



# A BRIEF REVIEW ON ADHATODA VASICA NEES.

Kreena Parmar<sup>1</sup>, Mr. Ravi Bhatt<sup>2</sup>, Dr. Kinjal Shah\*<sup>3</sup>

1 Student, B. Pharmacy College, Rampura

2 Assistant Professor, B. Pharmacy College, Rampura

3. Professor, B. Pharmacy College, Rampura

## ABSTRACT:

*Adhatoda vasica* Nees belong to family acanthaceae. It contain certain chemical constituents like alkaloids, flavoids, fatty acids and triterpens. *Adhatoda vasica* extensively used for treating joint pain, lumbar pain, sprains, malaria, cold cough, chronic bronchitis and asthma. *Adhatoda vasica* have wide range of pharmacological activity mainly used in Bronchodilator, Anti-bacterial, Abortifacial, Insecticidal and HIV protease inhibitor activity. Main phytochemicals are that has been investigated are 2-4 dihydroxychalcone 4-glucoside. This review article helps the researcher for further investigation.

**Keywords:** *Adhatoda Vasica* Nees, pharmacological activity, phytochemical activity, chemical constituents.

## 1. *Adhatoda vasica* Nees.

### 1.1.1 INTRODUCTION

**BIOLOGICAL SOURCE<sup>1</sup>:** Drug consist of dried as well as fresh leaves of *Adhatoda Vasica* Nees. Belongs to family Acanthaceae.

### VERNACULAR NAMES<sup>1</sup>:

Sanskruit : Vasa, Amalaka, bashika

Hindi : Adusa, adalsa, Atarusaka

Gujrati : Aradusi, adulso<sup>2</sup>

Kannad : Adusoge, kurchigida, pavate<sup>2</sup>

Malyalum	: Adalodakam
English	: Malabar nut, Vasaka
Tamil	: Adhatodai
Telugu	: Adasaramu
Bengali	: Basak
Assam	: Vachaka
Marathi	: Adulsa

**PARTS USED:**Leaves, roots, flowers, bark<sup>1</sup>, stem and fruits<sup>3</sup>

**Botanical description:**Vasaka is a small, evergreen, perennial shrub, reaching 1.0-2.5 m height with opposite, ascending branches. The Leaves are simple, opposite, lanceolate and leathery, 7-19 cm long and 4-7 cm wide, pubescent, and light green in colour above, darker on the lower surface. The flowers are large, dense, terminal spikes with large bracts. The corolla is white, the lower lip often streaked with pink or purple, and the capsule small, clavate and longitudinally channeled, containing four globular seeds.<sup>1</sup>Fruits of the *Adhatodavasicare* are four seeded capsules. In Pakistan, fruits of the plants are used for cold, antispasmodic and bronchitis. The fruit of the plants are also used for Diarrhea, Dysentery, Fever and as laxative<sup>2</sup>. Stem used to stimulate uterine contraction during childbirth, antipasnodiatic, emmenagogue and abortifacient.<sup>5</sup>

**Habitat:**The plant grows throughout the Indian peninsula up to an altitude of 1300 m, on wastelands in a variety of habitats and types of soil. It is sometimes cultivated as a hedge plant and the twigs and leaves used as "green manure." It is also found in Sri Lanka and Malaysia.<sup>1</sup>

### 1.1.2 Chemical Constituents:

**Alkaloids:**Vasicine (= peganine), a quinazoline alkaloid, is the major alkaloid present in all parts of the plant. The leaves also contain vascisinone, 7-methoxyvasicinone, vasicinol, adhatodine, adhatonine, adhavasinone, betaine, deoxyvasicine, deoxyvasicinone, 1-vasicinone, 1-vasicol, maiontone, 5-methoxyvasicinone, 7-methoxyvasicinone, N-oxides and glycosides of vasicine, N-oxides and glycoside of vasicinone, peganidine, vasnetine, hydrate anisotine, 3-hydroxyanisotine, desmethoxyaniflorine, vasicoline and vasicinolone.<sup>2-</sup>

<sup>5</sup> The root contains vasicinol, vasicinolone, vasicinine, adhatonine<sup>6,7</sup> and vasicol<sup>8</sup>. (3)

**Phytosterols and triterpenes:**Daucosterol,  $\alpha$ -amyrin,  $\beta$ -carotene, 3-hydroxy-oleanane-5-ene-pitaraxerol, 3 $\alpha$ -hydroxy-hexatetracont-1-en-15-one<sup>7</sup> are present.<sup>9</sup>

