REVIEW ARTICLE

Nardostachys jatamansi: A Review on Extraction Isolation Bioactivities of Phytoconstituents Chemical Structures and Traditional Uses

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ABSTRACT

Nardostachys jatamansi, commonly known as "*jatamansi*," is a perennial herbaceous plant renowned for its medicinal properties. The rhizomes of *N. jatamansi* have been traditionally used in various medicinal practices owing to their therapeutic benefits. This abstract delves into the extraction process and isolation of phytoconstituents from *N. jatamansi* rhizomes, elucidating the extraction, purification, and structural analysis methods. The extraction of bioactive compounds from *N. jatamansi* rhizomes commonly employs soxhlet extraction, percolation, and maceration extraction techniques. These methods enable the efficient extraction of phytoconstituents from the plant material, ensuring optimal yield and purity. *N. jatamansi* has a rich history of traditional uses, including its application in Ayurvedic and traditional medicine systems for its diverse therapeutic properties. The rhizomes are reputed for their efficacy in treating various ailments, such as anxiety, insomnia, epilepsy, and gastrointestinal disorders. Furthermore, the bioactivity of isolated phytoconstituents from *N. jatamansi* rhizomes has been extensively studied. These bioactive compounds exhibit a range of pharmacological activities, including neuroprotective, anti-inflammatory, antioxidant, and antimicrobial effects. Structural elucidation of these phytoconstituents through advanced analytical techniques provides insights into their chemical composition and potential therapeutic mechanisms. The study concludes that the extraction, purification, and structural analysis of phytoconstituents from *N. jatamansi* rhizomes contribute to understanding its medicinal properties and pave the way for developing novel therapeutics with diverse pharmacological applications.

Keywords: Bioactivity, Extraction process, *Nardostachys jatamansi*, Phytoconstituents, Traditional uses.

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INTRODUCTION

Within the Valerianacae family, *Nardostachys jatamansi* is one of the rarest and most ancient species. It is tiny, dwarf, hairy, perennial, rhizomatous, and herbaceous. Distributed throughout the Himalayas from Pakistan, India (including Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim), Nepal, Tibet, and China, these regions demonstrate the historical and contemporary applications of homeopathy, Ayurveda, ethnomedicine, and the Indian System of Medicine (ISM). There are three forms of polyploidy in *Verbena officinalis*: diploid, tetraploid, and octaploid. Tatamansi Nardostachys D.C. The herb known as "spikenard" is a woody rootstock that is tall and robust, coated with fibers from the petioles of withered leaves. It grows naturally at an altitude of 11–17 thousand feet in the Himalayan areas, rising eastward through Punjab, Kumaon, Sikkim, and Bhutan.[1]

Jatamansi is mentioned in various ancient writings, such as the Sushruta Samhita, Nighantus Chikitsagranthas, and Charaka Samhita, indicating its importance in the classics of Ayurveda. Sangyasthapana talks about its qualities in the Charaka Samhita, while Mahakashaya serves as Hikkashwasa's dhumvarti in Kushtha. Hriveradighrita is used to treat illnesses such as Arsha and Kasa. Furthermore, Mahaishachikaghrita is used in unmade. It is known as Kumararasayana in the Sushruta Samhita.[2-5]

The plant was first known by the name Valeriana in the ninth and eleventh centuries. Ancient medical traditions such as Ayurveda in India, Unani in ancient Greece and Arabia, and the medical systems of ancient Egypt and Rome have all acknowledged the great therapeutic efficacy of jatamansi throughout history. Its enduring significance underscores its longstanding reputation as a therapeutic herb with multifaceted applications in traditional medicine systems across different cultures and civilizations.[6, 7]

The powdered root of *N. jatamansi* is significant in some Islamic traditions; it is said to symbolize the fruit that Adam

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ate in heaven, even though God forbade it. The plant gains additional spiritual significance from this esoteric connection. Furthermore, *N. jatamansi* was used to season food in medieval European cuisine, especially as a component of spice mixes that were used to flavor meals. Notably, realizing the plant's potential health advantages, Hippocrates, the ancient Greek physician sometimes hailed as the founder of medicine, included the herb to wine concoctions that were spiced and sweetened. The medicinal qualities of the rhizomes of *N. jatamansi* are highly valued in the Ayurvedic medical system. They are employed as a bitter tonic to stimulate digestion, as a stimulant, and to address conditions such as epilepsy, antispasmodic, and hysteria. This extensive usage across diverse cultures and historical periods underscores the plant's versatility and perceived medicinal value, making it a revered botanical in traditional medicine systems worldwide.[8-10]

