



## **A Review on Endangered Medicinal Plant *Nardostachys jatamansi*: An Important Himalayan Herb**

**Hem Chandra Pant<sup>1</sup>, Srishti Jalal<sup>2</sup>, Indra Rautela<sup>2</sup>, Yunus Ali<sup>3</sup>, Anjali Thapa<sup>3</sup>, Pragya Verma<sup>1</sup>, Harsh Vardhan Pant<sup>3</sup> and Naveen Gaurav<sup>1\*</sup>**

<sup>1</sup>Department of Biotechnology, School of Basic and Applied Sciences, Shri Guru Ram Rai University, Patel Nagar, Dehradun- 248001, Uttarakhand, India

<sup>2</sup>Department of Biotechnology, School of Applied and Life Sciences, Uttaranchal University, Dehradun-248001, Uttarakhand, India

<sup>3</sup>Shri Guru Ram Rai (P.G) College, Dehradun- 248001, Uttarakhand, India.

\*Corresponding author: [naveensri17@gmail.com](mailto:naveensri17@gmail.com)

### **ABSTRACT**

*Nardostachys jatamansi* DC is a well-known medicinal and fragrant plant. It is used as an Ayurvedic medicine that can be found in a wide range of formulations. Details about medicinal plants can also be found in the Quran, the Bible, and other texts. Mental weakness, skin disorders, digestive problems, epilepsy, hysteria, and syncope have all been treated with this plant. The *N. jatamansi* root and rhizome extracts are used to treat a variety of neurological problems, including anxiety. Jatamansone, Sesquiterpenoid, Spirojatamol, patchouli alcohol, Jatamol-A and nardostachone are some of the most prominent phytochemicals found in *N. jatamansi*. Anticonvulsant, antispasmodic, antibacterial, antipyretic, antifungal, antidote, antiemetic, and analgesic are only a few of the therapeutic properties found in *N. jatamansi* components and phytochemicals. *N. Jatamansi* is expected to play a significant role in the rapidly growing field of herbal products and the management of potential health issues. This article discusses some of the plant's main ingredients, biological activities, and medicinal properties that can be used to treat a variety of diseases.

**Keywords:** *Nardostachys jatamansi*, conservation, roots and rhizome, Chemical constituents

### **INTRODUCTION**

*N. Jatamansi* is a perennial, aromatic, herbaceous plant with a height of 10-60 cm. Rhizome of the plant is small, grey, woody and coated with the reddish-brown, tufted, fibrous remains of dead leaves' petioles (Pant et al., 2021a). The leaves of the plant are rosette-shaped, lanceolate (Naya et al., 1988). Light purple flowers with a campanula shape. The *N. jatamansi* species from August through September blooms. The plant species has been employed in Ayurvedic and Unani treatment for the time of many years ago (Nautiyal et al., 2003). The main commercial portion of the plant is root and rhizome, which extracts

have been utilised in over 26 Ayurvedic treatments and many other formulations (Airi et al., 2000; Sharma et al., 2016; Rautela et al., 2018). The rhizome of jatamansi is used in the manufacture of medicinal oils and oils have numerous properties as an aromatic additive to restore hair problems (Kirthikar et al., 1993). The plant's roots are get to generate a necessary oil that has been proven to have antibacterial, antifungal, hypotensive, and anticonvulsant effects (Arora et al., 1958; Rao et al., 2005). Different Himalayan region photograph of the plant is shown in Figure-1.



Figure-1: *Nardostachys jatamansi* Plant Different Himalayan Region of Uttarakhand

### HISTORICAL BACKGROUND

*N. jatamansi* plant has been used from ancient times for healing systems for ages. Since the Ayurvedic times in India, the plant has played an important function. It is also used as a medicinal system for other medicinal systems such as Unani in ancient Greek and Arab scripts, as well as ancient Egypt, Rome, and Islamic scripts. In Medieval European cuisine, *N. jatamansi* is frequently used to season meals, particularly as part of a spice blend. Hippocrates recommended a wine drink that was sweetened and spiced (Singh et al., 2013). The plant's rhizomes were also utilised in Ayurvedic medicine as a bitter tonic, stimulant,

antispasmodic, epilepsy treatment, and hysteria treatment (Jha et al., 2012). The plant has been used to make fragrances and dyes, and it is economically important.