**Flavonoids:** Apigenin, astragenin, kaempferol, quarcetin, vitexin, isovitexin, and violanthin, and 2''-O-xylosylvitexin, rhamnosylvitexin, 2'-hydroxy-4 glucosyloxychalcone are present in the leaf and flower.<sup>10, 11</sup>

**Essential oil:** The flower volatile oil contains a ketone identified as 4-heptanone as the major compound, together with at least 36 other components including 3-methylheptanone.<sup>10</sup>

**Fatty acids and hydrocarbons:** The leaf oil is a complex mixture of over 50 compounds, the major component being decane, together with the hydroxyalkanes, 37-hydroxy hexatetracont-1-en-15-one and 29-methyl triacontan-1-ol and linolenic, arachidonic, linoleic, palmitic and oleic acids.<sup>12, 13</sup>

#### **Chalcone:**

2'4-dihydroxychalcone-4-O- $\beta$ -D-glucopyranoside, hydroxyoxychalcone, 2'glucosyl-4-hydroxyl-oxychalcone are extracted from leaves of adhatoda vasica.<sup>3</sup>

#### **Steroid:**

Epitaraxerol is extracted from leaves.<sup>3</sup>

#### **Galactose & Glucose:**

$\beta$ -glucoside-galactose,  $\beta$ -sitosterol-D-glucoside, D-glucose, D-galactose, O-ethyl- $\alpha$ -D-galactoside, sitosterol- $\beta$ -D-glucoside are extracted from leaves.<sup>3</sup>

#### **Amino Acids:**

Amino-n-butyric acid, Glycine, proline, serine, and valine are extracted from leaves.<sup>3</sup>

#### **1.1.3 Ethanobotanical uses:**

The leaves, flowers, fruits and root are extensively used for treating joint pain, lumbar pain, sprains, malaria, eczema, cold, cough, whooping cough, chronic bronchitis and asthma, as a sedative, expectorant, antispasmodic and anthelmintic. The dry leaves are given with other expectorants and form a part of several proprietary compounds. In chronic bronchitis, these are efficacious and afford relief, especially when the sputum is thick and tenacious. The cough is relieved and the sputum is liquefied and is easily expelled. The leaf juice is stated to cure diarrhea, dysentery and glandular tumor, and is given as an emmenagogue.<sup>14</sup> It is also used for the treatment of bleeding piles<sup>7</sup>. In southeast Asia, the paste, the powder and decoction of root is used for curing tuberculosis, diphtheria, malarial fever, leucorrhoea and eye diseases<sup>7</sup>. The root decoction is also used for gonorrhoea. Mainly yellow leaves of the plants are exploited for cough and smoke and ash of leaves is used for asthma. In India, leaves of the plant are used for checking postpartum

haemorrhage and urinary trouble and pregnant women in the gora village of Lucknow use them to induce abortion. A decoction of the leaves is used by Neterh at people in Bihar to stimulate and heal before and after delivery. In Sitapur district of Uttar Pradesh, people use the paste of roots mixed with sugar for treatment of acute nightfall. Moreover, the macerated roots of *A. vasica* are applied on vagina to help parturition. The leaf powder boiled in sesame oil is used to stop bleeding, earaches as well as pus from ears and jaundice.<sup>7</sup>

#### 1.1.4 Pharmacological reviews

- **Bronchodilatory and antihistaminic activity**

Gupta et al.<sup>15</sup> has investigated that vasicine showed bronchodilatory activity both *in vitro* and *in vivo*, the activity being comparable to that of theophylline.

Bhalla et al.<sup>16</sup> has investigated that vasicinone, however, showed bronchodilatory activity *in vitro* but bronchoconstriction *in vivo*. The two alkaloids in combination had a more potent bronchodilatory activity and the combination of vasicinone with aminophylline also had an additive effect.

- **Antibacterial activity**

Brantner et al.<sup>17</sup> has studied methanolic extract of the leaves for antibacterial activity using the paper disc and dilution methods. The *in vitro* screening showed a strong activity of the alkaloid fraction against *Pseudomonas aeruginosa* (MIC=164µg/ml). Significant antibacterial activity against the gram positive bacteria *Streptococcus faecalis*, *Staphylococcus aureus*, *Staphylococcus epidermidis* and the gram negative *E. coli* was also noted.

