



## Review Article

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### ***NARDOSTACHYS JATAMANSI*: IMPORTANCE OF HIGHLY SIGNIFICANT AND ENDANGERED PLANT IN AYURVEDA**

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#### ABSTRACT

Medicinal herbs have a rich history of their utilization for a variety of ailments. India is considered among those countries which have produced a vast variety of medicinal plants. Medicinal plants are the source of new drugs across the world. Most of the drugs available today have some herbal content of plants in them. Due to this over-utilization of the herbal plant, it becomes endangered. *Nardostachys jatamansi* is a popular aromatic herbal plant. This plant is also on the verge of extinction due to the overexploitation of the rhizomes part of the herb. It is small, hairy, perennial, rhizomatous species of Valerianacea family. It is cultivated mostly in higher altitude areas. Jatamansi demonstrates various folk, Ayurvedic and pharmacological uses. Jatamansone and nardostachone are the main compounds present in the plant that possesses various activities like antimicrobial, antifungal, hypotensive, antiarrhythmic and anticonvulsant activity, etc. In this review, the phytochemicals pharmacological properties, Ayurvedic properties and folk uses of *N. jatamansi* are briefly explained.

**Keywords:** Jatamansi, Ayurveda, Endangered, Jatamol, Anti-Parkinson's

#### INTRODUCTION

Herbal plants and natural resources show immense remedial, medicinal and pharmacological responses in present day<sup>1</sup>. The medicine derived from the plants shows high-quality results with no side effects as compared to synthetic drugs or medicine. The use of a traditional medicinal system for the preparation of herbal medicines is called herbalism. In herbalism, herbal plants are used in a holistic manner and mainly based on their empirical and traditional uses<sup>2</sup>. *Nardostachys jatamansi* (Figure 1) is a medicinal plant that demonstrates several pharmacological activities. Due to various medicinal uses of the Jatamansi species, it is on the verge of extinction<sup>3,4</sup>. It is a small, dwarf, hairy, perennial, rhizomatous species of Valerianacea family<sup>5</sup>. This plant is mostly cultivated 2300 m to 6000 m above the sea level. *Nardostachys jatamansi* is commonly called as 'Indian nard', 'Jatamansi' and 'Spikenard'<sup>6</sup>. The herb is also mentioned in the Holy Quran and Bible. It was used by Mary to anoint Jesus's feet. The root and rhizomes of the *Nardostachys jatamansi* herb are the most significant parts having excellent medicinal potential<sup>7</sup>. In Ayurveda, the rhizomes of the jatamansi are utilized mostly as an anticonvulsant and anti-stress agent<sup>8</sup>. The essential oil extracted from the rhizomes part of the jatamansi is widely utilized in the market for hair treatment<sup>9</sup>. The phytochemical constituents of *N. jatamansi* have been revealed with both volatile and non-volatile compounds. Sesquiterpenes and coumarins are the main active chemical constituents of the plant<sup>10</sup>. The roots are used in various formulations for commercial benefits and therapeutic uses<sup>11</sup>. The herb is found to have antimicrobial<sup>12</sup>, antifungal<sup>13</sup>, hypotensive<sup>14</sup>, anti-arrhythmic and anticonvulsant activity<sup>15</sup>. Due to the over-exploitation, the species *N. jatamansi* become endangered. Reports of Conservation Assessment and Management Plan (CAMP) suggested that plant population declines up to 75-80%

and classified jatamansi as an endangered plant in India. The herb is critically endangered in Uttarakhand<sup>16</sup>. Convention on International Trade of Endangered Species (CITES) has announced that jatamansi is endangered. The use of jatamansi is minimized by the storage of the seeds. Various scientific studies on the viability and germination also help in minimizing some pressure on the survival of the endangered therapeutic plant<sup>17</sup>. *N. jatamansi* is a potent plant that needs conservation of biodiversity to maintain its existence in the world. This review paper aims to provide whole information on the general basis, phytochemicals, medicinal applications and various reported studies of the *N. jatamansi* plant. Vernacular names and Taxonomy of *N. jatamansi* are given in Table 1 and 2 respectively.



