adhatoda*'s antibacterial properties have been clinically evaluated by Brantner AH and Chakraborty A, 1998. While aqueous and methanolic leaf extract of *Adhatoda vasica* showed antibacterial activity against E.coli and Klebsiella at 15mm, 12mm and 17mm, 14mm respectively (Chauhan, Jaryal, Saxena, & Kanishak, 2012). Flowers, leaves, and roots are frequently added as antiseptic on internal use (Usmanghani, Saeed, & Alam, 1997).

Oxytocic/ Abortifacient

During the last 20 years, several scientific studies and reports on abortifacient and uterotonic effects of alkaloid vasicine and another potent alkaloid present in the plant *Adhatoda vasica* have appeared. (Narimanian, et al., 2005). It's one of the most important alkaloids named Vascine provides an oxytocic activity by releasing prostaglandin thus stimulate the uterine contractions and helps in the passage of birth during parturition and also as abortifacients as oxytocin. (Roy, Chandra, Shark, Munnan, Faruqee, & Md, 2013). Many experiments were carried out to validate the oxytocic activity of *Adhatoda vasica*, Rassins hamsters and guinea pigs were experimented with vasicine resulted as abortifacient which was possibly due to the release of prostaglandin. In this study, the effective dose of alkaloid was within the range of 2.5 to 10mg/kg. (Chandhoke, 1982).

Another experiment was carried out on the uterine strips of the pregnant and non-preganant uterus and were treated with Adhatoda resulted in stimulating the uterine activity as similar to oxytocin (Pahwa, Zutshi, & Atal, 1987). The effects were more remarkable and prominent when *Adhatoda vasica* was primed with oestrogen (Nath, Sethi, Singh, & Jain, 1992). The dried powder root, mixed with black pepper is taken by kondh women in southwestern Orissa to expedite childbirth (Parrotta, 2001). It does not only work as the abortifacient, but its medical efficacy has also been claimed to use in postnatal care (Medicinal Plants in Folklores of Orrisa, 2006).

Wound healing

Many studies have been done to validate the efficacy of *Adhatoda vasica* in wound healing. The methanolic extract ointment of *Adhatoda vasica* showed a significant effect in excision wound model as compared to standard drug and other two extracts of ointment, by calculating the parameters, percentage closure of excision wound model. (Vinothapooshan & Sundar, 2010). Another study showed that the rate of healing was found to be higher in the wounds of buffaloes who got treated with plant extract. (Zama, Singh, & Kumar, 1991). Chloroform and alcoholic extract of *Adhatoda* in powdered form on buffalo calves showed significant healing and reported to have more hydroxyproline hexosamine and zinc thus increase tensile strength extensibility in wound repair and healing. (Bhargava, Singh, & Kumar, 1988). The powdered leaves, as well as a strong decoction, are reported to used in a form of a poultice to relieve counter-irritant and inflammatory swellings and to treat fresh wounds and urticaria. The root paste is used as an external application for treating eczema among the munda in southern Bihar (Parrotta, 2001). *Adhatoda vasica* leaves are used in wounds and cuts and gave beneficial results in the experiment carried out in 2011. (Alam, Singh, & Singh, 2011; Arunachalam & Subhashini, 2010).

Hypoglycemic

Its leaves have been used against diabetes in Asian countries such as in India and northeast of Pakistan. Ethanolic extract of leaves and roots at doses (50 and 100mg/kg) showed a significant reduction in blood glucose levels in acute toxic studies (Gulfarz, et al., 2011). Various other studies have established the remarkable effect of *Adhatoda vasica* in lowering the blood glucose level. The methanolic extract from the leaves of *Adhatoda vasica* Nees (Acanthaceae) showed the highest sucrase inhibitory activity with sucrose as a substrate (Gao, Huang, Gao, Li, Inagaki, & Kawabata, 2008).

Madak & Rao studied the non-nitrogeneous principle of the leaves in suspension form at a particular dose (25 mg/kg) decreased the blood sugar level in rabbits in a very short period of time (Dhar, Dhar, Dhawan, Mehrotra, & Ray, 1968; Madak & Rao, 1996).

Antitussive

Adhatoda vasica is a popular and traditional medicine to treat upper respiratory tract ailments for a long time. Both principle alkaloid of *Adhatoda vasica* are known for their therapeutic effect (Dorsch & Wanger, 1991; Usmanghani, Saeed, & Alam, 1997). Both alkaloids are bronchodilator in vitro and bronchoconstrictor in vivo whereas combined in vitro effect exhibited bronchodilator activity both in vivo and in vitro (Narimanian, et al., 2005). Another study revealed that vasaka posses the effect as codeine both electrically and mechanically in anaesthetized guinea pigs (Dhuley, 1999; Narimanian, et al., 2005).