- **Antitubercular activity**

Grange et al.<sup>18</sup> has investigated that bromhexine and ambroxol, semi synthetic derivatives of vasicine, an alkaloid from *Adhatodavasica*, and are widely used as mucolytics which have pH dependent growth inhibitory effect on *Mycobacterium tuberculosis*.

- **Antidyspepsia activity**

Chaturvedi et al.<sup>19</sup> has examined that syrup of *Adhatodavasica* improved symptoms of dyspepsia

- **Insecticidal activity**

Srivastava et al.<sup>20</sup> had found that leaves control insect pests in oil seeds, in both laboratory and warehouse conditions.

Saxena et al.<sup>21</sup> has studied that vasicinol produced antifertility effects in *Dysdercus koenigii* and *Tribolium castaneum*, due to blocking of the oviduct.

Kokate et al.<sup>22</sup> had investigated that essential oil showed insecticidal activity against granary pests, e.g. *Sitophilusoryzae*, *Rhizoperthadominica* and *Bruchuschinensis*, and also juvenile hormone mimicking activity in *Dysdercuskoenigii*. It exhibited repellent activity against *S. oryzae* and *B. Chinensis*.

- **Abortifacient and uterine activity**

Gupta et al.<sup>23</sup> had investigated that vasicine showed an abortifacient effect in guinea pigs (although not in rats), depending on the stage of pregnancy. The effect was more marked under the priming influence of oestrogens, indicating that the action of the vasicine was probably mediated via the release of prostaglandins.

- **Wound – healing activity**

Bhargava et al.<sup>24</sup> had done a comparative studies of powdered plant, alcoholic extract and chloroform extract of *Adhatodavasica* for wound healing activity. The alcoholic extract was the most effective.

- **Hepatoprotective activity**

Bhattacharya et al.<sup>25</sup> has studied that the leaves shows the significant hepatoprotective effect at a dose of 50-100 mg/kg on the liver damage induced by d-galactosamine in rats.

- **Anti-inflammatory activity:**

A dose of 50 µg/pellet alkaloid fraction (methanol extract) has been reported to be potent anti-inflammatory agents as was shown in modified hen's egg chorioallantoic membrane.<sup>2</sup>

- **Anti-ulcer activity:**

*Adhatodavasica* also has immense potential as an anti-ulcer agent which is used to treat or ameliorate peptic ulcer or irritation of the gastrointestinal track of great therapeutic relevance. *Adhatodavasica* leaf powder showed a considerable degree of anti-ulcer activity in rats with the highest degree of activity (80%) observed in the ulceration model induced by ethanol in comparison to pylorus and aspirin induced peptic ulcer (41%).<sup>2</sup>

- **Anti-diabetic activity:**

*Adhatodavasica* has also been proved for its anti-glucosidase activity. In screening experiment, 40 traditional herbs were tested for rat intestinal  $\alpha$ -glucosidase. The methanolic extract from the leaves of AV showed the highest sucrose inhibitory activity.<sup>9</sup>

- **Anti-oxidant activity:**

Oral administration of *A.vasica* leaves extract at 800 mg/kg controlled hematological parameters to normal like GSH and LPO level in post irradiated animals. Pretreatment with *A.vasica* at 100 and 200 mg/kg also significantly improves SOD, catalase and GSH levels in CCl<sub>4</sub>- induced hepatotoxicity<sup>7</sup>.

- **Antispasmodic and Anti-spasticity activity:**

An essential oil from the leaves of *vasica* showed smooth muscle relaxant activity in the isolated guinea-pig tracheal chain. Vasicinone from the plant *Adhatodavasica* has stimulatory effects on rat/guinea pig uterus and tracheal muscle as well as, on other tissues.<sup>2</sup>

- **Anti-allergy activity:**

Methanolic extract of the plant has been shown to possess anti-allergic activity in guinea pigs of 6 mg per animal<sup>11</sup> or 2.5 gm/kg respectively.<sup>2</sup> A plant extract containing the alkaloid vasicinone and 20% vasicinone inhibited allergic reactions induced by ovalbumin about 37% at a concentration of 5 mg. Vasicinone has been shown to be a potent anti-allergen in tests on mice, rats and guinea pig.<sup>2</sup>