### DESCRIPTION OF THE SPECIES

*Nardostachys jatamansi* DC is the scientific name of plant.

**Family:** Caprifoliaceae Synonyms: *Nardostachys jatamansi* DC

**Nepali name:** Jatamansi, Bhulte, Jataman

Spikenard is the English name for this plant.

Jatamansi, Balchhad, and Bhulte are some of the trade names for this plant.



**Table-1: Plant parts, different extracts and their biological activities.**

Plant Part	Extract	Activity	Reference
Leaves	Crude extract	Constipation	Khan and Gilani, 2011
	Crude extract and subsequent fractions	Enzyme inhibition activity	Khuda et al., 2014
Roots	Extract in dichloromethane	Neurodegeneration	Vishwakarma et al., 2014
	Essential oil, methanolic chloroform and aqueous extract	Antioxidant activity	Thusoo et al., 2014
Rhizome	Aqueous and methanoic extract	Anti-inflammatory activity	Shubhan et al., 2007
	Oil and extract	Antioxidant activity	Pandian and Nagarajan et al., 2015
Whole plant	Hydrodistilled oil	Topical anti-inflammatory activity	Agnihotri et al., 2011
	Ethanollic extract	Anxiety	Yan et al., 2011

### *N. jatamansi* botany and taxonomy

*Jatamansi* is the most well-known of the herbs listed in the literature. The plant has several stems that are 15–45 cm long. Leaves are of two types, radical and cauline. Radical leaves are cordate–ovate, 2.5–8 cm, toothed or sinuate, long-stalked, while cauline leaves are few, small, entire, or lobulate (Bell, 2004). Flowers are white or tinged with pink and occur in flat-topped corymbose clusters on erect, nearly leafless peduncles. Flowers are unisexual; male and female flowers appear on different plants. The fruit is small, about 4 mm in length, coated and flavours (Weberling et al., 1975). Corolla is funnel-shaped with five lobes. Fruits are crowned with a persistent pappus-like calyx. Flowering and fruiting occur from March–April. Seeds ripen in April–May. The oil is greenish in colour and has a terrible musk pod-like odor (Pradhan and Paudel, 2014).

### OCCURRENCE AND DISTRIBUTION

The *jatamansi* species is found in subalpine to alpine environments. The herb grows best between 3300 and 5000 meters above sea level (Nayar et al., 1988). The *N. jatamansi* plant is critically endangered and a few others are due to over-exploitation of the rhizome. *Jatamansi* production trials at three altitudes (low-1800 m, intermediate-2200 m, and natural environment-3600 m) using vegetative propagules and seedling transplantation procedures under various treatments (Nautiyal et al., 2003).

### PHYTOCHEMISTRY

Both volatile and non-volatile components have been found in *N. jatamansi*. Sesquiterpenes make up the majority of volatile chemicals, while nonvolatile extracts are dominated by sesquiterpenes, coumarins, lignans, alkaloids, and steroids (Chatterjee et al., 1997; Rastogi et al., 1990).

Sesquiterpene was later discovered in abundance in both groups, with higher levels of accumulation. *Jatamansone* is a sesquiterpene that can be found in concentrations as high as 0.7 percent. The chemical contents of *N. jatamansi* and discovered a new sesquiterpene acid, nardin as well as a new pyranocoumarin. Several coumarins were already discovered apart from these two (Hoerster et al., 1977; Rastogi, 1991; Singh et al., 2009). The roots of the *jatamansi* plant contain significant amounts of sesquiterpenes and coumarins, which are primarily responsible for the needed oil. This plant's major secondary metabolite are dihydro *jatamansin*, *jatamansinol*, *seselin*, *oroselone*, *nardostachyin*, *jatamansic acid* *nardosinone*, *jatamol A*, *jatamansinone*, *valeranal*, *spirojatamol* *Actinidine* is another alkaloid that has been discovered (Rucker et al., 1978; Rucker et al., 1993; Bagchi et al., 1990) (Table-1).

