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REVIEW ON POTENTIAL NATURAL MEDICINAL HERB: ADHATODA VASICA

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ABSTRACT

The increasing incidence of adverse drug reactions due to use of allopathic drugs from past few decades have attract the attention of researchers and also medical practitioner towards the herbal drugs. These herbal drugs have been utilizing by the tradition system of medicine and in Ayurveda since last 1000 years. Numerous families of medicinal plants exist out of which Acanthaceae family along with other families like Euphorbiaceae, Meliaceae etc are found noteworthy. Adhatoda vasica (*Vasa*) is well known drug in Ayurveda, has been known to possess enormous biological potential. In Ayurveda, it is use to cure diseases like *Gulma, Raktapitta, Swasa-kasa* due to its properties like *Tikta-Kashaya rasa, katu vipaka, sheeta virya*. The chief chemical composition of it consists of vasicine, adhatonine, vasicol etc which possess important pharmacological actions like: anti-microbial, bronchodilator, anti-inflammatory, anticancer etc. Thus, this article aimed to present an overall detail review of the pharmacological and phytochemical potential of this plant.

KEYWORDS: Adhatoda vasica(*Vasa*), *Tikta-Kashaya rasa*, biological activities, secondary metabolites.

INTRODUCTION

Plants have provided a source of inspiration for novel drugs compounds and we are using crude plants as medicines since Vedic period. An extraordinary influence of herbal medicine results into increase in demand of herbal medicine in everywhere in globe.[1] There are many herbal plants in the world among which *Vasa i*s considered to be the ruler of herbs due to its

great medicinal ethics. Various medicinal properties are well documented in Hindu mythology. The literature revealed that *Vasa* from different geographical origins existed variety of chemical constituents, and the researchers found vide and varied applications in traditional healthcare system.[2]

Herbal medicines are in great demand in the developed as well as developing countries for primary healthcare because of their wide biological and medicinal activities, higher safety margins and lesser costs. *Adhathoda vasica* which is generally known as *vasa* is one of the drugs with great therapeutic value and is widely distributed in widely in India. *Vasa* is Sanskrit word that means "which restores normal health." *Adhathoda vasica* (synonym-Justica adhathoda) of *Acanthaceae* family is well known plant drug in *Ayurveda*. *Vasa*, which has synonyms as *Vajidanta, Bhisaka mata etc*. is one among the major drug in the Ayurvedic system of medicine which is native to South Asia mainly from India and its leaves or whole plant is extensively used in various types of diseases. It consists of *Titka* and *Kashaya Rasa, Katu Vipaka, Sheeta Virya* and *Laghu, Rusha Guna*. It is commonly known as Malabar nut.

*Vasa (*Adhatoda vasica) is a well- known herbal drug in Ayurvedic System of medicines. Drug known as *vasa or vasaka* consists of fresh dried leaves and roots of Adhatoda vasica. The plant is widespread throughout the tropical regions tropical regions of Southern Asia including plains of India especially in the lower Himalayan regions up to range of 1000 meters above sea level. The plant is known by multiple names in different languages, like *Vasa, Vasaka, arusa, atarusaka* or Malabar nut. This plant is source of Vitamin c and has medicinal uses, mainly antispasmodic, antipyretic, antitussive, anti-inflammatory, bronchodilator and oxytocic. It is astringent, diuretic, anti-periodic, purgative and expectorant. In Ayurveda, the plant has been used in treatment of cough, cold, pneumonia, fever, jaundice and asthma due to main action as expectorant and antispasmodic. More-over the importance of *Vasa* plant in treatment of respiratory disorders can be understood from the ancient Indian saying" No man suffering from phthisis need despair as long as vasa plant exists".[3]

It has been used in indigenous system of medicine in India for more than 200years.
It is used as herbal remedy for treating cold, cough, whooping cough, chronic bronchitis and asthma as sedative expectorant, antispasmodic and anthelmintic. Its primary alkaloids are vasicine and vasicinone. Essential oils of the leaves of vasa contain ketones, terpene which

have antitumour, antioxidant, antimutation effects. In *Bhavaprakash Vasa* is describe as *Kaph Nisarak, Kusthahar, Kasahar, Jwarhar, Swashhar.*

According to *Acharya Charaka* and *Vagbhata, Vasa* is used in *Gulma.*

LATIN NAME: Adhatoda vasica Nees.

Synonyms: Justica adhatoda Linn. \ Adhatoda zeylanica Medik.

FAMILY: Acanthaceae.

Kula: Vasa kula.

