International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 16-04-2026, Accepted: 17-05-2026, Published: 01-06-2026
Volume 11, Issue 2, 2026, Page No. 363-369

A systematic review on botany, ethnomedicinal uses and phytochemistry of *Justicia adhatoda* L.

Dr. Manoj Kumar Meena[1], Ashok Kumar Bairwa[2*], Shashi Kant Jatav[2]
[1] Assistant Professor, Department of Botany, M.S.J. Government College, Bharatpur, Rajasthan, India
[2] Assistant Professor, Department of Botany, Raj Rishi Government College, Alwar, Rajasthan, India
Corresponding Author: Ashok Kumar Bairwa
DOI: https://doi.org/10.66856/ijbs.2026.11.2.11126

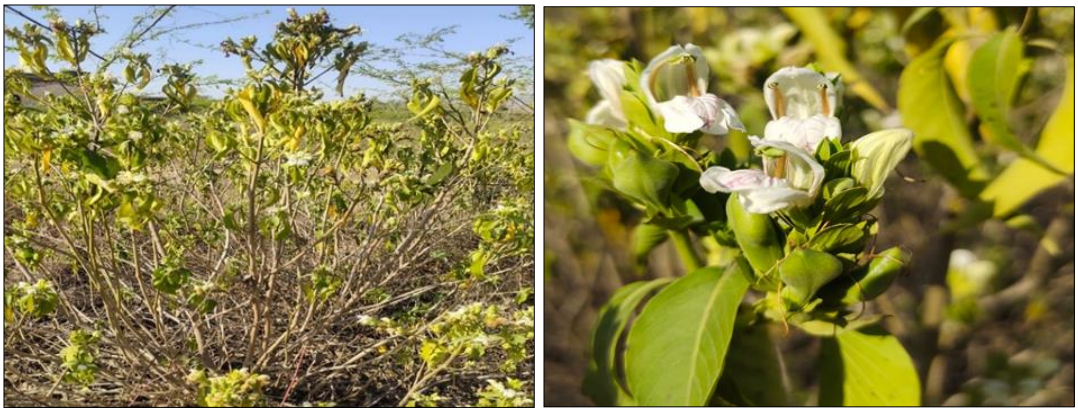
Abstract
Justicia adhatoda L. is an important medicinal plant belonging to the family Acanthaceae and is widely used in Ayurveda, Unani, Siddha, and folk medicine for the treatment of various diseases. The present systematic review compiles ethnomedicinal uses and phytochemical constituents reported from different plant parts including roots, leaves, flowers, fruits, and whole plant preparations. Information was collected from research articles, review papers, books, and scientific databases such as Google Scholar, ScienceDirect, PubMed, Wiley Online Library, PubChem, and NISCAIR Online Periodicals Repository (NOPR). A total of 39 published articles were critically analyzed for this review. Ethnomedicinal studies revealed that different plant parts are extensively used for the treatment of respiratory disorders such as cough, asthma, bronchitis, cold, tuberculosis, and tonsillitis. Leaves were identified as the most frequently used plant part and were traditionally administered in the form of extracts, decoctions, juice, paste, and ash for treating fever, diabetes, rheumatism, skin diseases, and respiratory ailments. Phytochemical investigations documented 128 bioactive compounds belonging to alkaloids, flavonoids, terpenoids, steroids, chalcones, amino acids, glucosides, essential oils, and other compounds. The rich ethnomedicinal importance and phytochemical diversity of *Justicia adhatoda* support its traditional therapeutic applications and highlight its potential for future pharmaceutical and herbal drug development.

Keywords: Acanthaceae, adusa, ethnomedicinal use, *Justicia adhatoda*, phytochemistry

Introduction
The Acanthaceae is ranked as the ninth-largest family of dicotyledonous plants, encompassing more than 200 genera and 2000 species [1]. *Justicia adhatoda* L. belongs to the family Acanthaceae. It is a small, evergreen perennial shrub that grows throughout the open plains, especially in the lower Himalayas up to 1300 meters. *Justicia adhatoda* is also known as Malabar nut (English), arusa, baansa, and adulsa (Hindi), shwetavasa, vasa and vasaka (Sanskrit), basak (Bengali), aradusi and adusa (Gujarati), bansa, basuti, bhekkar, and vasaka (Punjabi), bahekar, baikar, basuth, and bhenkar (Kashmiri), adusoge (Kannada), arusa and basung (Oriya), adhatodai (Tamil) and addasaramu (Telugu) [2], Sada basak (Chakma) [3], ata-lotakam (Malayalam) [4]. This plant is native to Asia and grows frequently in India, Pakistan, Sri Lanka, Burma, Nepal, Bangladesh, Germany and Malaysia, throughout all the seasons [5-6]. *J. adhatoda* a well-known Indian medicinal plant, has been traditionally utilized in the Ayurvedic system of medicine. The root, leaves, flowers, fruit and seeds are extensively used for treating cold cough, whooping cough, chronic bronchitis and asthma, as a sedative, expectorant and antispasmodic.