Extraction Process and Isolation of Phytoconstituents

The finely powdered *N. jatamansi* was air-dried and extracted in 90% ethanol. The extraction process employed a soxhlet extractor, which allowed for the effective extraction of bioactive chemicals over 72 hours at temperatures between 50 and 60°C. A concentrated extract was created by cooling the liquid extract after extraction and using a rotary evaporator to concentrate the solvent content.[11-13]

The method for isolating and purifying bioactive compounds is as follows:[14-17]

Extraction

This is the initial step where solvents extract bioactive compounds from the natural source material. Different solvents can be used depending on the targeted compounds' properties.

Separation and refinement

After extraction, the crude extract may contain a mixture of compounds. Separation techniques such as column chromatography can be employed to isolate the desired bioactive compounds from the mixture. Column chromatography separates compounds based on their different affinities for the stationary phase within the column.

Purification

Once separated, the bioactive compounds may still contain impurities. Purification steps are necessary to obtain highly pure compounds. High-pressure liquid chromatography (HPLC) is a powerful tool for this purpose. It allows for the separation of compounds based on their differential interaction with the stationary phase under high pressure, enabling faster and more efficient purification compared to traditional chromatographic methods.

Identification

After purification, the isolated compounds undergo a crucial phase of identification, where spectroscopic techniques play a vital role. Mass spectrometry, nuclear magnetic resonance (NMR), infrared (IR), and UV-visible spectroscopy are among the commonly utilized methods for this purpose. Each technique offers unique insights into the compounds' molecular structure, composition, and properties, facilitating researchers in confirming their identity and elucidating their characteristics.

UV-visible spectroscopy involves the measurement of the absorption of ultraviolet and visible light by the compound. This technique provides insight into the electronic transitions occurring within the molecule, aiding in the identification of chromophores and functional groups. By comparing the absorption spectra with known standards, researchers can confirm the identity and purity of the compounds.[18]

Infrared (IR) spectroscopy measures the absorption of infrared radiation by the compound, providing information about the functional groups present in the molecule. Each functional group absorbs infrared radiation at characteristic frequencies, allowing for the identification of specific chemical bonds and confirming the molecular structure.[19]

Nuclear magnetic resonance (NMR) spectroscopy relies on the interaction between nuclei with spin and an external magnetic field. It provides detailed information about the molecular structure, including the connectivity of atoms, stereochemistry, and molecular dynamics. By analyzing the signals generated by different atomic nuclei within the molecule, one can deduce its structure and confirm its identity.[20]

Mass spectrometry enables the determination of the molecular weight and structural information of the compounds by ionizing them and analyzing the mass-to-charge ratios of the resulting ions. This technique helps in identifying the elemental composition and structural features of the molecules.[21]

The outlines of the procedure are depicted in Figure 1.

The popular methods adopted in the extraction of the *N. jatamansi* rhizomes are represented in Table 1.

The Common Methods Adopted in The Extraction of *Nardostachys jatamansi* Rhizomes

Soxhlet extraction

It is a technique used for the extraction of soluble components from a solid material into a solvent. It is commonly employed in

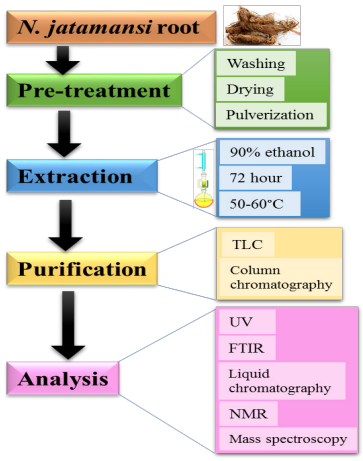


Figure 1: The procedure of extraction, purification, and structural analysis of *Nardostachys jatamansi* rhizome

Table 1: The prevalent procedure approved in the extraction of *Nardostachys jatamansi* rhizomes