### PLANT REPRODUCTION

According to Pant et al. (2021b), the plant will be cultivated *in vitro* concentration at the different concentrations of phytohormone (BAP, IBA, Kinetin and NAA). Seeds and rhizome cuttings can both be used to propagate *N. jatamansi* with the former being the preferred method. Seeds treated with gibberellic acid (GA3) for 48 hours and rhizomes also treated with GA3 for 48 hours both show rapid germination. Sand: farmyard manure (1:1:1) media have been shown to be appropriate in October at lower altitudes and in May at higher elevations (Chauhan and Nautiyal, 2007).

### BIOLOGICAL PROCESSES

**Antioxidant activity:** *N. jatamansi* causes organisms to become more resistant to stress. Restraint stress (RS) is one of the most common stressors in experimental medicine. The outcome of *N. jatamansi* on RS-induced alterations in several indices, along with the act of its

antioxidant activity rats were given different quantities of ethanolic extracts of *N. jatamansi*, tracked by five days of immobilization stress. No clinical indication of toxicity was seen in rats given varying amount of NJE, and an *in vitro* investigation revealed NJE's free radical scavenging capability, as indicated by its low IC<sub>50</sub> value (Bhattacharya et al., 1999).

The antioxidant properties of *N. jatamansi* root aqueous extract were investigated. Haloperidol was given to male albino rats to induce catalepsy. However, all drug-treated groups showed a substantial reduction in cataleptic ratings and appear greatest reduction. (Lyle et al., 2009; Rasheed et al., 2010).

**Nootropic:** In both young and old mice, the ethanolic extract of *N. jatamansi* was given in different quantities; the extract improved remembrance in young mice, whereas in older animals, it restored age-related forgetfulness. As a result, *N. jatamansi* could be a beneficial drug in the treatment of dementia in the elderly (Joshi et al., 2006; Karkada et al., 2011).

**Nervous system:** *In vitro* activity of methanolic and successive water extracts of *N. jatamansi* and for *in vitro* acetylcholinesterase activity in the nervous system water extracts were appear to be fewer activity than other types of extracts like methanolic (Vinutha et al., 2007).

**Antidepressant activity:** Rats have given an alcoholic preparation of the roots of *N. jatamansi* DC. Serotonin (5-HT), 5-hydroxyindoleacetic acid (5-HIAA) nor-

epinephrine (NE), dopamine (DA) were given to examine how they were affected. Acute oral administration of NE and DA did not affect the levels of 5-HT and 5-HIAA, but it significantly elevated the levels of 5-HT and 5-HIAA (Prabhu et al., 1994).

## MEDICINAL CHARACTERISTICS AND USES OF *JATAMANSI*

The plant has been used since ancient times for various medicinal purposes, and it is a highly regarded healing system in Ayurveda (Bhatt et al., 2015). Only a few clinical trials have been carried out (Sahu et al., 2016). Because of its antioxidant properties, it takes action to boost memory and avoiding cell damage helps with anxiety and sleeplessness (Suriya et al., 2016). Purnima et al. (2015) describe that because of its antifungal and antioxidant properties, using Jatamansi oil on the skin improve infections and prevents aging. Jatamansi also promotes hair growth by increasing follicular size and lengthening the hair growth period. Hair growth can be enhanced by using Jatamansi oil Nakoti et al., 2006. Hair can also benefit from jatamansi root paste, which helps to strengthen and grow hair (Gottumukkala et al., 2011; Patel et al., 2015) Many medicinal property is found in *N. jatamansi* plant oil is used to smooth, and healthy hair; cure disorder of illness, loss of balance, mental disorders, heart problem and many other various problems (Figure-2; Joshi et al., 2006; Razack et al., 2012; Jadhav et al., 2009).