Table No 1: Vernacular Names.[4]

Language	Name
Sanskrit	Vasa, Vasaka, Acchadayati, Simhasya, Atarusha, Vrisha, Bhishagmata
English	Malabar Nut
Hindi	Adosa, Arusha, Bansa, Rus, Adusa
Tamil	Eadadad, Adathodai
Bengali	Adulsa, Bakash, Vasok
Marathi	Adulsa, Adusa
Telgu	Addasaramu, Adam kabu, Adampaka
Punjabi	Vamsa, Bhekkar
Gujrati	Adusol, Aradusi, Aduraspee, Bansa
Kannada	Adusogae, Adu, Muttada, Soppu
Malayalam	Adolokam

Etymology of synonyms

1.Vasa.

It is a shrub which covers the ground with dense foliage.

2. Atarusha.

It is useful drug which alleviates number of disease.

3.Vajidanta.

It has white bilabiate flowers.[5]

4. Shimhasya.

Its flowers are like opened mouth of lion.

5.Vrusha.

Its flowers has profuse nectar.

6.Bhishagmata.

It cures diseases of various organs and thus called "mother of physician".[6]

7. Karkasa.

It has minutely pubescent leaves

8. Kaphaha.

It is useful particularly in respiratory disorders caused by kapha.

9. Kasanotpatana.

It is useful for cough.

10. Raktapittaprasadani.

It is useful for raktapitta

11. Raktamutrajita.

It is useful for raktamutra

12. Dantasattvapradayi.

It provides strength to teeths.[7]

Table no 2: Synonyms of Vasa.

Synonym	*Bhv.N*[8]	*D.N*[9]	*R.N*[10]	*M.N*[11]	*K.N*[12]
Vasa	+	+	+	+	+
Vasaka	+	+	+	+	+
Atarushaka	+	+	+	+	+
Bhisagmata	+	+	+	+	-
Vrusha	+	+	+	+	+
Vajidanta	+	-	+	-	+
Shimhika	+	+	+	-	+
Shimhasya	+	+	+	-	+
Tamra	+	-	-	-	-
Shitaparni	-	-	+	-	-
Nasa	+	-	-	-	-
Panchamukhi	+	-	-	-	-
Shimhaparni	-	+	+	+	+
Shitavalli	-	-	-	-	+
Shimhavalli	-	-	-	-	+

Classification According to Ayurvedic Text.

I. ***According to Karya-Karana Bheda –*** *Karya Dravya*

II. ***According to Chetanachetana Bheda –*** *Chetana Dravya*

III. ***According to Yoni Bheda –*** *Audbhida Dravya*

IV. ***According to Aushadha –*** *Aushadhi Dravya*

V. ***According to Rasa –*** *Tikta, Kashaya.*

VI. ***According to Vipaka –*** *Katu Vipaki Dravya*

VII. ***According to Veerya –*** *sheeta Veerya Dravya*

VIII. ***According to Doshakarma –*** *Kaphapitta-shamaka*

IX. ***According to Guna –*** *Laghu, Ruksha*

Review of Vasa as per *Veda, Samhita and Nighantus Vedas*.

In Vedic compendia any description of *Vasa* was not found.

***Charak Samhita* (1000 B.C. - 4 A.D.)**

Vimanasthana: In *Rogabhishakjitiya adhayaya Vasa* is included in *Tikta skandha.*[13]

Chikitsasthana: *Vasa* in mentioned in *chikitsa of urdhvagata raktapitt*a.

Also used in treatment for *Gulma, krimikustha and Rajyakshma.*[14]

Sushruta Samhita (1000 B.C.- 500 A.D.)

Sutrasthana: In *Annapanavidhi adhayaya Vasa* is mentioned in *pusha and shaka varga. Vasa shaka is mentioned as tikta rasatmaka and is Kapha-pitta nashaka. Vasa pushpa is mentioned as tikta rasatmaka, Katu vipaki and is used for kasa and shaya roga.*

Chikitsasthana: In Medhaayushkamiyarasayana adhayaya, Vasa mulu is used for rasayana karma.[15]

Uttarsthana: It is used in treatment of swasaa, raktapitta and shosha[16]

Ashtang Samgraha (600 A.D.) and Ashtang Hridya (700 A.D.)

Sutrasthana: In Annaswarupvigyaniya adhayaya, Vasa is mentioned as one of 28 patra shaka. It has katu vipaka, tikta rasa and is grahi, vatala and Kapha-pitta nashaka.

Chikitisa sthana: In jwarachikitsa adhayaya, in treatment of vatta-pittaj jwara.