Figure 1: *Nardostachys jatamansi*

**Table 1: Vernacular names of *N. Jatamansi***

Language	Names
English	Muskroot, Indian spikenard
French	Nard Indian
German	Achte Narde
Greek	Narde Indike
Arabic	Sambul-u-l hind
Persian	Sunbul uttib
Chinese	Gan Song, Xiang Song
Nepali	Japoy
Sanskrit	Mamsi, Jatamansi, Bhytajata, Tapaswani
Assamese	Jatamansi
Bengali	Jatamansi
Gujarati	Baalchad
Hindi	Balchara
Marathi	Jatamansi
Orissa	Jatamansi
Punjabi	Billilotan
Tamil	Jatamanji
Telugu	Jatamansi
Kashmiri	Butijatt, kuklipot
Garhwali	Masi
Rest of the world	Muskroot, Spikenard <sup>18,19</sup>

**Table 2: Taxonomy of *Nardostachys jatamansi***

Taxonomical rank	Taxon
Kingdom	Plantae
Class	Dipsacales
Division	Mangoliophyta
Order	Mangnoliopsida
Family	Valerianaceae
Genus	<i>Nardostachys</i>
Species	<i>Jatamansi</i>
Common Name	Jatamansi <sup>20,21</sup>

### Botanical description

*Nardostachys jatamansi* is an erect, hairy, perennial herb. Its height ranges up to 10-60 cm. The rhizomes and roots of the herb are mainly used as a drug. Rhizomes are 2.5 to 7.5 cm in length<sup>22</sup>. The plant is long with stout and long woody rootstocks covered with a tail like brown fibers. The roots of the plant enter deep into the soil. Leaves are rosy, slightly pink and blue in dense cymose. Reddish-brown tufted fibers act as a crown for the dark grey rhizomes. The leaves of the *Nardostachys jatamansi* plant are narrow and long. It is reddish grey from inside. The transverse section of the rhizome presents a thin periderm, a large parenchymatous cortex that is rich in starch and an endodermis containing globules of volatile oil. Flowers are bilaterally symmetric and bisexual. The flower forms a cluster. The fruit is 4 mm long, covered with minute hair. The corolla is joined and having 5 lobes<sup>23,24</sup>.

### Geographical distribution

*N. Jatamansi* is widely distributed in the subalpine to alpine areas of India, Pakistan, Nepal, China and Yunan. This herb is mostly cultivated in high altitude areas like Jammu and Kashmir, Himachal Pradesh, Uttarakhand and Sikkim<sup>25</sup>.

### Phytochemical constituents of *N. jatamansi*

The phytochemical studies of the plant *N. jatamansi* are focused mainly on the rhizome and roots of the plant<sup>26</sup>. Scientific studies discovered that jatamansi have both the volatile and non-volatile

constituents present in it. Sesquiterpenes and Coumarins are the main active chemical constituents in the jatamansi plant<sup>27</sup>. The main volatile oils are extracted from the root part of the plant. Sharma *et al.*, investigated the volatile oils present in the roots of the Jatamansi such as Sesquiterpene including jatamansic acid, jatamansinone, nardostachone, jatamansinol, nardostachone, Jatamol, nardostachyin, nardosinone, pymocoumarin A and B and Sesquiterpene acid<sup>28</sup>. Jatamansome is considered as a primary Sesquiterpene. Malik *et al.*, also investigated some different Sesquiterpenes that includes Alphapatcho-ulense,  $\beta$ -eudesemo,  $\beta$ -sitosterol, elemol, angelicin, jatamansin, jatamansinol, calarene, Jatamansone  $\beta$ -atchoulense, n-hexaco-sanyl, n-hexacosane, Oroselol, valeranal, valeranone, seychelane, nardostachol, nardostachone<sup>29</sup>. Singh *et al.*, examined in their study that the unstable oil, fundamental oil, gum, sugar, starch, ketone, jatamansic corrosive, Jatamansome, lupeol, Malliene, Calarenol, coumarin jatamansin, propionate, cyclohexanal ester, heptacosanyl pentanoate are extracted from the rhizome part<sup>30</sup>. Rahman *et al.* examined briefly some phytochemical constituents which possess different properties, especially on the skin. These chemical compounds are Nardostachone, Tetrahydronardostachon e,  $\beta$  – Malliene, Tetrahydronardostachol, Tetrahydronardostachane, Jatamansinone, Nardol, Angelcin, Jatamansic Acid, Seychellene, Seychelane, Valeranone,  $\beta$ -Cedrene, Tricyclovetivene, Gama – Patchoulene, Seychellanol, Seychellanodiol, Alpha – Patchoulene, Beta – Patchoulene, Patchouli alcohol and Norseychellanone<sup>31</sup>. Pai *et al.* reported the presence of esters, phenolic compounds, terpenic ketone, valcranone, valeranal, nardol, calavenol, nordostechone, n-hexacosanyl arachidate, n-hexacosamol, calrene, jatamansin,  $\beta$ - sitosterol, iridoid in the jatamansi<sup>32</sup>. Bagchi *et al.*, investigated that terpenic ketone have 9 monoterpenes (1.7%), 25 Sesquiterperies (43.9%) and non terpenic compounds (24.7%), Jatamansone, semicarbazone, spirozatamole, Jatamol A and B, nardostachysin and calarenol<sup>33-35</sup>. The major Sesquiterpene ketones are Jatamansone and  $\alpha$ -gurjunene. They are extracted from the rhizomes part of jatamansi<sup>36</sup>. Nardole (10.1%),  $\alpha$ -selinine (9.2%),  $\gamma$ -gurjunene (2.3%),  $\beta$ -caryophyllene (3.3%), cubebole (2.9%) and  $\alpha$ -humilene (2.3%) are the other Sesquiterpenes isolated from the rhizomes of *N. jatamansi*. Pyranocoumarin and Nardin are the new Sesquiterpene acid isolated from the rhizome. Some chemical constituents of *N. jatamansi* along with their chemical structure shown in Figure 2.