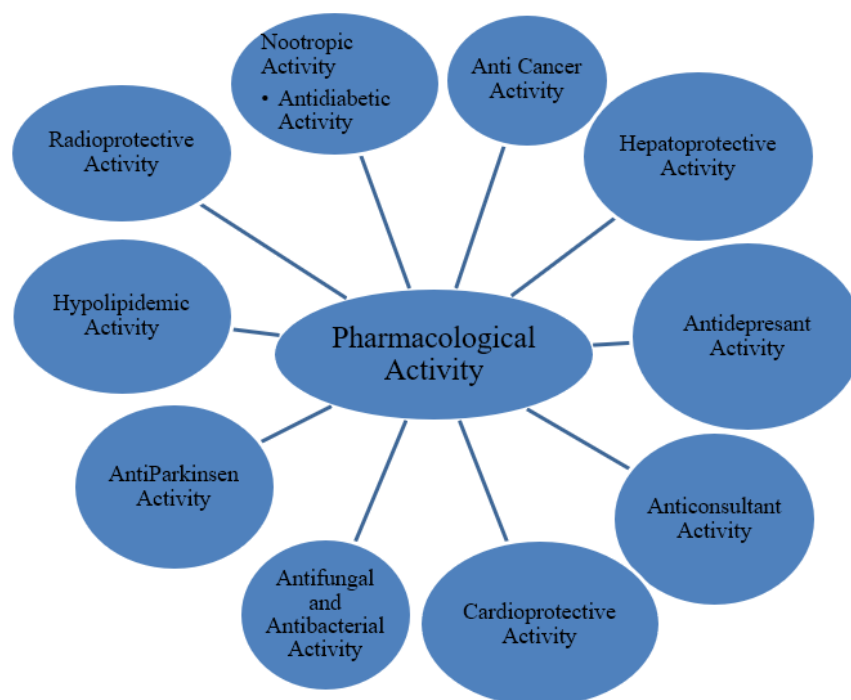


Figure-2: Different Pharmacological activities of *N. jatamansi* plant.

### ***N. Jatamansi* has many benefits some are:**

1. **Anxiety:** The herb *jatamansi* can help with anxiety symptoms. The imbalance of the body is the primary cause of anxiety. Anxiety symptoms can be alleviated with the use of *jatamansi*. This is owing to its Tridosha balancing property as well as a unique Medhya impact.
2. **Epilepsy:** *Jatamansi* is used to treat epilepsy symptoms. Epilepsy is known as Apasmara in Ayurveda. Seizures are a common occurrence in epileptic patients. A seizure occurs when the brain experiences aberrant electrical activity, which causes uncontrollable and rapid body movements. It is possible that this will result in unconsciousness.
3. **Sleeplessness:** *Jatamansi* can help you have a good night's sleep. According to Ayurveda, renders the nervous system sensitive, resulting in insomnia. Because of its balancing properties, *jatamansi* soothes the nervous system.
4. **Memory Problems:** When administered on a regular basis, *jatamansi* aids in the management of memory loss symptoms. *Jatamansi* improves memory and provides immediate mental alertness.
5. **Healing of wounds:** *Jatamansi* and its oil promotes rapid wound healing, reduce swelling, and restores the skin's natural texture. The combination of *Jatamansi* oil with coconut oil aids wound healing and lowers inflammation.
6. **Anti-Wrinkle Treatment:** Wrinkles appear because of age, dry skin, and a lack of moisture in the skin. According to Ayurveda *jatamansi* and its oil aid to reduce wrinkles and boosting the skin's moisture content. It also aids in the removal of excessive dryness, softens, and nourishes the skin.
7. **Loss of hair:** When applied to the scalp, *jatamansi* oil helps to reduce hair loss and encourage hair growth. This is owing to the fact that hair loss is mostly caused by an in the body. *Jatamansi* or its oil helps to prevent hair loss. It also encourages hair development and eliminates dryness (Pant et al., 2020)
8. **Antidepressant:** Because *jatamansi* extract has antidepressant properties, it may be good for persons who are depressed due to sleep disorders (Sahu et al., 2016).
9. **Antihyperglycemic:** In a rat model, the rhizome of *jatamansi* showed a significant antihyperglycemic effect.
10. **Anticonvulsant:** The roots of *jatamansi* increased the seizure threshold significantly.
11. **Anticancer Agent:** A 95 percent ethanolic extract of the roots of *jatamansi* was found to have a strong inhibitory effect on the proliferation of neuroblastoma cell lines in an in vitro research.
12. **Internal uses:** *Jatamansi* affects the digestive, circulatory, urinary, neurological, and skin systems, as well as the reproductive system.
13. **Nervous system:** *Jatamansi* primarily affects the nervous system. It is a tonic for the mind and body. It is known as *bhutaghna* or *rakshoghna* because it is effective in treating convulsions and pain, as well as epilepsy, hysteria, and syncope. The bulbous root, flowers are also used as a brain tonic in various conditions, and it is useful in memory loss. One of the best sedatives for headaches is *jatamansi*.
14. **Circulatory system:** Cardiac depressive and hypotensive medication for the circulatory system. The best drug for anasarca and hypertension is *jatamansi*.
15. **Digestive system:** It acts as an appetizer, digestive laxative, and cholagogue, and is beneficial during pregnancy. It possesses *vataprashaman karma* and is an analgesic and laxative. *Jatamansi* is utilised for loss of appetite, stomach distension, abdominal pain, and amoebiasis because of this karma. By acting as a cholagogue, it can also help with liver enlargement and jaundice.
16. **Urinary system:** It stimulates the kidneys and increases micturition, making it useful in the treatment of dysuria and cystitis.