Uttar sthana: In mukharogapratisheda adhayaya, used of Ghanakwatha of vasa bark for local application.[17]

Amarkosha (5th Cent.A.D)

This book is the complication done by Amar Singh. The total subject was narrated with synonyms. *Vasa* has been mentioned in the *Vanaushadhi varga*. Following synonyms are mentioned here i.e *Vasika, Vaidhyamata, Singhi, Vrisha, Singhasya, Vasak, Vajidanta* is given.[18]

***Sausruta Nighantu* (6th Cent.A.D)**

Several synonyms of *Vasa* i.e *Aatrushak, Vrish, Singhamukhi* have been mentioned and vasa is indicated *in Raktapitta.*[19]

***Ashtanga Nighantu* (8th Cent.A.D)**

In this *Nighantu Vasa* has been described in *Shyamadi and Virtaradi gana.*

Following synonyms are mentioned here i.e *Vrisha, Singhasya, Aatrushak*[20]

***Dhanvantari nighantu:* (10th - 13th Cent. A.D.)**

In the beginning of *Nighantu*, author has mentions its name as *Dravyavali.* In the last section of *Dravyavali* author has describe the drugs of *Dravyavali* with their synonyms and after that he has described their properties and *guna karma* and actions along with synonyms. In this *Nighantu Vasa* has been described in '*Guduchyadi Varga'*. Here, following synonyms of vasa are mentioned i.e., *Singhaparni, Singhika, Atrushak, Bhisagmata, Singhamukhi*. Along with synonyms *Tikta* and *Shita guna of vasa with Kushthagna(skin disorder), Kasahara (respiratory diseases), Jvarhara* (antipyretic), *Chardighna* (antivomiting) actions are described.[21]

***Sodhala nighantu*: (12th Cent. A.D.)**

This *Nighantu* was composed by *Sodhala* in two parts named as *Namasangraha* dealing with synonyms and *Gunasangraha* dealing with properties and actions. In *this varga* synonyms of '*Vasa' i.e Singhiparni, Vrish, Singhika, Atrushak, Bhisagmata, Singhmukhi, Svetamukh, Asvadant*, have been mentioned. *Vasa* is indicated in *Mutraraktata.*[22]

***Hridayadipaka nighantu*: (13th Cent. A.D.)**

The author of this work is *Bopadeva.* The subject matter of this work is well divided into eight *Vargas.* It follows metric style of *Paryaya ratnamala of Madhava*. In this *Nighantu Vasa* has been mentioned in *Kapha-pittaghna varga.*[23]

***Abhidhanaratnamala (Sadrasa Nighantu*) (13th Cent. A.D.)**

In *Abhidhanratnamala* synonyms of *Vasa* are described in '*Tikta dravya skandha'* Following synonyms are mentioned here *Vasa, Vrsha, Snghimukhi, Bhishagmata, Aatrushak.*[24]

***Madhava-dravyaguna*: (13th Cent. A.D.)**

In *Madhava dravyaguna Vasa is mentioned under the Vividh-aushadi varga*. Here, in *Madhava dravyaguna Vasa is described in Vividh-aushadi varga*. Here, *Vasa* is used in the treatment of *Kasa, Svaravikar, Raktapitta, kaphaj-vikara*[25]

***Madanpala nighatuu*: (14th Cent. A.D.)**

Vasa has been mentioned in "*Abhyadi varga". Madanapala* has mentioned synonyms of *Vasa like: Vrisha, Singhika, Aatrusaka, Bhishagmata, Singhimukhi* etc. Its property is

Kaphavatahara and indicated in Svasa & kasa (respiratory diseases*), Jwara (fever), Chardi (vomiting)i, Meha (diabetes), Kustha* (skin diseases).[26]

***Kaiyadev nighantu: (Pathyapathya Vibodhaka*) (15th Cent. A.D.)**

In this *Nighantu 'Vasa'* is described in "*Aushadhi Varga" by* their different synonyms some new synonyms are also given here these are *as Shatavalli matraka, Vajidantaka*. Vasa has been described as *Shita in Virya, Tikta and Kashaya rasa*. The following *karma* of *vasa* has been enumerated: *Svasa & kasa (respiratory diseases), Jvara (fever), Chardi (vomiting)i, Meha (diabetes), Kustha (skin diseases), Kshaya (tuberculosis).*[27]

***Bhavaprakasa nighantu*:(16th Cent. A.D.)**

This book is written by *Bhavamishra*, is an important landmark in the history of Indian Medicine. This *Nighantu* stands as a bridge between the medieval and modern period. *Vasa* has been present in *Guduchyadi varga* in this *Nighantu* further Different Synonyms i.e, *Vajidantaka, Aatrushaka, Vrisha, Vrisha* are mention and it is indicated in *Swasa & kasa* (respiratory diseases), *Jvara (fever), Chardi(vomiting)i, Meha (diabetes), Kustha* (skin diseases[28]

***Gunaratnamala:* (16th Cent. A.D.)**

In *Gunaratnamala of Bhavamishra 'Aarusha'* word has been used in place of *Vasa* and its *Guna karma* along with characteristic features of *Vasa* are described as *Shita Virya, Tikta, Kashaya; rasa, Laghu; guna*, and indicated in *Kaphpittaraktanashak* and mentioned in the treatment of *Svasa & kasa* (respiratory diseases*), Jwara* (fever), *Chardi* (vomiting)i, *Meha* (diabetes), *Kustha* (skin diseases), *Kshaya* (tuberculosis).[29]