Methodology
The methodology involved the soxhlet process
95% ethyl alcohol was used as the extraction solvent for 7–8 hours[22]
95% ethanol is used as the extraction solvent[23]
Using 95% ethanol as the extraction solvent for 7–8 hours[24]
95% ethanol is used as the extraction solvent[25]
95% ethanol was used as the extraction solvent for 7–8 hours[26]
90% ethanol as the extraction solvent, heated to 50–60°C for 72 hours[27]
90% ethanol as an extraction solvent[28]
90% ethanol as solvent for extraction[29]
90% ethanol as solvent for extraction[30]
90% ethanol as solvent for extraction and fractioning with n-hexane, chloroform, n-butanol and water[31]
80% ethanol as solvent for extraction at 60–70ºC for 6 hours[32]
80% ethanol as solvent for extraction at 60–70ºC for 6 hours[33]
75% ethanol is used as the extraction solvent[34]
75:25 and 50:50 ethanol as a solvent for extraction[35]
70% ethanol as solvent for extraction at 50–60ºC for 72 hours[36]
50% ethanol as a solvent for extraction at 60°C for 18 hours[37]
50% ethanol as a solvent for extraction[38]
50% ethanol as a solvent for extraction[39]
50% ethanol as a solvent for extraction[40]
50% ethanol as a solvent for extraction[41]
80% ethanol as a solvent for extraction at 90ºC[42]
50% ethanol as a solvent for extraction[43]
Methodology involved the maceration process
90% ethanol as a solvent for extraction[44]
50% ethanol as a solvent for extraction[45]
90% ethanol as a solvent for extraction[46]
90% ethanol and 10% acetic acid (9:1) used as a solvent[47]
90% ethanol as solvent at 95ºC for 90 minutes[48]
90% ethanol as a solvent for extraction[49]
90% ethanol as solvent at 90ºC for 16 hours[50]
90% ethanol as a solvent for extraction[51]
90% ethanol as a solvent for extraction[52]
90% ethanol as a solvent for extraction[53]
90% and 50% ethanol as solvent for extraction[54]
80% ethanol as a solvent for the extraction[55]
80% ethanol by cold maceration at room temperature[56]
80% ethanol, chloroform, and acetone as solvents for cold maceration at room temperature[57]
Methodology involved the percolation process
99.9% ethanol, petroleum ether, chloroform, and ethyl acetate[58]
90% ethanol as solvent at 60–80ºC[59]
80% ethanol at room temperature[60]
70% ethanol at room temperature[61]
50% ethanol at room temperature[62]
Methodology involves a combination process
90% ethanol as a solvent for extraction using hot percolation and cold maceration[63]
70% ethanol as a solvent by percolation and maceration[64]
90% ethanol as a solvent for extraction by both cold maceration and soxhelation[65]
70% ethanol as a solvent by maceration, percolation, and soxhlet extraction[66]
90% ethanol as a solvent by maceration, percolation, and soxhlet extraction[67]

chemistry laboratories for the extraction of organic compounds from a solid matrix.

The setup typically consists of a soxhlet extractor, a condenser, a round-bottom flask, and a heating source. Here's how the process generally works:

- *Solid sample preparation*

The *N. jatamansi* rhizomes are finely ground or chopped into small pieces to increase the surface area available for extraction.

- *Extraction*

The *N. jatamansi* rhizomes are laced in a porous thimble made of filter paper or cellulose, which is then loaded into the soxhlet extractor. The extractor is filled with the extraction solvent.

- *Heating and cycling*

The solvent is heated, causing it to vaporize and rise into the condenser. As the vapor cools in the condenser, it condenses back into liquid form and drips back into the soxhlet extractor. This process continues cyclically: the solvent repeatedly evaporates, condenses, and drips back into the sample. This cycle allows for efficient extraction of the target compounds from the solid sample.

- *Collection*

The condensed solvent, now containing the extracted compounds, accumulates in the round-bottom flask positioned below the Soxhlet extractor. The process continues until a satisfactory level of extraction is achieved.

Soxhlet extraction is particularly useful for extracting compounds that have low solubility in the extraction solvent or for separating mixtures of compounds with varying solubilities. It's widely used in various fields such as pharmaceuticals, food analysis, environmental analysis, and natural product extraction in chemistry research.