- **HIV-protease inhibitor activity:**

The crude extracts of *adhatodavasica* plants exhibited powerful inhibitory activity of pepsin enzyme thus it might be an effective inhibitor of HIV-protease which belongs to the same family of enzyme aspartate and sharing the same signature group at the active site.<sup>2</sup>

- **Cardioprotective activity:**

Vasicinone and vasicinone from the leaf extract of the plant showed significant reduction in cardiac depressant effects was observed. No effects were shown by DL-form of vasicinone, however L-form was found to be effective stimulating cardiac muscle weakly.<sup>2</sup>

- **Thrombolytic activity:**

The thrombolytic potential of crude extract of roots of AV using *in vitro* clot lysis model. In another experiment, at 5 mg/ml concentration of root extract of AV showed 19.33% clot lysis activity which was significant comparing with negative control, normal saline.<sup>9</sup>



- **Anti-gingival activity:**

An experiment was conducted to investigate the oral hygiene and gingival health benefits of toothpaste formulated with a mixture of the herbs of which AV was one. One millimeter of resting saliva was collected to ascertain anaerobic and aerobic bacterial counts, plaque index, percentage sites with bleeding on probing and pocket depth at 6 sites/tooth were recorded at baseline. Home use of the allocated toothpaste (test or placebo) twice a day for 12 weeks was followed. Significant reduction was noted in test sample treated group indicating the beneficial effects of this herbal toothpaste containing AV on oral hygiene and gingival health variables.<sup>9</sup>

- **Anti-Alzheimer activity:**

Extracts of AV has inhibitory effect on acetylcholinesterase, and this effect on enzyme is reversible. Researcher claimed that the herbal drug AV may be used in the treatment of Alzheimer.

Along with above said beneficial health effects, the AV also showed few other activities which have indirect effect on human health conservation, namely, antifungal, larvicidal, anticestodal and acaricidal.

Although AV has been used as a medicine from long back and claimed to be safe for the use as medicine still few adverse effects have also been reported like cytotoxicity, adverse reaction in the form of urticarial, exanthema, and contact dermatitis in swedan population.<sup>9</sup>

- **Radioprotective activity:**

Swiss albino mice when exposed to <sup>60</sup>Co radiations showed radiation-induced sickness including marked changes in histology of testis and chromosomal aberrations in bone marrow cells with 100% mortality within 22 days. The ethanolic extract of *A. vasica* leaf when given orally at a dose of 800 mg kg<sup>-1</sup> body weight per mouse for 15 consecutive days and then exposed to radiation, death of *Adhatoda* pretreated irradiated mice was reduced to 70% in 30 days. *Adhatoda* pretreatment significantly prevented radiation-induced chromosomal damage in bone marrow cells, which suggests that *Adhatoda* plant extract has significant radioprotective effects on testis.

- **Allopathic activity:**

The allopathic activity of *Adhatoda vasica*. The aqueous leaf and flower extracts showed inhibitory effects on seed germination and seedling survival of turnip. Remarkably lesser inhibitory effect of the flower extract was noted at all doses. The lower and moderate doses, on seed weight of turnip.<sup>3</sup>

- **Anti-cholinesterase activity:**

Vasicinone obtained from the roots, produces transient hypotension in cats, contraction of isolated intestine and depression of isolated heart in guinea pigs, thus showing good anticholinesterase activity.<sup>14</sup>

- **Cholagogue activity:**

In laboratory experiments on cats and dogs, *Adhatodavasicaw* was found to increase bile activity when the animals were given an intravenous dose of 5 mg/kg. In dogs, the amount of excreted bile increased by 40-100%. The animals also showed an increase in bilirubin excretion.<sup>16</sup>

- **Anti-malarial activity:**

Vasicine, pyrrolquinazoline alkaloid and embelin, and a benzoquinone obtained from *A. vasica* and *Embeliaribes* respectively, exhibited antiplasmodial activity in schizont maturation inhibition assay and lactate dehydrogenase inhibition assay, which are based on morphological criteria and biochemical reaction respectively.<sup>11</sup>

- **Anti-Anthelmintic activity:**

10% aqueous extract of leaves of *A. vasica* exhibited mortality rate of 73% on *Melodogyne incognitachit*.<sup>7</sup>

### 1.1.5 Phytochemical reviews

Bhartiya et al.<sup>26</sup> had investigated a new moiety 2'-4-dihydroxy chalcone 4- glucoside in the flowers.