***Rajanighantu: (Nighantu Raja, Abhidhana chudamani*) (17th Cent. A.D.)**

This Nighantu is written by Narhari Pandit, in which first place is given to *Dravyaguna in Astanga Ayurveda*. This book is particularly based on the *Dhanwantari nighantu.* The subject matter has been divided into 23 chapters. *Vasa is indicated in "Shatahavadi varga*". It possesses *Tikta and Katu rasa; Shita virya*. In this *Nighantu* Sixteen synonyms of *'Vasa'* are mentioned. This is useful in *Rakta-pittaj* disorders. Synonyms of Vasa mentioned in *Raja nighantu i.e, vasaka, Singhika, Vasa, Bhisagmata, Vasadani, Aatrushaka, Singhimukhi, Singhi, Kanthorvi, Vrish, Shitparni, Vaajidanta, Naasa, Panchmukhi, Singhiparni, Mrigendrani.*[30]

Priya Nighantu: **(20th Cent. A.D.)**

Acharya Priyavrata Sharma has mentioned *'Vasa'* in *Shatpushpadi Varga.* Its properties are *Tikta rasa; Laghu guna; and Shita virya*; and *Kaphapittahara in karma*. It is prescribed to cure *Kasa & Svasa* (respiratory diseases), *Raktapitta (Haemoptysis) Kshaya (tuberculosis)) and Kustha (skin diseases).*[31]

Table no 3: Classification of Vasa.

Charaka Samhita	***Tikta skandha***
Vagbhata	*Durvadigana*
Amarkosha	*Vanaushadhi Varga*
Ashtanga Nighantu	*Shyamadi and Virtaradi gana*
Dhanvantari Nighantu	*Guduchyadi Varga*
Sodhala Nighantu	*Guduchyadi varga*
Abhidhanrantamala	*Tikta dravya skandha*
Madhav dravyaguna	*Vividh-aushadi varga*
Madanpal Nighantu	*Abhyadi varga*
Kaiyadev Nighantu	*Aushadhi Varga*
Bhavprakash Nighantu	*Guduchyadi Varga*
Raj Nighantu	*Shatahavadi varga*
Priya Nighantu	*Shatpushpadi Varga*

Table no 4: Rogadhikara of Vasa as per Samhita & Nighantus.

	Charaka samhita	***Sushruta Samhita***	***Vagbhata***	***Bhv.N***	***D.N***	***R.N***	***M.N***	***K.N***
Raktapitta	+	+	+	+	+	+	-	-
Jwara	-	-	+	+	+	+	+	+
Swasa	+	+	-	+		+	+	+
Kasa	+	+	+	+	+	+	+	+
Shayaroga	+	+	-	+	+	+	+	+
Prameha	-	-	-	+	-	-	+	+
Kustha	+	-	-	+	+	-	+	+
Kapharoga	-	-	-	-	-	+	-	+
Kamala	-	-	-	-	-	+	-	-
Trushna	-	-	-	+	+	-	-	+
Chardi	-	-	+	+	+	-	+	-
Gulma	+	-	-	-	-	-	-	-
Mukharoga	-	-	+	-	-	-	-	-

Table no 5: Properties of Vasa.

Rasa	*Tikta, Kashaya (Bhv.N, P.N) Tikta, Katu (R.N, A.N)*
Guna	*Laghu, Ruksha, Garhi*
Veerya	*Sheet*
Vipaka	*Katu*
Doshaghnata	*Kapha-pitta shamaka*
Karma	*Rasayana, Kusthagna, Ratkapittahara, Jwarahara, Pramehaghna, Swasa-kasa hara*

Useful part

Leaves, Flowers, Root, Whole plant

Dose

Putpaka swarasa- 20-30mL

Flower powder- 6-12gm

Leaves powder- 2.5- 5gm

Panchang kwatha – 20-25 mL

Formulations[32]

Vasa-avleha

Vasa-aristha

Vasapanaka

Vasachandanadi tailam

Ethnobotanical uses

Vasa has been used in various chest and respiratory tract infection. It is also used in treatment of bleeding piles, impotency and sexual disorders. Various parts of the plant have been used in Indian traditional medicines for treatment of asthma, joint pain, lumbar pain, sprains, cold, cough, malaria, rheumatism, swelling and venereal diseases.[33]

i)Roots: Paste of fresh roots applied on abdomen and vagina minutes before childbirth facilitates easy delivery. Root decoction has been used for gonorrhoea and as an expectorant, anti-spasmodial\ anthelmintic agent.[34]

ii)Leaves: The various preparations of leaves had been used. The various preparations of leaves had been used for curing bleeding, haemorrhage, skin diseases, wounds, headache and leprosy. The fresh juice of leaves mixed with honey and ginger juice cures all types of acute cough, chronic bronchitis, breathlessness, asthma. The crushed fresh leaves had been used to treat snake bite.[35] The leaf powder boiled in sesame oil stop pus from ear as well as earaches and jaundice. Externally warmed leaves have been used for rheumatic pain and dislocation in joints, stomach catarrh with constipation, gout, fever and urinary stone.[36]

iii)Flowers: The flowers have been known to possess expectorant and anti-asthmatic, antiseptic properties and have been used against of ophthalmia, cold, phthisis, asthma,

bronchitis, cough, antispasmodic, high fever and gonorrhoea. Also, the flowers improve blood circulation and hectic heat of blood.[37]