Percolation

It is a method of extracting soluble components from a solid material using a solvent by passing the solvent through the solid material in a continuous flow. It's often used in the extraction of active compounds from plant material or the preparation of herbal extracts. Here's a general procedure for percolation extraction:

- *Preparation of solid material*

The solid material (*N. jatamansi* rhizomes) is placed in the percolator. The particle size may vary depending on the specific requirements of the extraction process.

- *Assembly of percolator*

The percolator consists of a vessel with a perforated plate or a filter at the bottom to hold the solid material (*N. jatamansi* rhizomes). Above the solid material, there is space for the solvent to pass through. At the top of the percolator, there's an outlet for the solvent.

- *Saturate the solid material*

Initially, the solid material is saturated with the solvent to ensure even distribution and thorough extraction. This can be done by pouring the solvent over the solid material and allowing it to soak for some time.

- *Continuous flow of solvent*

Once the solid material is saturated, a continuous flow of the solvent is introduced into the percolator. The solvent passes through the solid material, dissolving the soluble components and carrying them along.

- *Collection of extract*

As the solvent percolates through the solid material, it picks up the dissolved compounds and exits through the outlet at the bottom of the percolator. The solvent containing the extracted components is collected in a receiving vessel.

- *Monitoring and adjustment*

Throughout the extraction process, the flow rate and volume of solvent are monitored and adjusted as necessary to optimize extraction efficiency.

- *Completion of extraction*

The extraction process continues until the desired amount of solvent has passed through the solid material, or until the concentration of extracted compounds reaches a satisfactory level.

- *Concentration (Optional)*

If a concentrated extract is desired, the collected solvent extract may undergo further processing to remove the solvent and concentrate the desired compounds.

Percolation is a widely used method in various industries, including pharmaceuticals, herbal medicine, and food processing, for extracting bioactive compounds from natural sources. It offers advantages such as efficient extraction, scalability, and the ability to control extraction parameters for tailored extraction processes.

Maceration extraction

It is a simple and commonly used method for extracting compounds from plant materials (*Nardostachys jatamansi* rhizomes) using a solvent. Here's a step-by-step procedure for maceration extraction:

- *Prepare the plant material*

The plant material (*N. jatamansi* rhizomes) should be cleaned and dried if necessary. It's often recommended to grind or chop the plant material into smaller pieces to increase the surface area for extraction.

- *Select a solvent*

Choose a suitable solvent based on the properties of the compounds you want to extract. Common solvents include ethanol, methanol, water, or a mixture of these solvents depending on the polarity of the target compounds.

- *Combine plant material and solvent*

Place the prepared plant material (*N. jatamansi* rhizomes) into a clean glass container, such as a jar or beaker. Add the chosen solvent to cover the plant material completely. The ratio of solvent to plant material can vary depending on factors such as the desired concentration of the extract and the solubility of the target compounds.

- *Seal and store*

Seal the container to prevent evaporation and contamination. Store the mixture in a cool, dark place to allow for extraction to occur. The duration of maceration can range from several hours to several weeks, depending on the desired strength of the extract and the properties of the plant material.

- *Agitate or stir*

Periodically agitate or stir the mixture to enhance the extraction process. This helps to ensure that the solvent comes into contact with all parts of the plant material, facilitating the extraction of the desired compounds.

- *Filter*

After the desired extraction time has elapsed, filter the mixture to separate the liquid extract from the solid plant material. This can be done using filter paper, cheesecloth, or a fine mesh strainer.

- *Evaporation (Optional)*

If necessary, the solvent can be evaporated to concentrate the extract. This can be done using gentle heat under controlled conditions, such as a rotary evaporator or a vacuum oven.

- *Storage*

Transfer the filtered extract into a clean, airtight container for storage. Store the extract in a cool, dark place away from direct sunlight to maintain its stability and potency.

Maceration extraction is a straightforward method suitable for extracting a wide range of compounds from plant materials. It's often used in herbal medicine, natural product extraction, and botanical research.