Materials and Methodology
The overall information of *Justicia adhatoda* L. was collected from various resources, including research papers, review papers, books, and reports. All these data were searched from Google (https://www.google.co.in/), Google Scholar (https://scholar.google.com/), Science Direct (https://www.sciencedirect.com/), Wiley Online Library (https://onlinelibrary.wiley.com/), PubMed (https://pubmed.ncbi.nlm.nih.gov/), PubChem (https://pubchem.ncbi.nlm.nih.gov/) Sci-hub (https://www.sci-hub.se/) and NISCAIR Online Periodicals Repository (NOPR) (https://nopr.niscair.res.in/). The articles and the literature were searched from the relevant websites using the keywords *Justicia adhatoda, A. zeylanica, A. vasica*, the taxonomy of *J. adhatoda*, botanical characterization of *J. adhatoda*, botanical activities of *J. adhatoda*, chemical constituents of *J. adhatoda*, phytochemical constituents of *J. adhatoda*, pharmacological activities of *J. adhatoda*, and ethnopharmacological uses of *J. adhatoda, etc.* The scientific and common names of *Justicia adhatoda* L. have been verified by the International Plant Names Index (*https://www.ipni.org*), World Flora Online (https://www.worldfloraonline.org), TOPICOS (http://www.tropicos.org) and Plants of the World Online (http://www.plantsoftheworldonline.org/).

Botanical Description
Justicia adhatoda L. is an evergreen shrub and is 1-3m in height with brown and opposite ascending branches. The root is normal with secondary and tertiary rootlets. The stem is erect, straight, long, herbaceous above and woody below, having opposite and long trunks with yellow bark. The lateral branches emerged in an ascending manner from the trunk. Leaves are simple, petiolate, exstipulate, lanceolate and opposite decussate. They are 9-15.5 cm in length and 2-3.7 cm in width and have an oval stoma. The color of both younger and older leaves is dark green above and paler beneath [7]. Flowers are white or creamish-white in color and arranged in elongated spikes. They are small irregular, bisexual zygomorphic, and hypogynous. Fruits are pubescent and four-seeded in the form of a capsule [4].



(a) (b)

(c) (d) (e)

Fig 1: *Justicia adhatoda* (a) Whole Plant (b) Flower (c) Fruits (d) Mature fruit with seeds (e) Seeds

Scientific Classification

The systematic position of *Justicia adhatoda* L. has been presented according to the modern angiosperm classification system, followed by the International Plant Names Index (IPNI) and Plants of the World Online (POWO), Royal Botanic Gardens, and Kew.

Kingdom: Plantae
Phylum: Streptophyta
Class: Equisetopsida
Subclass: Magnoliidae
Order: Lamiales
Family: Acanthaceae
Genus: *Justicia*
Species: *adhatoda*
Binomial name: *Justicia adhatoda* L.

Synonyms

Homotypic Synonyms

Adhatoda adhatoda (L.) Huth in Helios 11: 132 (1893), not validly publ.
Adhatoda zeylanica Medik. in Hist. & Commentat. Acad. Elect. Sci. Theod.-Palat. 6: 393 (1790)
Ecbolium adhatoda (L.) Kuntze in Revis. Gen. Pl. 2: 487 (1891)
Gendarussa adhadota (L.) Steud. in Nomencl. Bot., ed. 2, 1: 668 (1840)

Heterotypic Synonyms

Adeloda serrata Raf. in Fl. Tellur. 4: 61 (1838)
Adhatoda arborea Raf. in Fl. Tellur. 4: 61 (1838)
Adhatoda pubescens Moench in Methodus: 431 (1794)
Adhatoda vasica Nees in N.Wallich, Pl. Asiat. Rar. 3: 103 (1832)
Dianthera latifolia Salisb. in Prodr. Stirp. Chap. Allerton: 103 (1796)

Ethnomedicinal Uses of The Plant

- **Root:** *Justicia adhatoda* L. is an important medicinal plant widely used in traditional healthcare systems. The fresh root paste of this plant is traditionally administered to facilitate easy delivery during childbirth [8]. Root extracts are commonly used in the treatment of fever and dysentery due to their therapeutic properties [9]. Additionally, the roots are valued for managing respiratory ailments such as cough, asthma, and bronchitis [10].