Brain et al.<sup>27</sup> has been determined HPLC method for vasicine and vasicinone and also reported the studies on stability of vasicine and vasicinone in solutions and plant extracts.

Rajni et al.<sup>28</sup> has reported that treatment of *Vasaka* cell with chloramphenicol (100-200mg/l) antibiotic doubled the production of quinazoline alkaloids.

Das et al.<sup>29</sup> has been developed HPTLC method for the determination of pharmacologically important quinazoline alkaloids vasicine and vasicinone in *Vasaka*. The assay combines the separation and quantification of analytes on silica gel 60 GF254 HPTLC plates with visualization under UV light and scanning at 270-281 nm.

Shilpa et al. had investigated ethnomedicinal value and pharmacognosy of the *Adhatodavasic* that leaves contain pyrroloquinazoline alkaloids, chiefly vasicine (1,2,3,9-tetrahydropyrrolo[2,1-b]quinazolin-2-ol, C<sub>11</sub>H<sub>12</sub>N<sub>2</sub>O), and vasicinone (3-hydroxy-2,3-dihydropyrrolo[2,1-b]quinazolin-9[1H]-one, C<sub>11</sub>H<sub>10</sub>N<sub>2</sub>O<sub>2</sub>). Addition of 2-aminobenzylamine to



the vicinyl vicinal tricarbonyl reagent leads to the synthesis of vasicine. The novel quinazoline alkaloid characterized as 1, 2, 3, 9-tetrahydro-5-methoxypyrrol[2,1-b]quinazolin-3-ol, and adhavasinone has also been isolated from leaves. A new moiety 2'-4-dihydroxy chalcone-4-glucoside has been identified in flowers.

## References

1. Prajapati, Kumar, Purohit, Sharma; A Handbook Of Medicinal Plants; Agrabios; 2006:17
2. Ajay sharma, Damanjit Singh Cannoo and GarimaBhardwaj Overview of phytochemistry and pharmacology of *Adhatodavastica*2019.
3. Thokchom P. Singh, Okram M. Singh and Huidrom B. Singh; *Adhatodavastica*: Phytochemical and pharmacological profile 2011.
4. Lahiri PK, Pradhan SN 1964; "Pharmacological investigation of vasicinol, an alkaloid from *Adhatodavastica*Nees." **Indian journal of experimental biology**2:219
5. Rabiakhan ,YasmeenShamsi, SadiaNikhat; medicinal benefits of *Adhatodavastica*Nees – in unani and contemporary medicine 2020.
6. Willaman JJ, Li HL 1970; "Alkaloid-bearing plants 1957-1968." *Lloydia*33S:1
7. Poonamarora; ompotence of AhatodavasticaNees in traditional system of medicine:review, 2019.
8. Thappa RK, Agarwal SG, Dhar KL, Gupta VK, Goswami KN "Two pyrroloquinazolines from *Adhaladavastica*." **Phytochemistry**; 1996; 42(5):1485
9. SaritaM.kapgate, Abhijit B. Patil; *AdhatodaVasica*; a critical review,2017:S654.
- 10.Abd FJ-McgecdHashem F, Ahmed El-sawi S. "Isoquinoline and quinazolinic alkaloids of *Adhatodavastica*." **Pharmacy and Pharmacology Letters**; 1998; 8(4):167
- 11.Shilpayadav ,Vinod K. Yadav; Ethnomedicinal value and pharmacognosy of the member of Acanthaceae: *AdhatodaVasica*(Linn.) 2018.
- 12.Jain MP, Koul SK, Dhar KL Atal CK. "Novel nor-harmal alkaloid from *Adhatodavastica*." **Phytochemistry**; 1980;19:1880
- 13.Jain MP, Sharma VK, "Phytochemical investigation of roots of *Adhatodavastica*." **PlantaMedica**; 1982; 46:250
- 14.Prodip Kumar Baral, Satyajiy Roy and Sakina Sultan; a review article on *Adhatodavastica*Nees: A potential source of bioactive compunds, 2018.