Traditional Uses

N. jatamansi has a long history of traditional uses in various cultures, particularly in Ayurveda, traditional Chinese medicine (TCM), and Tibetan medicine. Some of the traditional uses of *N. jatamansi* include:

- Jatamansi oil is noted for its antiarrhythmic properties and is utilized as a flavoring agent in medicinal oil formulations.[68]

- In modern medicine, *N. jatamansi* is predominantly employed for its benefits in cognitive and neurological functions.[69]
- Jatamansi is known to alleviate symptoms such as vertigo and seizures during fever episodes.[70]
- Medicated jatamansi oil contributes to smooth, silky, and healthy hair.[71]
- The herb exhibits a protective effect against conditions like epilepsy, cerebral ischemia, and liver damage.[72]
- *N. jatamansi* is highly effective in managing non-specific stress manifestations.[73]
- It finds application in mental disorders, insomnia, hypertension, and heart diseases.[74]
- Used as a carminative, *jatamansi* acts as an antispasmodic in conditions such as hysteria, palpitations, convulsions, and seminal debility.[75]
- It is recommended for treating scorpion stings.[76]
- *Jatamansi* aids in increasing appetite, relieving phlegm in cough and asthma, proves beneficial in hepatitis, and addresses liver enlargement.[77]

Bioactivity of Isolated Phytoconstituents and Their Chemical Structures

The bioactivity of isolated phytoconstituents from *N. jatamansi* has been of interest to researchers due to the plant's traditional medicinal uses and potential therapeutic benefits. Some of the bioactivities associated with the phytoconstituents of *N. jatamansi* include (Table 2):

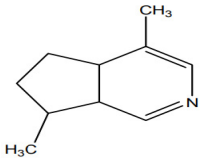
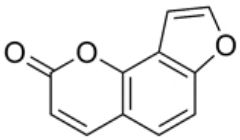
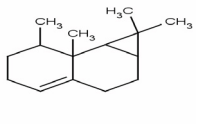
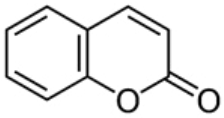
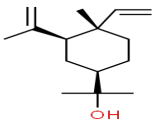
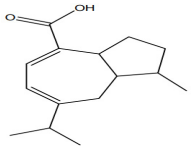
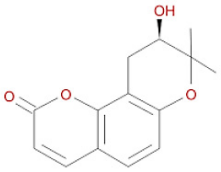
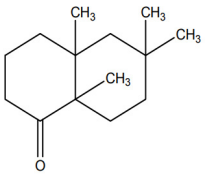
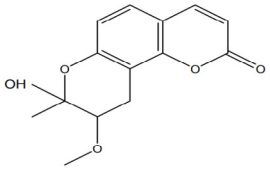
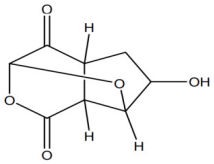
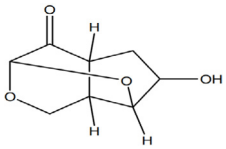
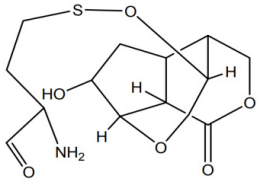
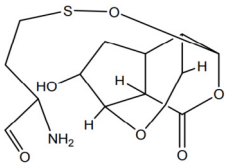
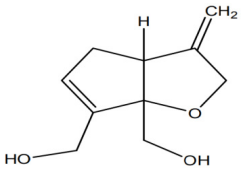
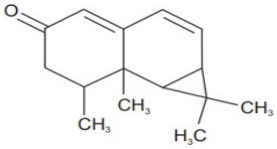
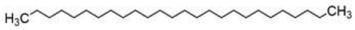
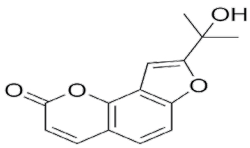
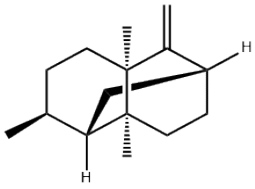
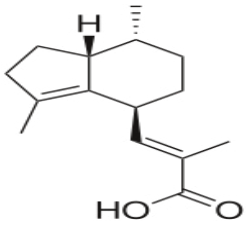
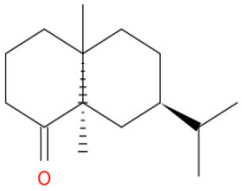
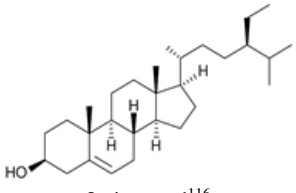
The vital contents in *N. jatamansi* rhizomes (the techniques expressed in Table 1) with their structures are illustrated in Table 3.