Systemic uses

External uses

Paste is anti -inflammatory, antibacterial and analgesic and cure skin diseases. Local application of paste is useful in arthritis, inflammatory ulcers, nerve disorders and skin diseases. In disorders like amnesia and convulsions, oil massage is done on areas. To kill bacteria in ulcers, the affected area is washed with leaf juice.

Internal use

Nervous system: The use of vasa causes vasodilation, stimulates vagus nerves. This increases the heart rate and lowers B.P.

Digestive system: Being astringent and *sheeta*, it is useful in diarrhoea, dysentery especially with bleeding disorders.

Circulatory system: It acts on *rakta dhatu*. Therefore, it is very useful in bleeding disorder. It is also haemostatic and blood purifier. It contracts smaller blood vessels, hence it is useful in bleeding disorders, bleeding piles, menorrhagia and haemoptysis.

Respiratory system: This is main area of action of *Vasa* due to its action on blood flow and vagus nerve action, mainly acts on lungs. *Vasa* liquifies *the kapha* which gets expectorated. It leads to bronchodilation and therefore breathing becomes easier. This is a long- lasting effect and thus vasa is used in asthma, breathlessness and throat infection. The action of *vasa* makes it useful in chest congestion and tuberculosis. Dried vasa leave when mixed with *dhatura* leaves and are smoked relieves breathlessness.

Urinary system: It is a diuretic. Flowers are used in dysuria, burning micturition and other urinary disorders.

Skin: It is a diaphoretic and *Kusthaghna* and thus useful in skin infections especially those with discharge and bleeding.

Temperature: Used in fever induced by *pitta and kaphapitta.*

Satmikaran: Due to its *titka rasa*, its stimulates *rasa dhatu* which then enhance the action of all *dhatu.* It stops the formation of *kapha from rasa dhatu* and instead stimulates the formation of successive *dhatus like rakta, mansa* etc. thus it is useful in tuberculosis.

Table no 5: Taxonomy[38]

Kingdom	Plantae
Division	Angiosperms
Class	Eudicots
Order	Lamiales
Family	Acanthaceae
Genus	Justicia
Species	Adhotada (Adhatoda vasica)

Growth and Cultivation[39]

Soil and Climate: Seen in almost all types of climate. Prefers loamy soils with good drainage. It can tolerate high temperature and can withstand drought to great extent, but is sensitive to frost.

I)Propagation

Commercial propagation method is done by using 15-20 cm long 3-4 nodded stem cuttings. Terminal portion is more ideal for planting, however, lower stem portion also used when planting material requirement is more. Either rooted or unrooted cuttings can be used for planting. Cuttings root easily and become a ready for planting within 4-5 weeks. Rooted cuttings ensure better establishment during periods of insufficient rains.

II)Planting

Planted during April-May within onset of monsoon. It is cultivated as a pure crop or as intercrop in plantation crops. The land is ploughed repeatedly to a good tilth, mixed with manures and beds of 1m breath and convenient length are prepared and cuttings planted. Spacing: 60×30cm, about 20,000 cuttings are required per acre.

III)Manuring

The plant usually grows well without any special care. However, for higher yields in commercial cultivation application of manures and fertilizers are recommended.

IV)Pest and diseases

Incidence of pests and disease is low.

Leaf stop disease: during rainy periods, leaf spots appear on older leaves. Infested leaves turn yellowish and falls down.

V)Harvest and processing

The plant is harvested as whole plant and also as leaves and roots.

Leaf harvest: from first year onwards at 3-4 months interval.

Root harvest: after 2 years.

December-January is deal for root harvest since alkaloids content is higher during these months. Roots are collected by digging and stems are cut 15cm above the root, dried and stored.

Morphology of Vasa[40]

It is dense shrub 1.2-2.4 m, sometimes arborescent 6m high with many long opposite ascending branches.