- **Leaves:** The leaves of the plant are widely used in traditional medicine for treating a broad range of ailments, demonstrating their high ethnomedicinal importance. Leaf extracts and decoctions are most frequently employed, particularly for respiratory disorders such as cough [11, 13], cold [12], asthma [10, 14, 15], bronchitis [12], and tuberculosis [14, 19]. The preference for extracts and decoctions suggests that the bioactive constituents of the leaves are effectively released in aqueous preparations. In some cases, leaves are converted into ash or paste, especially for asthma [10, 14, 15], tuberculosis [14, 19], and dysentery [8]. Leaves are also commonly used to manage fever through extracts and juice [8, 12] and as antipyretics using decoctions [16],

indicating their role in reducing body temperature and inflammation. The use of leaf juice in diabetes [17] suggests possible hypoglycemic activity. Additionally, leaf paste is applied for rheumatism [18], while paste and decoction are used for treating skin diseases [19], reflecting anti-inflammatory and antimicrobial properties.

- **Flower:** Flowers of the plant are traditionally used to treat respiratory disorders, reflecting their ethnomedicinal importance. They are commonly employed in the management of cough [10, 19], asthma [10, 20], and bronchitis [10, 19]. Their use in treating tuberculosis [20, 21].
- **Fruit:** Fruit extracts are commonly administered for diarrhea and dysentery [22], as well as for managing cold and fever [22]. Additionally, fruit extracts are reported to possess antispasmodic properties and are used in the treatment of bronchitis [22]. Beyond individual plant parts, the whole plant is traditionally used to manage tonsillitis [23], suggesting its broader therapeutic potential. Table 1 summarizes the ethnomedicinal importance of the different plant parts of *Justicia adhatoda* L., with particular emphasis on their traditional uses in the treatment and management of various human ailments across diverse traditional healthcare systems.

Table 1: The ethnomedicinal uses of the different plant parts of *Justicia adhatoda* L

Sr. No.	Plant Parts	Aliments	Preparation methods	References
1.	Root	Easy delivery	Fresh root paste	8
2.	Root	Fever	Extract	9
3.	Root	Dysentery	Extract	9
4.	Root	Cough	*	10
5.	Root	Asthma	*	10
6.	Root	Bronchitis	*	10
7.	Leaves	Cough	Extract, Decoction	11, 12 13
8.	Leaves	Dysentery	Paste	8
9.	Leaves	Cold	Extract	12
10.	Leaves	Asthma	Ash, Decoction	10, 14, 15
11.	Leaves	Bronchitis	Extract	12
12.	Leaves	Tuberculosis	Ash, Decoction	14,19
13.	Leaves	Fever	Extract, Juice	8, 12
14.	Leaves	Antipyretic	Decoction	16
15.	Leaves	Diabetes	Juice	17
16.	Leaves	Rheumatism	Paste	18
17.	Leaves	Skin disease	Paste, Decoction	19
18.	Flower	Cough	*	10,19
19.	Flower	Asthma	*	10, 20
20.	Flower	Bronchitis	*	10,19
21.	Flower	Tuberculosis	*	20, 21
22.	Fruit	Diarrhea, Dysentery	Extract	22
23.	Fruit	Cold, Fever	Extract	22
24.	Fruit	Antispasmodic, Bronchitis	Extract	22
25.	Whole Plant	Tonsilitis	*	23

Phytochemical Constituents/ Phytochemistry

- **Alkaloids:** The phytochemical profile of the plant reveals a rich diversity of alkaloids distributed across different plant parts, underscoring its significant medicinal potential [Table 2]. Leaves are the most extensively studied and chemically rich organ, containing numerous alkaloids such as 2-acetyl benzylamine [31], 3-hydroxyanisotine [24], 7-methoxy-vasicinone [25], adhavasinone (5-methoxyvasicinone) [33], desmethoxyaniflorine [25], vasicine acetate [31], vasicinolone (7-hydroxyvasicinone) [33], vasnetine [24], and the widely reported vasicine (peganine) [24]. Roots also contribute substantially to the alkaloid spectrum, yielding compounds such as 9-acetamido-3,4-dihydropyrido-(3,4-b)-indole [26], adhatonine [27], deoxyvasicinone [26], vasicinol (7-hydroxyvasicine) [27], vasicinone [27,29], and vasicol [27,29]. Young plants are another important source of bioactive alkaloids, including adhatodine, anisotine, vasicine, vasicoline, and vasicolinone [28]. Additionally, aerial parts contain alkaloids such as paganidine and vasicinone [30], further expanding the chemical diversity of the plant.