### **CONCLUSION**

This review presents all of the available information on this critically endangered medicinal plant species, highlighting the significant knowledge gap in key areas of its biology. *N. jatamansi* is a medicinal plant with a wide range of uses. It is a significant herb in Ayurvedic medicine. According to the current review, *N. jatamansi* possesses a wide range of biological activities, boosting its use. Because of its therapeutic characteristics, it is a very beneficial plant. *N. jatamansi* is a significant medicinal plant used in the Ayurvedic and Unani systems to treat a variety of ailments. The various animal experiments show a considerable influence on the various activities outlined in traditional treatises.

## REFERENCES

- Airi, S., Rawal, R.S., Dhar, U. and Purohit, A.N. (2000). Assessment of availability and habitat preference of *jatamansi*- a critically endangered medicinal plant of west Himalaya. *Curr Sci.* **79**: 1467- 1470.
- Arora, R.B., Singh, K.P., Das, P.K. and Mistry P.N. (1958). Prolonged hypotensive effect of the essential of *N. jatamansi*. *Arch Intern Pharma Ther.* **113**:367-376.
- Bagchi, A., Oshima, Y. and Hikino, H. (1990). Spirojatamol, a new skeletal sesquiterpenoid of *Nardostachys jatamansi* roots. *Tetrahedron.* **46**:1523-1530.
- Bell, C.D. (2004). Preliminary phylogeny of Valerianaceae (Dipsacales) inferred from nuclear and chloroplast DNA sequence data. *Mol Phylogenet Evol.* **31**:340-350.
- Bhatt, M. and Kothiyal, P. (2015). A review article on phytochemistry and pharmacological profiles of *Nardostachys jatamansi* DC-medicinal herb. *Journal of Pharmacognosy and Phytochemistry.* **3(5)**: 102-106.
- Bhattacharya, D. and Sur, T.K. (1999). Effects of Panax Gin-sen and diazepam on nor epinephrine levels in whole brain and hypothalamus during stress. *Indian J Pharmacol*; **31**:124-127.
- Chatterjee, A. and Pakrashi, S.C. (1997). The Treatise on Indian Medicinal Plants *National Institute of Science Communication: New Delhi.* 99-101.
- Chauhan, R. S. and Nautiyal, M. C. (2007). Seed germination and seed storage behaviour of *Nardostachys jatamansi*: An endangered medicinal herb of high altitude Himalaya. *Curr. Sci.* **92(11)**:1620–1624.
- Digvijay, G.K., Netaji, T.N., Nitin, B.G. and Shrinivas, K.S. (2014). Evaluation of diuretic activity of ethanolic and petroleum ether extracts of *Nardostachys jatamansi* DC roots in rats. **5(4)**:27-31
- Gottumukkala, V.R., Annamalai, T. and Mukhopadhyay, T. (2011). Phytochemical investigation and hair growth studies on the rhizomes of *Nardostachys jatamansi* D.Pharmacogn Mag. **7(26)**: 146–150.
- Hoerster, H., Ruecker, G. and Tautges, J. (1977). Valeranone content in the roots of *Nardostachys jatamansi* and *Valeriana officinalis*. *Phytochem.* **1**:1070-1071.
- Jadhav, V.M., Thorat, R.M. and Kadam, V.J. (2009). Herbal anxiolyte: *Nardostachys jatamansi*. *Journal of Pharmacy Research.* **2 (7)**:1208-1211