15. Dhar KL, Jain MP, Koul SK, Atal CK "Vasicol, a new alkaloid from *Adhatodavasica*." **Phytochemistry**; 1981; 20(2):319
16. Atul Kumar Gangwar, Ashoke K Ghosh; medicinal uses and pharmacological activity of *Adhatoda Vasica* Nees, 2020.
17. Rahman AU, Sultana N, Akhter F, Nighat F, Choudhary MI "Phytochemical studies on *Adhatodavasica*." **Pakistan Natural Product Letters**; 1997; 10(4):249
18. Bhartiya HP, Gupta PC 1982 "A chalcone glycoside from the flowers of *Adhatodavasica*." **Phytochemistry**; 1982; 21(1):247
19. Ahmed El-Sawi S, Abd El-Megeed Hashem F, Ali AM "Flavonoids and antimicrobial volatiles from *Adhatodavasica* Nees." **Pharmacy and Pharmacology Letters** 1999; 9(2):52
20. Singh RS, Misra TN, Pandey HS, Singh BP "Aliphatic hydroxyketones from *Adhatodavasica*." **Phytochemistry**; 1991; 33(11):3799
21. Singh RS, Misra TN, Pandey HS, Singh BP "A new aliphatic alcohol from *Adhatodavasica*." **Fitoterapia**; 1992; 63(3):262
22. Dr. K.M. Kulkarni's **Indian Materia Medica**; Popular prakashan; 1:40-43
23. Gupta OP, Anand KK, Ghatak BJ, Atal CK. "Pharmacological investigations of vasicine and vasicinone - the alkaloids of *Adhatodavasica*." **Indian Journal of Medical Research**; 1977; 66(4):680
24. Bhalla HL, Nimbkar AY, Preformulation studies III. "Vasicinone, a bronchodilatory alkaloid from *Adhatodavasica* Nees" **Drug Dev. Indian. Pharm**; 1982; 8(6):833
25. Brantner AH, Chakraborty A "In vitro antibacterial activity of alkaloids isolated from *Adhatodavasica* NEES." **Pharmacy and Pharmacology Letters**; 1998; 8(3):137
26. Grange JM, Sucll NJC "Activity of bromhexin'e and ambroxol, semi-synthetic derivatives of vasicine from the Indian shrub *Adhatodavasica*, against *Mycobacterium tuberculosis in vitro*." **Journal of Ethnopharmacology**; 1996; 50(1):49
27. Chaturvedi GN, Rai NP, Dhs:li R, Tiwari SK, "Clinical trial of *Adhatodavasica* syrup (vasa) in the patients of non-ulcer dyspepsia (Amlapitta)." **Ancient Science of Life**; 1983; 3(1):19
28. Srivastava AS, Saxena HP, Singh DR "Adhatodavasica, a promising insecticide against pests of storage." **Lab. Dev**; 1965; 3(2):138

- 29.Saxena BP, Tikku K, Atal CK “Insect antifertility and antifeedantalleochemics in *Adhatodavasica*.” **Insect Sci. Appl**; 1986; 7(4):489
- 30.Kokate CK, D'Cruz JL, Kumar RA, Apte SS “Anti-insect and juvenoidal activity of phytochemicals derived from *Adhatodavasica*Nees.” **Indian Journal of Natural Products**; 1985; 1(1-2):7
- 31.Gupta OP, Anand KK, Ghatak BJ, Ray, Atal CK “Vasicine, alkaloid of *Adhatodavasica*, a promising uterotonicabortifacient.” **Indian Journal of Experimental Biology**; 1978;16(10):1075
- 32.Bhargava MK, Singh H, Kumar A “Evaluation of *Adhatodavasica*as a wound healing agent in buffaloes.” *Clinical, mechanical and biochemical studies*. **Indian Veterinary Journal**; 1988;65(1):33
- 33.Bhattacharya D, Pandit S, Jana U, Sen S and Sur TK.”Hepatoprotective activity of *Adhatodavasica* aqueous leaf extract on d-galactosamine induced liver damage.” **Fitotherapia**; 2005:76,223-225
- 34.Bhartiya HP, Gupta PC “A chalcone glycoside from the flowers of *Adhatodavasica*.” **Phytochemistry**; 1982; 21(1):247
- 35.Brain R and BhupendraB,”Highperformance liquid chromatographic determination of vasicine and vasicinone in *Adhatodavasica*Nees, **J Chromatography**, 1983:258(4), 183-188
- 36.Rajni M and Bhavsar GC, “*Adhatodavasica*Nees, Effect of chloramphenicol on total alkaloids.” **Indian Drugs**; 1993:30,87-88
- 37.Das C, Poi R and Chowdhury A,”HPTLC determination of vasicine and vasicinone in *Adhatodavasica*.” **Phytochemical analysis**; 2005: 16(2), 90-92