Hepatoprotective

Adhatoda vasica leaves showed significant hepatoprotective effect at the doses of 50-100 mg/kg on liver damage, induced D-galactosamine in rats (Bhattacharyya, Pandit, Jana, Sen, & Sur, 2005).

Antiulcer

The antiulcer activity was established on ethanol-induced and pylorus ligation plus aspirin-induced models and showed immense potential as an antiulcer agent (Chaturvedi, Rai, Dhani, & Tiwari, 1983). Mainly effective in the ulcers induced by the ethanol and aspirin but the high degree of anti-ulcerogenic activity was observed in ethanol-induced ulcer s with *Adhatoda* leaf powder, (Shriivastava, Srivastava, Banerjee, & Nivasarkar, 2006). So it can be concluded that *Adhatoda* has an immune potential as an antiulcer agent (Shrivastava, Shrivastava, Banarjee, & Nivsarkar, 2009).

Cholagouge activity

Lab experiments showed that 5mg/kg intravenous dose of *Adhatoda vasica* in drugs in dogs and cats increases bile activity by excreting bile up to 40 to 100%. Animals showed an increase in bilirubin excretion (Rabinivich, Leskov, & Gladikikh, 1966).

Antitubercular activity

It is universally accepted and established by many experiments that *Adhatoda* has immense potential as anti-tussive and good for treating upper respiratory tract infections due to the presence of the *bromhexine* and *ambroxol*, two widely used mucolytics. *Ambroxol* and *bromhexine* have a tendency of showing pH-dependent growth inhibitory effect on *Mycobacterium tuberculosis*. Their action suggesting that it may play an important role in adjunctive therapy in the treatment of tuberculosis (Grange & Snell, 1996). Water extracts of selected

medicinal plants *(Acalypha indica, Adhatoda vasica, Allium cepa, Allium sativum and Aloe vera)* were observed to have anti-tuberculosis activity (Gupt, et al., 2010; Usmanghani, Saeed, & Alam, 1997).

Insecticidal activity
It has been used as insecticidal since centuries, studies showed that in the laboratory also in Waterhouse condition showed good control insect pests because it has an antifertility effect agent several insect species by the blockage of the oviduct. It has also proven *Adhatoda* effectively acts as an insect repellent (Saxena, Tikku, & Atal, 1986; Hiremath, AHN, & KIM, 1997).

Digestive
In vitro studies showed that *Adhatoda vasica* stimulate the digestive process by activating trypsin enzyme when treated with the decoction of leaves. (Bhattacharyya, Pandit, Jana, Sen, & Sur, 2005).

CONCLUSION

The literature survey has shown that *Adhatoda vasika* is a chief source of many pharmacologically and medicinally important chemicals such as vasicine, vasicinone, vasicolone, and other various useful minor alkaloids. This herbal medicine contains a remarkable combination of alkaloids like pyrroquinazoline, vasicine, vasicinone and vasicolone which have phenomenal effects as preventive and therapeutic medicine. This plant has been widely studied for its pharmacological activities and accepted as a universal panacea in Unani medicines and find its position as a versatile plant having a wide spectrum of medicinal activities. As the world scenario is changing towards the use of non-toxic or herbal medicines, the development of a modern drug from *Adhatoda vasica* should be emphasized. More clinical trials should be conducted to support its therapeutic use as described in classical Unani literature.

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CONFLICT OF INTEREST

The authors have no conflicting financial interests.

REFERENCES

Ahmad S, Madhukar G, Maksood A, Mhaveer S, Tanwir AM, Husain AS. A Phytochemical Overview On *Aadhatoda Zyelanica Medica A Vasica(Linn.) Nees*. *Natural Product Radiance.* 2009; 8(5):549-554

Alam G, Singh MP, Singh A. Wound Healing Potential of some Medicinal Plants. *International Journal of Pharmaceutical Sciences Review and Research.* 2011;9(1):137-143.

Ali M. Text book of Pharmacognosy (2nd ed). (New Delhi: CBS), 1998

Anonymous. Medicinal Plants in Folklores of Orrisa. (New Delhi: CCRUM). 2006

Arunachalam KD. Investigations on the phytochemical activities and wound healing properties of *Adhatoda vasica* leave in Swiss albino mice. *African Journal of Plant Science*. 2011;5: (2):133-145.

Bhargava MK, Singh H, Kumar A. Evaluation of *adhatoda vasica* as wound healing agent in buffaloes. Clinical, Mechanical and Biochemical studies. *Indian Veterinary Journal*. 1988;65(1): 33.

Bhattacharyya D, Pandit S, Jana U, Sen S, Sur TK. Hepatoprotective activity of *Adhatoda vasica* aqueous leaf extract on D-galactosamine-induced liver damage in rats. *Fitoterapia*. 2005;76(5):10-14.