- Jha, S.V., Bhagwat, A.M. and Pandita N.S. (2012). Pharmacognostic and Phytochemical studies on the rhizome of *Nardostachys jatamansi* DC. Using different extracts. *Journal of Pharmacognosy.* **4(33)**: 16-23.
- Joshi, H. and Parle, M. (2006). *Nardostachys jatamansi* improves learning and memory in mice. *J Med Food.* **9**:113-8.
- Karkada, G., Shenoy, K.B., Halahalli, H. and Karanth, K.S. (2011). Differential effect of *Nardostachys jatamansi* rhizome extract on acetylcholinesterase in different regions of brain in rats under chronic stress. *Biomedicine.* **31**:13-21.
- Khuda, F., Iqba, Z., Khan, A., Zakiullah, Shahand, Y. and Khan, A. (2014). Screening of selected medicinal plants for their enzyme inhibitory potential – A validation of their ethno pharmacological uses. *Pak. J. Pharm. Sci.* **27(3)**:593-596
- Kirthikar, K.R. and Basu, B.D. (1993). Indian Medicinal Plants. *Mahendra Pal Singh BS, editor.* **2**: 1307.
- Lyle, N., Bhattacharya, D., Sur, T.K., Munshi, S., Paul, S. and Chatterjee, S. (2009). Stress modulating antioxidant effects of *Nardostachys jatamansi*. *Indian J of Biochem Biophys.* **46**:93-98.
- Nakoti, S.S., Juyal, D. and Josh, A.K. (2017). A review on pharmacognostic and phytochemical study of a plant *Nardostachys Jatamansi*. *The pharma innovation journal.* **6(7)**: 936-941.
- Nautiyal, B.P., Chauhan, R.S., Prakash, V., Purohit, H. and Nautiyal, M.C. (2003). Population studies for the evaluation of germplasm and threat status of the alpine medicinal herb *Nardostachys jatamansi*. *Plant Genet Resour News Lett.* **136**:34-39.
- Nayar, M.P. and Sastry, A.R.K. (1988). Red Data Book of Indian Plants, vol. II. *Botanical Survey of India, Calcutta.*
- Pandian, D.S. and Nagarajan N.S. (2015). Comparison of Chemical Composition and Antioxidant Potential of Hydrodistilled Oil and Supercritical Fluid CO<sub>2</sub> Extract of *Valeriana wallichii* DC. *Journal of Natural Products and Resources.* **1(1)**: 25–30
- Pant, H.C., Bisht, V.S., Pant, H.V., Kumar, A., Gaurav, N. (2020). A review on experimental analysis and *In vitro* propagation of *Nardostachys jatamansi*. *European Journal of Biotechnology and Bioscience.* **8(5)**: 01-05.
- Pant, H.C., Pant, H.V., Kumar, A., Tomar, H., Sharma, M.D., and Gaurav, N. (2021a). *In vitro* clonal propagation of *Nardostachys jatamansi*: A Traditional Himalayan medicinal plant. *Journal of Mountain Research.* **16(3)**:87-98.
- Pant, H.C., Tyagi, M., Sharma, M.D., Pant, H.V., Kumar, A. and Gaurav, N. (2021b). Collection practices of Himalayan medicinal plants (*Nardostachys Jatamansi*): Ancient, Ayurveda, traditional and present application. *International Journal of Botany Studies.* **6(2)**:18-21
- Patel, S., Sharma, V. and Chauhan, N.S. (2015). Hair Growth: Focus on Herbal Therapeutic Agent. *Current Drug Discovery Technologies.* **12**.