Table 2: Alkaloids extracted from *J. adhatoda* L.

Sr. No.	Alkaloids Name	Plant Parts	References
1	2-acetyl benzylamine	Leaves	31
2	3-Hydroxyanisotine	Leaves	24
3	7-Methoxy-vasicinone	Leaves	25
4	9-acetamido-3,4-dihydropyrido-(3,4-b)-indole	Roots	26
5	Adhatodine	Young Plants	28
6	Adhatonine	Roots	27
7	Adhavasinone (5-methoxyvasicinone)	Leaves	33
8	Anisotine	Leaves, Young Plants	24,28
9	Deoxyvasicinone	Roots	26
10	desmethoxyaniflorine)	Leaves	25
11	Paganidine	Aerial Parts	30
12	Vasicine acetate	Leaves	31

13	Vasicine or Peganine	Leaves, Roots, Young Plants	24,27,28
14	Vasicinol ((7-hydroxyvasicine)	Roots	27
15	Vasicinolone ((7-hydroxyvasicinone)	Leaves	33
16	Vasicinone	Leaves, Roots, Aerial Parts	24,27,29,30
17	Vasicol	Leaves, Roots	24,27,29
18	Vasicoline	Young Plants	28
19	Vasicolinone	Young Plants	28
20	Vasnetine	Leaves	24

- **Terpenoids**

The leaves of *Justicia adhatoda* were found to be the richest source of terpenoid compounds, indicating their major contribution to the medicinal and pharmacological importance of the plant. Terpenoids identified from leaves include (Z)-dihydrofarnesol [37], caryophyllene oxide, *d*-verbenone [32], lycopene [36], megastigmatrienone [32,37], neoandrographolide [36], phytol [32,37], squalene [36], vomifoliol [37], α-isomethylionone, and β-eudesmol [32]. Aerial parts also contained significant terpenoid constituents such as 3α-hydroxy-D-friedoolean-5-ene, 3α-hydroxy-oleanane-5-ene [34], and taraxerone [36]. Flowers were found to contain α-amyrin [35], an important pentacyclic triterpenoid with analgesic and anti-inflammatory activity. In addition, β-carotene [35], a carotenoid with antioxidant and provitamin-A activity, was reported from unspecified plant parts. Table 3 presents the diversity and distribution of terpenoids identified from different plant parts of *Justicia adhatoda*.

Table 3: Terpenoids extracted from *J. adhatoda* L.

Sr. No.	Compound Name	Plant Parts	References
1	(Z)-Dihydrofarnesol	Leaves	37
2	3 α-hydroxy-D-friedoolean-5-ene	Aerial parts	34
3	3α-hydroxy-oleanane-5-ene	Aerial parts	34
4	Caryophyllene oxide	Leaves	32
5	*d*-Verbenone	Leaves	32
6	Lycopene	Leaves	36
7	Megastigmatrienone	Leaves	32,37
8	Neoandrographolide	Leaves	36
9	Phytol	Leaves	32, 37
10	Squalene	Leaves	36
11	Taraxerone	Aerial parts	36
12	Vomifoliol	Leaves	37
13	α-Amyrin	Flowers	35
14	α-Isomethylionone	Leaves	32
15	β-Carotene	Part not specified	35
16	β-Eudesmol	Leaves	32

- **Flavonoids**

The flavonoid composition of *Justicia adhatoda* revealed a diverse range of bioactive constituents, predominantly distributed in leaves and flowers, indicating their important role in the plant's medicinal value. Phytochemical investigations reported several flavonoids from leaves and flowers, including 2″-O-xylosylvitexin, isovitexin [35], luteolin [34], rhamnosylvitexin, violanthin, and vitexin [35]. Leaves were additionally reported to contain anthocyanin [36], a naturally occurring flavonoid pigment known for its strong antioxidant and protective properties against oxidative stress. Flowers exhibited comparatively high flavonoid diversity and contained important compounds such as 2′,4-dihydroxychalcone-4-glucoside [36], astragalin or kaempferol 3-β-D-glucopyranoside, kaempferol [35], kaempferol 3-O-sophoroside [34], and quercetin [35]. Table 4 presents the diversity and distribution of flavonoid compounds identified from different plant parts of *Justicia adhatoda*. A total of thirteen flavonoid constituents were reported from leaves, flowers, and aerial parts.

Table 4: flavonoids extracted from *J. adhatoda* L.