Chandhoke N. Vasicine, the alkaloid of *Adhatoda vasica*. *Indian Drugs.* 1982;24:425-426.

Chaturvedi GN, Rai NP, Dhani R, Tiwari SK. Clinical trial of *Adhatoda vasica* syrup (vasa) in patients of non-ulcer dyspepsia(Amlapitta). *Ancient Science Of Life.* 1983;3(1):19.

Chauhan PK, Jaryal M, Saxena S, Kanishak. Antioxidant and Antimicrobial Activity of *Adhatoda vasica* against the bacteria isolated from the sputum samples of the asthmatic patients. *International Journal of Drug Research and Technology*. 2012;2(3):273-278.

Claeson UP, Malmfors T, Wikman G, Bruhn JG. *Adhatoda vasica*: a critical review of ethnopharmacological and toxicological data. *Journal of ethnopharmacology.* 2000;72(1-2):1-3.

Dhar ML, Dhar MM, Dhawan BN, Mehrotra BN, Ray C. Screening of Indian Plants for Biological Activity : I. *Indian Journal Of Experimental Biology*. 1968;6(4):232-247.

Dhuley JN. Antitussive effect of adhatoda vasica extracts on mechanical and chemical stimulation-l induced coughing in animals. *J Ethnopharmacol.* 1999;67(3):361-65.

Dorsch W, Wanger H. New antiasthmatics drugs from traditional Medicine? *Int Arch Allergy Appl Immunol*. 1991;94(1-4):262-5.

Gangwar KA, Ghosh KA. Medicinal uses and Pharmacological activity of *Adhatoda vasica*. *International Journal of Herbal Medicine.* pp.88-91, 2014

Gao H, Huang YN, Gao B, Li P, Inagaki C, Kawabata J. Inhibitory effect on α-glucosidase by *Adhatoda vasica Nees.Food Chem*. 2008;108(3):965-72

George M, Venkatraman PR, Pandalai KM. Investigation Plant Atibiotics part 2 .A search for antibiotic substances in some Indian Medicinal Plants. *J Sci Ind Res B.* 1947;42-46.

Grange JM, Snell NJ. Activity of bromhexine and ambroxol, semi synthetic derivatives of vasicine from Indian shrub *Adhatoda Vasica*, against Mycobacterium tuberculosis in vitro. *J Ethnopharmacol.* 1996;50(1):49-53.

Gulfarz M, Ahmad A, Asad MJ, Sadiq A, Afzal U, Imran M,

Anwar P, Zeenat A, Abbasi KS, Maqsood S, Qureshi RU. Antidiabetic activities of leaves and root extract of Justica *Adhatoda* Linn against alloxan induced diabetes in rats. *African Journal of Biotechnology.* 2011;10(32):6011-6013.

Gupta AK, Ahirwar NK, Shinde N, Choudhary M, Rajput YS, Singh A. Phytochemical Screening and Antimicrobial Assessment of Leaves of *Adhatoda vasica*, Azadirachta indica and *Datura stramonium*. *UK Journal of Pharmaceutical and Biosciences Journal.* 2013;1(1):40-47.

Gupta OP, Anand KK, Ghatak BJ, Atal CK. Vasicine, alkaloid of *Adhatoda vasica*, a promising uterotonic abortifacient. *Indian J Exp Biol.* 1978;16(10):1075-7.

Gupta R, Thakur B, Singh P, Singh HB, Sharma VD, Katoch VM, Chauhan SV. Anti-tuberculosis activity of selected medicinal plants against multidrug resistant *Mycobacterium tuberculosis* isolates. *Indian J Med Res*. 2010;131:809-13.

Hakeem MA. Bustan ul Mufridaat. (New Delhi: Zafar book depot), 1999

Hiremath GI, AHN Y, KIM S. Insecticidal Activity of Indian Plant Extracts against *Nilaparvata lugens* (Homoptera: Delphacidae). *Applied Entomology and Zoology.* 1997;32(1):159-166.

Iyengar MA, Jambaiah KM, Kamath MS, Rao MN. Studies on an antiasthma kada: A propriety herbal combination. Part1: Clinical study. *Indian Drugs.* 1994;31(5):183-186.

Kabiruddin. Mukhzanul Mufradat. (Lahore: Sheikh Mohd Basheer and Sons.), pp.116-117, 1996

Karthikeyan A, Shanthi V, Nagasathaya A. Preliminary phytochemical and antibacterial screening of crude extract of the leaf of *Adhatoda vasica*. L. *International Journal of Green Pharmacy*. 2009;3(1):78.