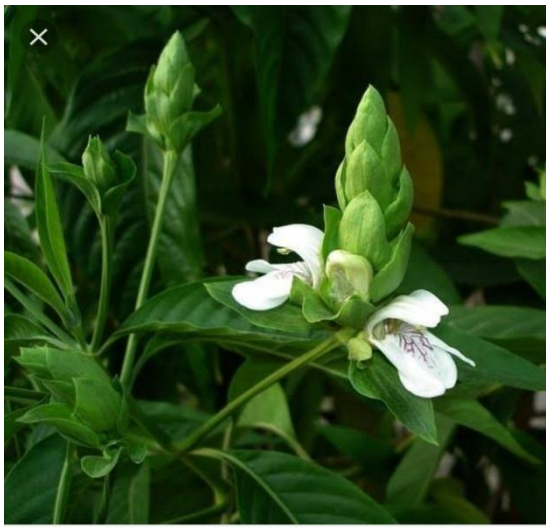
Leaves: 10-13cm long. Leaves are of ovate lanceolate shaped and light green in colour. It has characteristic odour. The taste is bitter. The apex of leaf is acuminate, margin slightly crenate to entire. The base of leaf is symmetric and venation is pinnate. Leaves are oppositely arranged, smooth -edged and borne on short petioles. Petioles are 1-2.5cm long. They are elliptic -lanceolate, minutely puberulous when young, glabrous when mature, entire dark above, paler beneath, base tapering. On drying they have dull brownish – green colour. Main nerve 10-12 pairs with reticulate venation between.

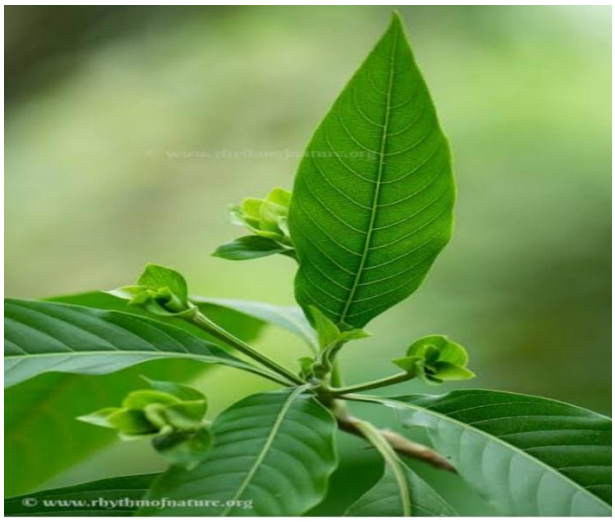
Stem: stem of this plant is long, opposite having ascending branches with yellowish bark, terete, glabrous.

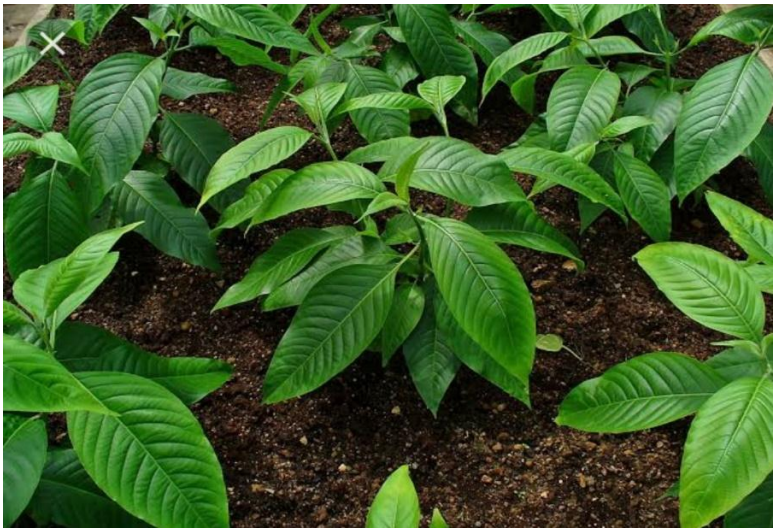
Flower: Present in short dense axillary peduncles 3-10cm, stout, shorter than the leaves, bracts reaching 1-2 by 0.5-1.2 cm, elliptic subacute, glabrous or nearly so, 5-7 nerved, closely reticulately veined; bracteoles 1.5-2 by 0.3-0.4 mm, oblong- lanceolate, acute, with ciliolate margins, 1-nerved, reticulately veined. Calyx rather less than 1.3cm, long, glaborous or slightly pubescent, divided to within 2mm, of the base; sepals imbricate, oblong -lanceolate, acute, 3-nerved, reticulately veined. Corolla white, with a few irregular pinkish coloured bars in throat,2.5-3cm.long, pubescent outside; tube 1-2cm. long, the lower half cylinder, 4mm diameter, the upper half much laterally inflated; upper lip 2 by 1.3 cm. long, ovate – oblong, curved, obtuse, notched; lower lip as long as the upper, the lobes 1.3cm. deep, ablong

rounded, the middle lobe the broadest. Filaments hairy at the base, long, stout, curved, lower anther-cells minutely apiculate at the base. Ovary pubescent; lower part of style pubescent, capsule 1.5-2 by 0.6-0.8 cm. clavate, subacute, shortly and bluntly pointed, pubescent; solid stalk flattened, 1cm long.

Seeds: 5-6mm. long, orbicular- oblong, tubercular – verrucose, glabrous.