Sr. No.	Compound Name	Plant Parts	References
1	2″ O-Xylosylvitexin	Leaves and Flowers	35
2	2′,4-dihydroxychalcone-4-glucoside	Flowers	36
3	Anthocyanin	Leaves	36
4	Apigenin	Aerial Parts	35
5	Astragalin or Kaempferol 3-β-D-glucopyranoside	Flowers	35
6	Isovitexin	Leaves and Flowers	35
7	Kaempferol	Flowers	35
8	Kaempferol 3-O-sophoroside	Flowers	34
9	Luteolin	Leaves and Flowers	34
10	Quercetin	Flowers	35
11	Rhamnosylvitexin	Leaves and Flowers	35
12	Violanthin	Leaves and Flowers	35
13	Vitexin	Leaves and Flowers	35

- **Steroids**

Table 5 summarises the steroidal constituents identified from different plant parts of *Justicia adhatoda*. A total of six steroidal compounds were reported from roots, aerial parts, leaves, and seeds. Sitosterol and its derivatives, including β-sitosterol and γ-sitosterol, were the predominant steroidal

constituents identified in the species. Leaves were found to contain stigmasta-3,5-dien-7-one, β-sitosterol, and γ-sitosterol [34], whereas roots contained Daucosterol and sitosterol [36]. Aerial parts were reported to contain epitaraxerol [35] and sitosterol [36], while β-sitosterol was additionally detected in seeds [34].

Table 5: Steroids extracted from *J. adhatoda* L.

Sr. No.	Compound Name	Plant Parts	References
1	Daucosterol	Roots	36
2	Epitaraxerol	Aerial parts	35
3	Sitosterol	Aerial parts, Roots	36
4	Stigmasta-3,5-dien-7-one	Leaves	34
5	β-sitosterol	Seeds and Leaves	34
6	γ-sitosterol	Leaves	34

- **Other phytochemical compounds**

Table 6 summarises other phytochemical compounds identified from different plant parts of *Justicia adhatoda*, including amino acids, chalcones, essential oils, glucose derivatives, glucosides, and compounds whose chemical nature was not specifically classified (CNNS). A total of seventy-three compounds were documented from leaves, roots, flowers, pollen, twigs, and seeds, demonstrating the remarkable phytochemical diversity of the species.

Pollen was reported to contain several amino acids such as amino-*n*-butyric acid, glycine, proline, serine, and valine [35]. Chalcone derivatives including 2',4-dihydroxychalcone-4-O-β-D-glucopyranoside and 2'-glucosyl-4-hydroxyl - oxychalcone [35], were identified from flowers and roots, respectively. These chalcones are known for their antioxidant and antimicrobial properties.

Leaves exhibited the highest diversity of miscellaneous phytochemicals and essential oil constituents. Several compounds categorised under CNNS were identified from leaves, including octadecenoic acid derivatives, phenolic compounds, triazine derivatives, furfural derivatives, fatty acids, catechins, naringenin, vitamin E, and glucopyranosides [37, 39]. Compounds such as catechin, epicatechin, epigallocatechin, epigallocatechin gallate, morin, naringenin, and p-hydroxy-benzoic acid [39] were reported from leaves, flowers, twigs, and seeds.

Essential oil analysis revealed the occurrence of numerous volatile constituents mainly from leaves, including α-caryophyllene, borneol [38], octanal, undecanal, tetradecane, pentacosane, nonacosane, tricosane, octene, and palmitic acid [32]. These volatile compounds contribute significantly to the aromatic, antimicrobial, insecticidal, and therapeutic properties of the plant.

Roots were reported to contain glucose derivatives and glucosides such as D-galactose, D-glucoside, and glucoside-galactose [35], indicating the presence of important carbohydrate-related metabolites in underground plant parts.

Table 6: Other Bioactive Compounds extracted from *J. adhatoda* L.