In addition to the above the herbaceous plant contains volatile oils, essential oils, resin, sugar and starch, bitter extractive matter, gum, ketone, steroids, alkaloids, sterols, tannins, mucilage, flavonoids, carbohydrates, gums, terpenes and glycosides.[117-120]

Table 2: The bioactivity of the phytoconstituents from *N. jatamansi*

Activity	*Description*
Antimicrobial	Strong activity was shown by the n-butanol fraction against every pathogen that was tested. Its efficacy against *Escherichia coli*, the pathogen with the highest susceptibility among the tests, was especially impressive.[78]
Anti-ulcer	Reduced gastric output, adjusted the pH of gastric juice, and decreased levels of free acidity in pyloric ligation animals to prevent the formation of ulcers, suggesting the possibility of managing gastric ulcers.[79]
Antihypertensive	The action of hydroalcoholic extract as an ACE inhibitor.[80]
Anticancer	Moderate outcomes while using these extracts for therapy, There were found morphological alterations in the cells.[81]
Insomnia	Notably sedative or hypnotically active, yet significantly anti-anxiety. This makes them more effective in treating anxiety neurosis.[82]
Anti-diabetic	Hydroalcoholic extracts in rats with diabetes caused by alloxan.[83]
Anti-diuretic	Urine and electrolyte excretion increased in a dose-dependent manner when petroleum ether and ethanol extracts were used. In comparison to petroleum ether extract, relatively greater activity was displayed by the ethanolic extract.[84]
anti-inflammatory	Protective impact against inflammatory models that are acute, subacute, and chronic.[33]
Insecticidal	Essential oils that have been water-distilled may be developed into natural fumigants or pesticides to keep insects out of grains that have been kept.[85]
Haematopoietic activity	Promoting or shielding bone marrow hematopoiesis and the rise in haematological components in peripheral blood that follows.[86]
Anti-depressant	Using well-established depression models, ethanolic extract combined with whole-body electron beam radiation caused depression in Swiss albino mice.[87]
Anticancer	Substantial anticancer efficacy in mice with solid tumours harbouring Sarcoma 180, which is similar to the gold standard 5-fluorouracil.[88]
Radioprotective	Because mice's higher levels of antioxidants and ability to scavenge free radicals.[89]
Anticataleptic	Behavioural, metabolic, and neurotransmitter levels in the haloperidol-induced catalepsy rat model of the illness using hydroalcoholic root extract.[90]
Hypertension	Extremely promising, safe, and successful medication when used in conjunction with dietary changes and lifestyle modifications to treat individuals with essential hypertension.[91]
Antibacterial and antiosidant	Only *K. pneumoniae* and *E. aerogenes* were shown to be susceptible among gram-negative bacteria. *P. aeruginosa* and *S. typhimurium,* however, were resistant. Antioxidant activity shows its capacity to lower DPPH.[92]
Antioxidant	How 70% hydroethanolic extract reduces stress.[93]
Cardioprotective	Effectiveness against doxorubicin-induced lysosomal and mitochondrial damage in rats. Its antioxidant action and the reduction of oxidative stress may be the mechanisms by which the cardioprotective effectiveness is mediated.[94]
Antianxiolytic	Jatamansone, sesquiterpenoid [0.0 2–0.1%], spirojatamol, patchouli alcohol, jatamol A and B, jatamansic acid, and nardostachone are among the elements of volatile essential oil. Other ingredients include gum, sugar, starch, resin, and bitter extractive matter.[95]

Table 3: Chemical structure of some important medicinal compounds

Structure & chemical content		
 Actinidine[96]	 Angelcin[97]	 Calarene[98]
 Coumarin[99]	 Elamol[100]	 Jatamansic acid[101]
 Jatamansinol [102]	 Jatamansone-1 [103]	 Jatamansone-2[104]
 Jatamansone-3[105]	 Jatamansone-4[106]	 Jatamansone-5[107]
 Jatamansone-6[108]	 Jatamansone-8[109]	 Nardostachone [110]
 n-hexacosane[111]	 Oroselol[112]	 Seychellene [113]
 Valeranal [114]	 Valeranone [115]	 β-sitosterol[116]

These phytochemicals contribute to the medicinal properties of *N. jatamansi*, which include anti-inflammatory, antioxidant, neuroprotective, and sedative effects, among others.