- Prabhu, V., Karanth, K.S. and Rao, A. (1994). Effects of *Nardostachys jatamansi* on biogenic amines and inhibitory amino acids in the rat-brain. *Planta Med.* **60**:114-117.
- Pradhan, R. and Paudel, K. (2014). Seasonal variation of the essential oil of *Nardostachys grandiflora* DC. *Bull. Dept. Pl. Res.* No. **36**: 76-78.
- Prakash, S. (2015). A review article on pharmacognostic and pharmacological profiles of *jatamansi* (*Nardostachys jatamansi* dc). An International Peer Reviewed. *Ayurved Journal.* **2**:1-10.
- Rajnish, K.S., Vaishali, K.P., Padala, N.M., Ghanashyam, P. and Pramod, K. (2014). Evaluation of anti-inflammatory potential of *Nardostachys jatamansi* rhizome in experimental rodents. *Journal of coastal life medicines.* **2**(1):38-43.
- Rao, V.S., Rao, A. and Karanth, K.S. (2005). Anticonvulsant and neurotoxicity profile of *Nardostachys jatamansi*. *J Ethnopharmacol.* **102**:351-356.
- Rasheed, A.S., Venkataraman, S., Jayaveera, K.N., Fazil A.M., Yasodha, K.J. and Aleem, M.A. (2010). Evaluation of toxicological and antioxidant potential of *Nardostachys jatamansi* in reversing haloperidol-induced catalepsy in rats. *Int J Gen Med.* **3**:127-136.
- Rastogi, R.P. and Mehrotra, B.N. (1990). Compendium of Indian Medicinal Plants, CDRI: Lucknow/PID, *CSIR: New Delhi.* **1**: 286-287.
- Rastogi, R.P. and Mehrotra, B.N. (1991). Compendium of Indian Medicinal Plants, CDRI: Lucknow/PID, *CSIR: New Delhi.* **2**:480.
- Rautela, I., Dhiman, M., Sharma, M.D. and Misra, P. (2018) In vitro regeneration of medicinal plant *Ephedra gerardiana*. *Int J Pharm Sci & Res;* **9**(3): 1183-88.
- Rucker, G., Paknikar, S.K., Mayer, R., Breitmaier, E., Will, G. and Wiehl, L. (1993). Revised structure and stereochemistry of *jatamansic acid*. *Phytochem.* **33**:141-143.
- Rucker, G., Tautges J., Sleck, A., Wenzl, H. and Graf, E. (1978). Isolation and pharmacological activity of the sesquiterpene valeranone from *Nardostachys jatamansi* DC. (in German). *Arzneim Forsch.* **28**:7-13.
- Sahu, R., Dhongade, H.J., Pandey, A., Sahu, P., Sahu, V., Patel, D. and Kashyap, P., (2016). Medicinal properties of *Nardostachys jatamansi* (a review). *Oriental Journal of Chemistry,* **32**(2): 859-866.
- Sakshima Thusoo, Sahil Gupta, Rasleen Sudan, Jaspreet Kour,
- Sakshima Thusoo, Sahil Gupta, Rasleen Sudan, Jaspreet Kour,
- Sakshima Thusoo, Sahil Gupta, Rasleen Sudan, Jaspreet Kour,
- Sharma, N., Rautela, I. and Sharma, M.D. (2016). Mass Propagation and GC-MS Analysis of Critically Endangered Plant *Withania Coagulans*. *International Journal of Applied Biology and Pharmaceutical Technology* **7**(2): 64-70.
- Singh, A., Kumar, A. and Duggal, S. (2009). *Nardostachys jatamansi* DC. Potential herb with CNS effects. *J Pharm Res Health Care.* **1**:276-290.
- Suriya, F. (2016). *Nardostachys jatamansi* - A transformational bridge between earth and heaven. *ITHMA-London.*
- Toolika, E., Ravi, M., Narayana, P.B., Suhas, K.S., Ravishankar, B. and Savitha, H.P. (2015). A comparative pharmacological study on the effect of *Tagara* (*Valeriana wallichii*) and *Jatamansi* (*Nardostachys jatamansi*) in the management of anidra w.s.r to primary insomnia. *The Journal of Phytopharmacology.* **4**(3):147-151.
- Vinutha, J.P. (2007). Acetyl cholinesterase inhibitory activity of methanolic and successive water extracts of *Nardostachys jatamansi*. *Indian J. Pharmacol.* **23**:127-131.
- Vishwakarma, S.K., Bardia, A., Tiwari, S.K., Syed, A.B., Paspala, and Khan A.A. (2014). Current concept in neural regeneration research: NSCs isolation, characterization and transplantation in various neurodegenerative diseases and stroke: A review. *J. Adv Res.* **5**(3): 277-294.
- Weberling, F. (1975). On the Systematics of *Nardostachys* (*Valerianaceae*). *Taxon;* **24**: 443-452.