Sr. No.	Compound Nature	Compound Name	Plant Parts	References
1	Amino Acid	Amino-n-butyric acid	Pollen	35
2	Amino Acid	Glycine	Pollen	35
3	Amino Acid	Proline	Pollen	35
4	Amino Acid	Serine	Pollen	35
5	Amino Acid	Valine	Pollen	35
6	Chalcone	2',4-dihydroxychalcone-4-O- β-D-glucopyranoside	Flower	35
7	Chalcone	2'-glucosyl-4-hydroxyl - oxychalcone	Roots	35
8	CNNS*	(4,6,8-Trimethyl-quinazolin-2-yl)-urea	Leaves	37
9	CNNS	(9E)-9-Octadecenoic acid	Leaves	37
10	CNNS	(9E,12E)-9,12-Octadecadienoic acid	Leaves	37
11	CNNS	1,2-Dimethyl-3 propenylidenecyclohexene	Leaves	37
12	CNNS	1,3,5-Triazine-2,4,6-triamine	Leaves	37
13	CNNS	2(OR3)–(1,1-Dimethylethyl) 4-methoxyphenol	Leaves	37
14	CNNS	2,3-Dihydro-3,5-dihydroxy 6-methyl-4H-pyran-4-one	Leaves	37
15	CNNS	2-Butylphenol	Leaves	37
16	CNNS	2-Ethylbenzaldehyde	Leaves	37
17	CNNS	2-Methoxy-4-vinylphenol	Leaves	37
18	CNNS	3,4-Dihydroxy-5-methyl dihydro-furan-2-on	Leaves	37
19	CNNS	3-Octadecyne	Leaves	37
20	CNNS	4-Ethyl-2-oxo-2,5,6,7-tetrahydro 1H-cyclopenta[B]pyridine 3-carbonitrile	Leaves	37
21	CNNS	5-Hydroxymethylfurfural	Leaves	37
22	CNNS	6-Octen-1-ol,3,7-dimethyl-,propanoate	Leaves	37
23	CNNS	9,10,11-Trioxabicyclo[6.2.1] undecane	Leaves	37
24	CNNS	Catechin	Leaves, Flowers, Twigs, Seeds	39
25	CNNS	Epicatechin	Leaves, Flowers, Twigs, Seeds	39
26	CNNS	Epigallocatechin	Leaves, Flowers, Twigs, Seeds	39
27	CNNS	Epigallocatechingallate	Leaves, Flowers, Twigs, Seeds	39
28	CNNS	Hexadecanoic acid	Leaves	37
29	CNNS	Linoleic acid	Leaves	37
30	CNNS	Methyl 6-hydroxycaproate	Leaves	37
31	CNNS	Morin	Leaves, Flowers, Twigs, Seeds	39
32	CNNS	N-(2,4-Dimethyl-1-penten-3-ylidene) isopropylamine	Leaves	37
33	CNNS	Naringenin	Leaves, Flowers, Twigs, Seeds	39
34	CNNS	Oxalicacid, cyclobutyl hexyl ester	Leaves	37
35	CNNS	P-hydroxy-benzoic	Leaves, Flowers, Twigs, Seeds	39
36	CNNS	Stictic acid	Leaves, Flowers, Twigs, Seeds	39
37	CNNS	Tetradecanoic acid	Leaves	37
38	CNNS	Usnic acid	Leaves, Flowers, Twigs, Seeds	39

39	CNNS	Vitamin E	Leaves	37
40	CNNS	Z-7-Decen-1-yl acetate	Leaves	37
41	CNNS	β-D-methylglucopyranoside	Leaves	37
42	Essential Oil	1,1,4a Trimethyl-5,6-dimethylenedecahydro naphthalene	Leaves	38
43	Essential Oil	1,2,3, Trimethyl benzene	Leaves	38
44	Essential Oil	17-Octadecynoic acid	Leaves	32
45	Essential Oil	2, tert 1-butyl-1,4-dimethoxy benzene	Leaves	38
46	Essential Oil	2-naphthalenemethanol	Leaves	38
47	Essential Oil	5-Octadecenal	Leaves	32
48	Essential Oil	8,11-Octadecadienoic acid	Leaves	32
49	Essential Oil	alpha-caryophyllene	Leaves	38
50	Essential Oil	Bicyclo[jundec-4-ene,4,11-trimethyl-8-methylene	Leaves	38
51	Essential Oil	Borneol	Leaves	38
52	Essential Oil	Cycloproplejazulene	Leaves	38
53	Essential Oil	Dodecane	Leaves	32
54	Essential Oil	Eicosane	Leaves	32
55	Essential Oil	Ethanonaphthalene	Leaves	38
56	Essential Oil	Heneicosane	Leaves	32
57	Essential Oil	Heptacosane	Leaves	32
58	Essential Oil	Hexamethyl dewar benzene	Leaves	38
59	Essential Oil	n-Hentriacontane	Leaves	32
60	Essential Oil	Nonacosane	Leaves	32
61	Essential Oil	Octanal	Leaves	32
62	Essential Oil	Octene	Leaves	32
63	Essential Oil	Palmitic acid	Leaves	32
64	Essential Oil	Pentacosane	Leaves	32
65	Essential Oil	Pentadecanol	Leaves	32
66	Essential Oil	Tetracontane	Leaves	32
67	Essential Oil	Tetradecane	Leaves	32
68	Essential Oil	Tetradecanol	Leaves	32
69	Essential Oil	Tricosane	Leaves	32
70	Essential Oil	Undecanal	Leaves	32
71	Glucose	D-galactose	Roots	35
72	Glucose	D-glucoside	Roots	35
73	Glucoside	Glucoside-galactose	Roots	35
	*CNNS-Compound Nature Not Specified			