### Folk view

Jatamansi (*Nardostachys jatamansi*) has been considered for its medicinal value for centuries in India, Greek, Arab, Egypt and Rome. The *Nardostachys jatamansi* is first drug originated from a 'song Zhou' of Chuan Xi which has been registered in the book 'Ben Cao Shi Yi' in China. The perfume formulation made from *N. jatamansi* is also quoted in the 'Book 18 of Homer's Iliad', is used Patroklos by Achilles. Jatamansi herb is known to be the Eleventh Herbs utilized for the Incense in the Holy Temple in Jerusalem. This herb has been mentioned twice in the biblical love poem, the 'Song of Solomon (1:12 and 4:13)'. It is also mentioned that the plant *N. jatamansi* is used by Mary to anoint Jesus's feet. In some Islamic traditions, the root powder of *N. jatamansi* is believed to be the fruit that Adam ate in Paradise. The Jatamansi herb was utilized as a seasonal cuisine in Medieval Europe. It was also utilized in sweetened and spiced wine drinks. This plant is found in India since 800 B.C. for the treatment of various ailments like hysteria, cholera, palpitations, epilepsy and convulsive disorder<sup>37,38</sup>.

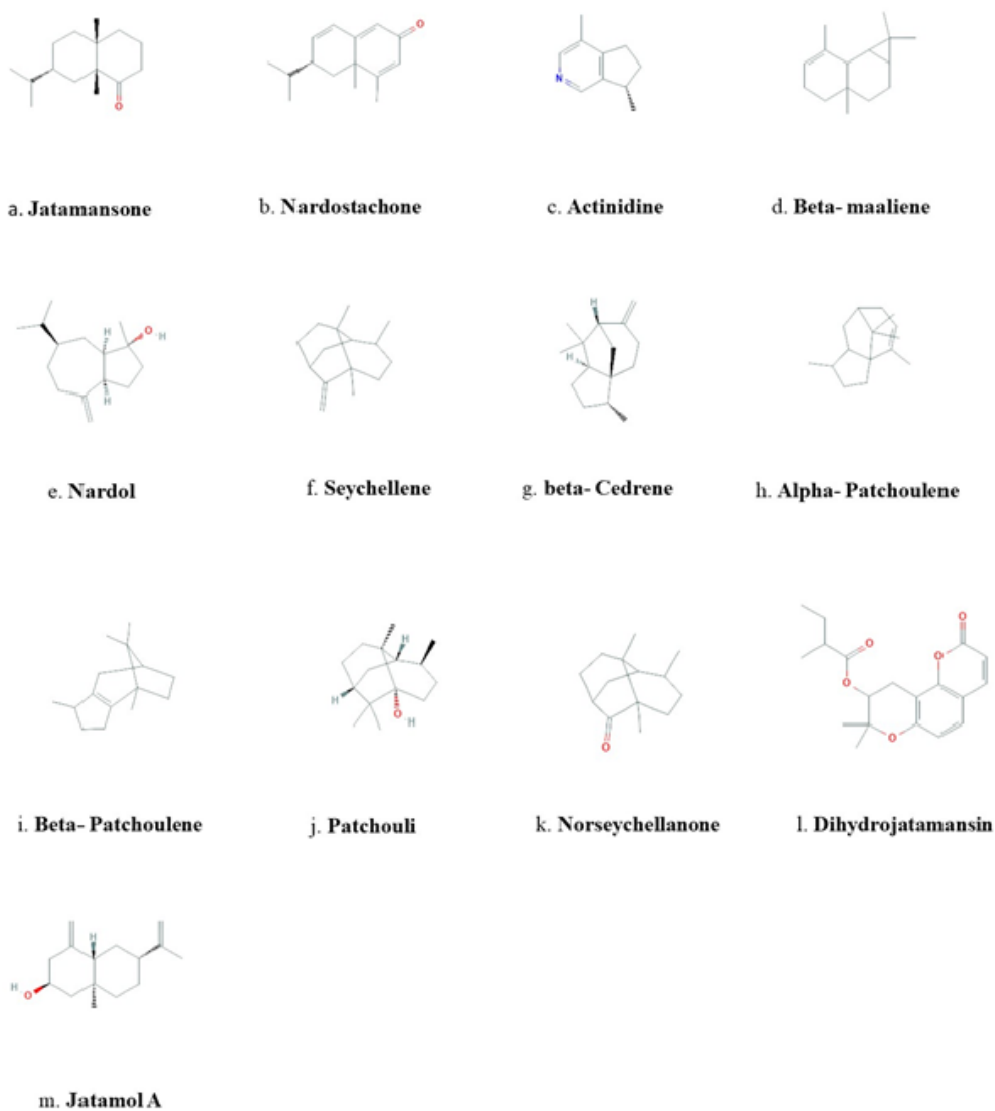


Figure 2: Chemical structure of some major phytochemicals of *N. jatamansi*

### Ayurvedic view

*Nardostachys jatamansi* is a high-altitude herbal plant. It is traditionally known as "Jatamansi" and "Bhootkeshi". There are various herbal formulations and nutraceuticals made for the treatment of neurological disorders like epilepsy, hysteria, syncope, convulsions and