Khan MA. Muheet e Azam (urdu translation). (New Delhi: CCRUM), 2014

Lahiri PK, Pradhan SN. Pharmacoogical investigation of vasicinol-an alkaloid from *Adhatoda vasica. Nees*. *Indian Journal Of Experimental Biology,* 1964;2;219-222.

Lyengar MA, Jambaiah KM, Kamath MS, Rao GO. A Proprietary Herbal Combination. *Indian Drugs.* 1994;183-186.

Madak AT, Rao R. Hypoglycemic activity of anon nitrogenous principle from the leaves of *Adhatoda vasica.Indian Journal Of Pharmacy.* 1996; 105-106.

Maurya S, Singh D. Quantitative Analysis of Total Phenolic Content in *Adhatoda vasica Nees* Extracts. *International Journal of PharmTech Research*. 2010;2(4):2403-2405.

Narimanian M, Badalyan M, Panosyan V, Gabrielyan E, Panossian A, Wikman G, Wagner H. Randomized trial of a fixed combination (KanJang) of herbal extracts containing *Adhatoda vasica*, Echinacea purpurea and Eleutherococcus senticosus in patients with upper respiratory tract infections. *Phytomedicine*. 2005;12(8):539-47.

Nath D, Sethi N, Singh RK, Jain AK. Commonly used Indian abortifacient plants with special reference to their teratological effects in rats. *J Ethnopharmacol*. 1992;36(2):147-54.

Pahwa GS, Zutshi U, Atal CK. Chronic toxicity studies with Vasicine from *Adhatoda vasica Nees* in rats and monkeys. *Indian J Exp Biol*. 1987;25(7):467-70

Pandita K1, Bhatia MS, Thappa RK, Agarwal SG, Dhar KL, Atal CK. Seasonal variation of alkaloid of *adhatoda vasica* and detection of glycosides and N oxides of vasicine and vasicnonei. *Planta Med.* 1983;48(2):81-2.

Parrotta JA. Healing plants of Peninsular India. (New York: CABI), 2001

Patel VK, Venkatakrishna-Bhatt H. In vitro study of antimicrobial activity of *Adhatoda Vasika* Linn. (leaf extract) on gingival inflammation--a preliminary report. *Indian J Med Sci.* 1984;38(4):70-2.

Prathiba M, Giri R. Pharmacognostic Study on *Adhatoda vasica En*. *Asian journal of Innovative Research*, 2018;3(1):48-54.

Purohit AP, Gokhale SB. Pharmacognosys (2nd ed.). (Punr: Nirali prakashan), 2003

Rabinivich MI, Leskov AI, Gladikikh AS. Cholegogic properties of Peganine. Vrachei, pp. 181, 1996

Rastogi RP, Mehrotra BN. Compendium of Indian Medicinal Plant. (Lucknow: Central Drug Research Institute of Lucknow and National Institute of Science Communication), 1990

Roy CD, Shaik MM, Munnan M, Faruqee, & Md, H. A brief review on phytochemistry and pharmacological properties of *Adhatoda vasica*. *Journal of Tropical Medicinal Plants*. 2013;14:115-124.

Saxena BP, Tikku K, Atal CK. Insect antifertility and antifeedant allelochemicals in *Adhatoda vasica*. *Insect sci Appl.* 1986; 489.

Shahwar D, Raza MA, Triq S, Riasat M, Ajaib M. Enzyme inhibition, antioxidant and antibacterial potential of vasicine. Pak. *J. Pharm. Sci*. 2012; 25:651-656.

Shriivastava N, Srivastava A, Banerjee A, Nivasarkar M. Anti ulcer activity of *Adhatoda vasica*. *Journal of Herbal Pharmacotherapy*. 2006; 43-49.

Shrivastava N, Shrivastava A, Banarjee A, Nivsarkar M. Anti-Ulcer Activity of *Adhatoda vasica Nees*. *Journal of Herbal Pharmacotherapy*. 2009;6(2):43-49.

Srinivasan K, Sivasubramanian S, Kumaravel S. Phytochemical profiling and GCMS Study of *Adhatoda vasica* Leaves. *International Journal Of Pharma and bioscience*. 2014

United State Department of Agriculture. Classification for Kingdom Plantae Down to Species Justicia *adhatoda L.*, 2013. Available at: http://www.plants.usda.gov/java/ Classification (accessed on 25th October, 2019)

Usmanghani K, Saeed A, Alam MT. Traditional Medicine of

Herbal, Animal and Mineral Origin in Pakistan. (Karachi: Indusyunic Medicine), 1997

Vinothapooshan G, Sundar K. Wound healing effect of various extracts of *Adhatoda vasica*. *International Journal of Pharma and Bio Sciences.* 2010;530-535.

Zama MM, Singh HP, Kumar A. Comparative studies on wound healing in buffaloes. *Indian Vet J.* 1991;864-866.