Conclusion

The extensive ethnomedicinal utilization and rich phytochemical diversity of Justicia adhatoda L. scientifically substantiate its long-standing therapeutic importance in traditional healthcare systems. The presence of numerous bioactive constituents, including alkaloids, flavonoids, terpenoids, steroids, essential oils, and phenolic compounds, highlights the plant as a valuable reservoir of pharmacologically active natural products with significant medicinal potential. These phytochemicals are largely responsible for the broad spectrum of biological activities associated with the species, particularly in the treatment of respiratory and inflammatory disorders. However, comprehensive studies involving phytochemical isolation, pharmacological evaluation, toxicity assessment, and clinical investigations are still required to understand better and scientifically validate the medicinal efficacy of this important species.

References

1. Grant WF. A cytogenetic study in the *Acanthaceae*. Brittonia,1955:8(2):121–149.
2. Yadav S, Yadav VK. Ethnomedicinal value and pharmacognosy of the member of *Acanthaceae*: *Adhatoda vasica* (Linn.). Asian Pac J Health Sci,2018:5(2):40–43.
3. Lal HS, Singh S. Study of plant biodiversity of Hazaribag district Jharkhand India and its medicinal uses. Biosci Discov,2012:3(1):91–96.
4. Gangwar AK, Ghosh AK. Medicinal uses and pharmacological activity of *Adhatoda vasica*. Int J Herb Med,2014:2(1):88–91.
5. Shamsuddin T, Alam MS, Junaid M, Akter R, Hosen SM, Ferdousy S, *et al*. *Adhatoda vasica* (Nees.): A review on its botany, traditional uses, phytochemistry, pharmacological activities and toxicity. Mini Rev Med Chem,2021:21(14):1925–1964.
6. Shoaib A. A systematic ethnobotanical review of *Adhatoda vasica* (L.) Nees. Cell Mol Biol,2021:67(4):248–263.
7. Tomy T, Ansary PY, Oommen SM, Shincymol VV. Taxonomical identification of different plant sources of Vaasa (*Adhatoda* spp.). Kerala J Ayurveda, 2023, 2(4).
8. Hussain S, Hore DK. Collection and conservation of major medicinal plants of Darjeeling and Sikkim Himalayas, 2007.
9. Sarmah R, Adhikari D, Majumder M, Arunachalam A. Traditional medicobotany of Chakma community residing in the northwestern periphery of Namdapha National Park in Arunachal Pradesh, 2008.
10. Manandhar NP. Medicinal plant-lore of Tamang tribe of Kabhrepalanchok district, Nepal. Econ Bot,1991:45(1):58–71.
11. Bhowmik S, Datta BK, Sarbadhikary SB, Mandal NC. Contribution to the less known ethnomedicinal plants used by Munda and Santal community of India with their ethnomedicinal justification. World Appl Sci J,2013:23(10):1408–1417.
12. Roy M, Sarkar BC, Shukla G, Debnath MK, Nath AJ, Bhat JA, *et al*. Traditional homegardens and ethnomedicinal plants: Insights from the Indian Sub-Himalayan region. Trees For People,2022:8:100236.
13. Choudhury PR, Choudhury MD, Ningthoujam SS, Das D, Nath D, Talukdar AD. Ethnomedicinal plants used