mental weakness. The diseases have broadly categorized according to adhishtana (place of the origin) into two types: Sharirik (physical) and Mansik (mental). According to Ayurveda, Jatamansi is considered as Sangyasthapaka and Manasdoshtar (psychotropic)<sup>39</sup>. The plant *N. jatamansi* is also worked as Rasayana (Rejuvenative to the

mind), Nidrajnana (Promotes sleep), Manasrogaghna (Alleviates mental diseases), Pachana (Digestive), Kasashwasahara (Stops skin diseases and itching) Daha prashamana (Stops burning sensation), Varnya (Benefits complexion) and Roma sanjanana (Promotes hair growth)<sup>40,41</sup>. According to Charaka, Jatamansi is classified as Sangyasthapana (group of herbs used in restoring consciousness), Kandughna (a group of herbs used to relieve itching) and Tikta Skandha (bitter tasting group of herbs). Sushruta mention Jatamansi as an Eladi Gana (group of elayachi and other herbs). Rasa Panchaka of Jatamansi as per Ayurveda is shown in Table 3.

Table 3: Rasa Panchaka (Properties and Action) of Jatamansi (*Nardostachys jatamansi*)

Sanskrit/English	Sanskrit/English
Rasa/Taste	Tikta, Kashaya, Madhura/Pungent, Sweet
Guna/Physical properties	Laghu, Snigdha/ Little, oily
Virya/Potency	Sheet/Cold
Vipaka/Metabolic properties	Katu/Bitter

### Ayurvedic Uses of Jatamansi (*Nardostachys jatamansi*)

Asranashini – Jatamansi is bitter tonic which balances pitta, it is widely used for the purification of blood.

Medhya – It helps in improving brain function.

Kantiprada – It improves the skin complexion and lustre.