Microscopic characters[41]

T.S of stem

The transverse section of stem is waxy in outline. The epidermis is outermost layer of stem made up of compactly arranged barrel shaped cells. The outer cell wall is greatly thick and heavily cutinise. Beneath the epidermis, multi-layered thick-walled hypodermis is present. Beneath hypodermis multi-layer parenchymatous cortex is present. The cortex is with large intercellular spaces. Endodermis and pericycle is not distinct. Inner to cortex a ring of many

conjoint, collateral and open vascular bundles are present. Pholem is present towards epidermis. Xylem is endarch and radially arrange medullary rays are present in between vascular bundles. Multi-layer polygonal compactly arranged cells are present at the center forming pith.

T.S of leaf

It is typical dicot leaf. The leaf is cover on both surfaces by a single layered epidermis. The epidermis is single layer and made up of compactly arrange barrel shaped parenchymatous cells. The outer surface of the epidermis is covered with cuticles. Stomata are found in both upper and lower epidermis. The mesophyll tissues are differentiate into palisade tissue towards upper epidermis and it contain double layer columnar cell compactly arrange with chloroplast. Spongy tissue towards lower epidermis, cells are polygonal loosely arrange with numerous intercellular spaces. Each vascular bundle are conjoint, collateral and closed. There is presence of xylem towards upper epidermis and phloem towards lower epidermis. The vascular bundles are enclosed by a parenchymatous bundle sheath.

T.S of root

Shows 6 to 15 layers of rectangular to slightly tangentially elongated, thin-walled cork cells; secondary cortex wide consisting of rectangular to polygonal, thin-walled parenchymatous cells a few containing oil globules, followed by more or less discontinuous, annular band of mostly rectangular groups of stone cells having distinct pits and striations; secondary phloem composed of 15 to 20 layered, rectangular, elongated, thin-walled cells having usual elements; secondary xylem composed of vessels, fibres, parenchyma and rays; vessel simple pitted; xylem rays mostly uniseriate, a few four seriate rays are also present; starch grains simple and compound, with 2 to3 156components, round to oval, 3 to 6 µ in dia., having concentric striations and hilum, present in secondary cortex and secondary pholem. Powder - Brownish-grey; shows fragments of cork cells; simple pitted vessels; stone cells mostly in groups; starch grains simple and compound having 2 to 3 components, round to oval, 3 to 6 µ in dia. having concentric striations and hilum.

Distribution

This is found in plains of India in wild condition and is cultivated in small scale in village shrubberies. Outside India it is found in Bangladesh, Burma, Malaya and Sri Lanka.[42]

Table No 6: Identity, Purity and Strength (Leaf).[43]

Foreign matter	Not more than 2 per cent	Appendix 2.2.2.
Total Ash	Not more than 21 per cent	Appendix 2.2.3.
Acid-insoluble ash	Not more than 1 per cent	Appendix 2.2.4
Alcohol-solube extractive	Not less than 3 per cent,	Appendix 2.2.6
Water-soluble extractive	Not less than 22 per cent	Appendix 2.2.7.

Table No 7: Identity, Purity and Strength (Root).[44]

Foreign matter	Not more than 1 per cent	Appendix 2.2.2
Total Ash	Not more than 5 per cent	Appendix 2.2.3.
Acid-insoluble ash	Not more than 1 per cent	Appendix 2.2.4
Alcohol-soluble extractive	Not less than 4 per cent	Appendix 2.2.6
Water-soluble extractive	Not less than 10 per cent	Appendix 2.2.7

Chemical Composition

This plant contains alkaloids, tannins, flavonoids, terpenes, sugars and glucosides. The principle constituents of vasa are its several alkaloids, the chief one being vasicine. Vasicine is a bitter quinazoline alkaloid, which is present in the leaves, roots and flowers. Beside vasicine, other alkaloids present in leaves are adhatodine, adhatonine, adhavasinone, anisotine, vasakine, deoxyand N -oxide, vasicinol, vasicinone, vasicinolone, vasicol and 6-hydroxy preganine. Betaine, steroid beta-sitosterol and alkanes are also present in leaves.[45]

The root alkaloids adhatodine, vasicine, vasicinol, vasicinone, vasicinolone, deoxyvasicinone, a steroid daucosterol, carbohydrates and alkanes. Roots are known to contain pegamine, sitosterol and also beta-glucose -galactose.[46]

Flavonoids (astragalin, kaempferol, quercetin,vitexin) alkanes, steroids, vasicinine triterpenes are present in flowers. Glycosides and minor alkaloids include adhatonine, vasinol are also found.[47]

T.L.C.

T.L.C. of alcoholic extract on Silica gel 'G' plate using Chloroform: Methanol (80 : 20) shows under U.V. (366 nm) four fluorescent zones at Rf. 0.57, 0.63 (both red), 0.83 (sky blue) and 0.87 (yellow). On exposure to Iodine vapour six spots appear at Rf. 0.07, 0.27, 0.52, 0.72, 0.87 and 0.93 (all yellow). On spraying with Dragendorff reagent two spots appear at Rf. 0.27 and 0.52 (both orange).