by traditional healers of North Tripura district, Tripura, North East India. J Ethnopharmacol,2015:166:135–148.
14. Jain SP, Puri HS. Ethnomedicinal plants of Jaunsar-Bawar hills, Uttar Pradesh, India. J Ethnopharmacol,1984:12(2):213–222.
15. Singh VK, Ali ZA, Siddiqui MK. Medicinal plants used by the forest ethnics of Gorakhpur district (Uttar Pradesh), India. Int J Pharmacogn,1997:35(3):194–206.
16. Bhattarai NK. Traditional phytotherapy among the Sherpas of Helambu, central Nepal. J Ethnopharmacol,1989:27(1-2):45–54.
17. Mannaf MA, Islam MA, Akter SA, Akter RA, Nasrin TN, Zarin IZ, *et al*. A randomized survey of differences in medicinal plant selection as well as diseases treated among folk medicinal practitioners and between folk and tribal medicinal practitioners in Bangladesh, 2013.
18. Jamir NS, Takatemjen L. Traditional knowledge of Lotha-Naga tribes in Wokha district, Nagaland. Indian J Trad Knowl,2010:9(1):45–48.
19. Kharel R. Indian traditional herbs *Adhatoda vasica* and its medicinal application. J Chem,2010:2(1):240–245.
20. Anis M, Sharma MP, Iqbal M. Herbal ethnomedicine of the Gwalior forest division in Madhya Pradesh, India. Pharm Biol,2000:38(4):241–253.
21. Kumar S, Parveen F, Narain P. Medicinal plants in the Indian arid zone, 2005.
22. Jothimangalam MS, Deepa M. Medicinal and therapeutic use of *Justicia adhatoda* L. Tamil Nadu: Thanuj International Publishers, 2022, 366.
23. Jain A, Katewa SS, Galav PK, Sharma P. Medicinal plant diversity of Sitamata wildlife sanctuary, Rajasthan, India. J Ethnopharmacol,2005:102(2):143–157.
24. Joshi BS, Bai Y, Puar MS, Dubose KK, Pelletier SW. 1H- and 13C-NMR assignments for some pyrrolo{2,1-b}quinazoline alkaloids of *Adhatoda vasica*. J Nat Prod,1994:57(7):953–962.
25. Thappa RK, Agarwal SG, Dhar KL, Gupta VK, Goswami KN. Two pyrroloquinazolines from *Adhatoda vasica*. Phytochemistry,1996:42(5):1485–1488.
26. Jain MP, Koul SK, Dhar KL, Atal CK. Novel nor-harmal alkaloid from *Adhatoda vasica*. Phytochemistry,1980:19(8):1880–1882.
27. Jain MP, Sharma VK. Phytochemical investigation of roots of *Adhatoda vasica*. Planta Med,1982:46(12):250–250.
28. Johne S, Gröger D, Hesse M. Neue alkaloide aus *Adhatoda vasica* Nees. Helv Chim Acta,1971:54(3):826–834.
29. Dhar KL, Jain MP, Koul SK, Atal CK. Vasicol, a new alkaloid from *Adhatoda vasica*. Phytochemistry,1981:20(2):319–321.
30. Atta-Ur-Rahman, Sultana N, Akhter F, Nighat F, Choudhary MI. Phytochemical studies on *Adhatoda vasica* Nees. Nat Prod Lett,1997:10(4):249–256.
31. Ignacimuthu S, Shanmugam N. Antimycobacterial activity of two natural alkaloids, vasicine acetate and 2-acetyl benzylamine, isolated from Indian shrub *Adhatoda vasica* Ness. leaves. J Biosci,2010:35:565–570.
32. Shukla S, Hegde S, Kumar A, Chaudhary G, Tewari SK, Upreti DK, *et al*. Chemical composition and antibacterial activity of essential oil from leaves of *Justicia adhatoda* against methicillian resistant and sensitive strain along with their clinical isolates. J Essent Oil Bear Plants,2017:20(1):116–122.
33. Joshi BS, Newton MG, Lee DW, Barber AD, Pelletier SW. Reversal of absolute stereochemistry of the pyrrolo[2,1-b]quinazoline alkaloids vasicine, vasicinone, vasicinol and vasicinolone. Tetrahedron Asymmetry,1996:7(1):25–28.
34. Khandelwal P, Wadhwani BD, Rao RS, Mali D, Vyas P, Kumar T, *et al*. Exploring the pharmacological and chemical aspects of pyrrolo-quinazoline derivatives in *Adhatoda vasica*. Heliyon,2024:10:25727.
35. Singh PT, Singh OM, Singh HB. *Adhatoda vasica* Nees: phytochemical and pharmacological profile. Nat Prod J,2011:1(1):29–39.
36. Jayaweera U, Shivashekaregowda NK, Herapathdeniya SK, Paranagama PA. Ethnopharmacological uses, phytochemistry, pharmacological activities and toxicity of *Justicia adhatoda* L.: a review. Discover Plants,2024:1(1):41.
37. Ali A, Khan N, Qadir A, Warsi MH, Ali A, Tahir A. Identification of the phytoconstituents in methanolic extract of *Adhatoda vasica* L. leaves by GC-MS analysis and its antioxidant activity. J AOAC Int,2022:105(1):267–271.
38. Sarker AK, Chowdhury JU, Bhuiyan HR. Chemical composition and antimicrobial activity of essential oil collected from *Adhatoda vasica* leaves. Bangladesh J Sci Ind Res,2011:46(2):191–194.
39. Ahmed W, Azmat R, Mehmood A, Qayyum A, Ahmed R, Khan SU, *et al*. The analysis of new higher operative bioactive compounds and chemical functional group from herbal plants through UF-HPLC-DAD and Fourier transform infrared spectroscopy methods and their biological activity with antioxidant potential process as future green chemical assay. Arab J Chem,2021:14(2):102935.