Balaprada – Works as an immunity booster

Dahanut – It relieves epigastric burning sensation

Visarpakushtanut – It is useful in curing herpes and skin diseases

Modakrut – Useful in treating anxiety and depression

Bhutadahaghni – Most beneficial for psychiatric condition

### Modern view

The primary issue which is faced by the global herbal drug industry in today's scenario is the practice of making these drugs adulterated. This is the reason behind the lost faith of people in these herbal drugs nowadays<sup>42-47</sup>. Adulteration can be either intentional or unintentional. In today's time, intentional adulteration is practiced in many different ways like by substituting standard commercial variety, by substituting superficially similar but inferior drugs, by substituting artificially manufactured drugs, substitution of exhausted drugs and by substituting toxic materials. These practices ultimately degrade the quality of the original drugs. The herbal plant vendors use these adulteration techniques so smartly that these remain undetectable until and unless examination on microscopic level and chemical level are implied<sup>48,49</sup>. The major disadvantages associated with adulteration are deterioration and degradation of drugs. Adulteration also increases the cost of drugs and produces adverse effects instead of showing actual biological affect<sup>50</sup>. The traditional herbal drugs and their formulations are associated with negligible toxicity and are free from any kind of adulteration. *N. jatamansi* is herbal plant also utilized in modern medicine mostly for neurological function. The oil formulation of jatamansi possesses antiarrhythmic activity. It also acts as a flavouring agent in the preparation of other medicinal oil<sup>51</sup>. Jatamansi oil formulation is highly profitable for smooth and healthy hair. Its use is also mentioned for the treatment of epilepsy, cerebral ischemia, liver damage, hypertension and heart diseases<sup>52-54</sup>. Joshi *et al.* demonstrated in their study that the rhizomes of *Selinum vaginatum* are the major adulterants in many formulations of *N. jatamansi*.

### Therapeutic uses of *N. jatamansi* (Jatamansi)

#### Learning and Memory

Reported studies assess the potential of *N. jatamansi* as a memory enhancer. The ethanolic extract of *N. jatamansi* was administered for 8 regular days to both young and aged mice in the doses of 50, 100, and 200 mg/kg, p. o. The ethanolic extract significantly improved learning and memory in young mice when it was administered in a dose of 200 mg/kg and also reversed the amnesia induced by diazepam (1 mg/kg, i. p.) and scopolamine (0.4 mg/kg, i. p.). Hence, *N. jatamansi* might prove to be a useful memory restorative agent in the treatment of dementia seen in elderly persons. The underlying mechanism of action can be attributed to its antioxidant property<sup>55</sup>. The ethanolic extract of the jatamansi administrated for 21 days in a rat model raised acetylcholinesterase (AChE) levels in the frontal cortex<sup>56</sup>.

#### Antioxidant Activity

*N. jatamansi* has anti-oxidant property too as per the literature data. It was demonstrated by an experiment on a rodent liver. The investigation showed that the concentration gave security as well as protection against lipid peroxidation. Aqueous extract of roots of jatamansi has cancer prevention property and anti-cataleptic impact. This activity has been demonstrated by a study conducted

on rodents by estimating different physiological, social and biochemical parameters<sup>57</sup>.

The activity of *N. jatamansi* was demonstrated by administration of ethanolic extracts in Wistar rats in 2 doses followed by immobilization stress on the 5<sup>th</sup> day. Some rats didn't show clinical signs of toxicity and some showed free radical scavenging activity. The rats treated with 200-500 mg/kg jatamansi extracts significantly decreased the lipid peroxidation and nitrate level<sup>58</sup>.

#### Anticonvulsant and Neurotoxicity

As per reports of a study conducted on mice, it was found that the ethanolic extract of jatamansi affected the generalized tonic-clonic seizures. The synergistic effects were also confirmed when jatamansi was combined with phenytoin and gives effect on the behavioural *Nardostachys jatamansi* considerably increased the input of seizures in an experimental model. The ethanol extract of jatamansi affected the generalized tonic-clonic seizures by showing a very less neurotoxic effect. The synergistic effect of *Nardostachys jatamansi* in combination with phenytoin showed a mark-able effect on the central nervous system<sup>59,60</sup>.

#### Nervous system

The acetylcholinesterase activity of Methanolic and water extracts of jatamansi showed inhibitory activity. Vinutha *et al.* investigated *in vitro* acetylcholinesterase inhibitory activity. Water extracts were reported to be less active than the Methanolic extract of jatamansi. These results also validated the traditional use of jatamansi for improving learning<sup>61</sup>. Another study was conducted on the rats. Models were treated with 250 mg/kg of alcoholic extract of *N. jatamansi* for 15 days. It was found that it protected them against focal ischemia caused by middle cerebral artery occlusion and improved glutathione content<sup>62</sup>.

#### Hepatoprotective Activity

Several studies have been proved that root extract of jatamansi have hepatoprotective activity. The experiment was conducted on thioacetamide-induced rats (800 mg/kg body wt.). It was found that 50% of the ethanolic extract of jatamansi showed hepatoprotective activity in the rats. It also reduced the level of serum transaminase and alkaline phosphatase significantly<sup>63</sup>.