Chromosomes number

Adhatoda vasica possess 2n= 34 metacentric chromosomes.[48]

Pharmacological activities

1.Antitussive

The extracts of Adhatoda vasica were showed to comprise a good antitussive activity in anaesthetized rabbits and guniea pigs as well as unanaesthetized guniea pigs. Because Vascinie showed the bronchodilatory activity both in-vivo and invitro. Although, Vascinone the main metabolitee of Vasicine, which is also present in adhatoda extracts, showed bronchoconstriction in-vivo. The two alkaloids in combined showed a bronchodilatory activity both invitro and in-vivo. It may be due to presence of the specific site of action of Vasicinone and Vasicine (major alkaloids) which supress coughing by its action on its neuronal system in medulla.[49]

2.Antimicrobial

The water extract of vasa had proved to be active against microbial flora isolated from patients with gingivitis.[62] The alcoholic extract of leaves and roots showed antibacterial activity against Staphylococcus aureus and Escherichia coli.[63] The crude ethanolic extract of the leaves exhibited antimicrobial activity against Staphylococcus epidermidis, Bacilius subtilis, Proteus vulgaris and Candida albicans. Moreover the methanolic extract exhibited positive antimicrobial activity for P.aeruginosa, S.aureus and B.subtilis. Growth of mycobacterium tuberculosis was found to be inhibited by ambroxol, bromhexine (semi synthetic derivatives of vasicine) due to their mucolytic actions. As these compounds are concentrated in macrophages they might exert clinically useful effects on intracellular tubercle bacilli by enhancement of lysozyme level in bronchial secretions. Therefore, these compounds are being active as adjunctive therapy of tuberculosis.[50]

3.Anti-inflammatory

Aqueous and alcoholic extracts showed anti- inflammatory action in rats using carrageenan induced rat paw edema model. The efficacy was found to be comparable to diclofenac sodium.[51]

4. Antioxidant

Oral administration of leave extract at 800mg\kg controlled hematological parameters to normal like GSH and LPO level in post irradiated animals. Pre-treatment with adhotda vasica at 100 and 200 mg\kg also significantly improved SOD, catalase and GSH level in CCL_4 induced hepatotoxicity.[54]

5. Antiulcer

In ethanol and aspirin induced ulcer model of rats, treatment with adhatoda leave extract exhibited significant antiulcer activity in experimental animals compared to control. Results were better in ethanol induced ulceration model.[55]

6. Uterotonic and abortifacient

Vasicine induced abortifacient effects were dose related and stage of pregnancy in rats, guinea pigs, rabbits. Aqueous solution of Adhatoda vasica leaves at 175mg\kg in guinea pigs revealed abortifacient activity. 50% ethanolic extract of leaves showed 66.6% anti - implantation activity in rats.[56]

7. Bronchodilator activity

Vasicinone, important alkaloid, exhibited powerful bronchodilator action both in normal and histamine induced bronchoconstriction in guinea pigslungs but vasicine exhibited bronchoconstriction with negative inotropic effect on heart. In invitro studies, vasicinone produced tracheal relaxation comparable to theophylline in-carbachol and histamine induced constriction. Vasicine exhibited significant respiratory stimulant activity that was found to be increase in presence of vasicinone. Aerosol inhalation of alkaloids of A.vasica at 10mg\ml exhibited significant protection against allergen induced bronchoconstriction.[57]

DISCUSSION AND CONCLUSION

Medicinal components from plants plays an important role in conventional as well as western medicine. The importance, necessity and efficacy of medicinal plants in practice of medicine today are well established and cannot be overlooked. Medicinal plants extract can be used directly or indirectly for treatment of various diseases. Powder, decoction and infusion of large number of medicinal plants are available in market which are used for the treatment of various diseases. Vasa due to its various chemical components like vasicine, adhatodine and properties like *Titka -Kashaya rasa, Sheeta virya, Katu vipaka and Karma* like *Swasa-Kasahar, Rasayan* have special effect on various disease like bronchial asthma, bleeding disorders, tuberculosis etc. Also, an increased antibiotic resistance has posed a problem worldwide due to the frequent uses of antibiotics. *Vasa* has been proved to be effective against antibiotic resistant microorganisms. Also, the volatile oils present in it are proved to be effective against the microbacterium tuberculi. Thus, it can be used in tuberculosis patient having resistance to antibiotics. Various formulation of *vasa like Vaasa-avleha, Vasaghrut, Vasa-aristha* are found to be more useful as compared to allopathic medication for various

condition like chronic cough, asthma, bronchitis, bleeding piles, malnourishment because they show long lasting effects and also don't have any side effects.

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