#### Anti-diabetic Activity

A study was conducted on alloxan-induced diabetic rats and it was found that the ethanolic extract at a high dose (1200 mg/kg) given for 7 days exhibited anti-hyperglycaemic activity<sup>64</sup>.

#### Cardio-protective Activity

*In-vivo* study on Wistar albino rats showed cardio protective activity. The model was doxorubicin-induced myocardial injury animal model. Doxorubicin is an anticancer drug that leads to cardio-toxicity. It was found that the ethanolic extract of *N. jatamansi* changed the serum and cardiac lipid metabolizing enzymes<sup>65</sup>. Another study was conducted on rats. The model was induced with triton. The 50% ethanolic extract of *Curcuma longa* and *N. jatamansi* in combination was found to be very effective. It elevated the HDL-cholesterol ratio in triton-induced hyperlipidaemia rats<sup>66</sup>.

#### Antidepressant Activity

The reported study was conducted in male albino Wistar rats to evaluate the antidepressant activity of *N. jatamansi*. The model was treated with alcoholic extract of the roots of *N. jatamansi*. It was found that the level of norepinephrine and dopamine remained unchanged but increase the level of 5-HT and 5-HIAA was noticed accordingly. The level of GABA and taurine increased significantly when compared to the control group<sup>67</sup>.

### Antifungal Activity

The oil of jatamansi has antifungal properties. It was found to be very efficient against *Aspergillus flavus*, *A. fumigatus*, *A. sulphureus*, *Mucor fragilis* and *Rhizopus stolonifera*<sup>68</sup>.

### Anti-Parkinson's Activity

Root extract of Jatamansi was administered to the rats in the dosage of 200, 400 and 600 mg/kg bodyweight for 3 weeks. On day 21, 2 µl of 6-OHDA (12 µg in 0.01% in ascorbic acid-saline) was infused, while 2 µl of the vehicle was infused in the sham-operated group. After three weeks of 6-hydroxydopamine (6-OHDA) injection neurobehavioral activity in rats was tested. It was found that 6-OHDA injections increased the drug-induced rotations and deficits in locomotor activity and muscular coordination. Thus the study indicated the anti-Parkinson's activity of jatamansi<sup>69</sup>.

### Anti-Alzheimer's Activity

Effect of Methanolic extract of jatamansi in sleep-deprived amnesic mice was examined. The animal model was pre-treated with MENJ and Piracetam drug for 14 days<sup>70</sup>. It was found the improvement in learning and cognition parameters in behavioural tests was observed. Also loss of memory and cognitive deficits due to sleep deprivation was found to be minimised<sup>71</sup>.

Alzheimer's disease is a progressive neurologic disorder that causes the brain to shrink and brain cells to die, which is related with mutations in Amyloid precursor protein (APP), Presenilin 1 (PS1), Presenilin 2 (PS2), or Apolipoprotein E (APOE). A study was conducted using homology modelling of these 4 proteins. It was found that the *N. jatamansi* in combination with Canscora and *Mucuna pruriens* were tied up successfully with the four proteins. These were also docked with nardal, ergotamine and xanthone. This whole combination was suggested the effective treatment of Alzheimer's disease<sup>72,73</sup>.

### Other Activities

The experimental studies performed on Jatamansone showed various properties like anti-estrogenic, antiarrhythmic, antihypertensive, anti-asthmatic, nematocidal and antibacterial activity<sup>74-79</sup>.

### CONCLUSION

Medicinal plants have been played a vital role in maintaining the health of the community since the ancient times. *Nardostachys jatamansi*; is one of the most commonly used medicinal herbs in various systems of medicines like Ayurveda, Siddha, Folk and Modern. This plant is associated with some significant therapeutic actions. It is utilized in the treatment of several diseases. As per the data of reported studies, each of its chemical constituents is associated with various pharmacological properties like anti-Alzheimer's, anti-Parkinson, hepatoprotective, cardio protective, anti-diabetic, antioxidant etc. Rhizome and roots are the active part of the plant. Jatamansone, Sesquiterpenes and coumarins are some major phytochemicals of this herb. It is used in various Ayurvedic herbal formulations for treating several disorders. As this significant plant is becoming extinct, there is a strict need to conserve this plant because of its vast pharmacological use in the field of Ayurveda.

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