CONCLUSION

In conclusion, the extraction, purification, and structural analysis of phytoconstituents from *N. jatamansi* rhizomes shed light on the plant's remarkable medicinal properties.

Through techniques such as soxhlet extraction, percolation, and maceration extraction, bioactive compounds are efficiently extracted, ensuring optimal yield and purity. With a rich history of traditional uses in various medicinal practices, *N. jatamansi* continues to be valued for its therapeutic benefits in treating ailments ranging from anxiety to gastrointestinal disorders. Moreover, extensive studies on the bioactivity of isolated phytoconstituents reveal their diverse pharmacological activities, including neuroprotective, anti-inflammatory, antioxidant, and antimicrobial effects. Structural elucidation of these compounds further enhances our understanding of their chemical composition and potential therapeutic mechanisms. Overall, these findings pave the way for the development of novel therapeutics rooted in the rich pharmacological potential of *N. jatamansi*, offering promising prospects for future medical applications.

REFERENCES

1. Pathak S, Godela R. Nardostachys jatamansi: Phytochemistry, ethnomedicinal uses, and pharmacological activities: A comprehensive review. Fitoterapia. 2023:105764.
2. Dhiman N, Bhattacharya A. Nardostachys jatamansi (D. Don) DC.-Challenges and opportunities of harnessing the untapped medicinal plant from the Himalayas. Journal of ethnopharmacology. 2020;246:112211.
3. Kaur N, Goyal A, Sama G. Antihypertensive Drugs-Ayurvedic Perspective. Journal of Ayurveda and Integrated Medical Sciences. 2023;8(9):132-9.
4. Sharma DS, Asutkar DS. Concept of Sangyaharana (Anaesthesia) and Pain Management in Ayurveda: A Critical Review.(2023). Int J Life Sci Pharma Res.13(6):L286-L92.
5. Narayana DA, Joshi H, Tiwari VHS. Overview of approaches in ayurveda for neurological health and disorders. Ayurvedic Herbal Preparations in Neurological Disorders: Elsevier; 2023. p. 41-88.
6. Gautam RD, Kumar A, Singh S, Chauhan R, Kumar A, Singh S. A comprehensive overview of breeding strategy to improve phenotypic and quality traits in Valeriana jatamansi Jones. Heliyon. 2023.
7. Thakur BK, Mahajan M, Pal PK. Chemical Diversity of Essential Oil of Valeriana jatamansi from Different Altitudes of Himalaya and Distillation Methods. Molecules. 2022;27(8):2387.
8. Quan L-Q, Zhou Y, Liu D, Chen C-H, Li H-M, Li R-T. Iridoids and sesquiterpenoids from Valeriana jatamansi and their anti-influenza virus activities. Bioorganic Chemistry. 2022;121:105692.
9. Ma Y-L, Wu Z-M, Liu X, Lan J-E, Zai W-J, Jin X, et al. Antidiarrheal activity of the extracts of Valeriana jatamansi Jones on castor oil-induced diarrhea mouse by regulating multiple signal pathways. Journal of Ethnopharmacology. 2022;298:115560.
10. Prem P, Naveenkumar S, Kamaraj C, Ragavendran C, Priyadharsan A, Manimaran K, et al. Valeriana jatamansi root extract a potent source for biosynthesis of silver nanoparticles and their biomedical applications, and photocatalytic decomposition. Green Chemistry Letters and Reviews. 2024;17(1):2305142.
11. Xie Q, Liu G, Zhang Y, Yu J, Wang Y, Ma X. Active edible films with plant extracts: A updated review of their types, preparations, reinforcing properties, and applications in muscle foods packaging and preservation. Critical Reviews in Food Science and Nutrition. 2023;63(32):11425-47.
12. Bitwell C, Indra SS, Luke C, Kakoma MK. A review of modern and conventional extraction techniques and their applications for extracting phytochemicals from plants. Scientific African. 2023;19:e01585.
13. Antonio-Pérez A, Durán-Armenta LF, Pérez-Loredo MG, Torres-Huerta AL. Biosynthesis of copper nanoparticles with Medicinal plants extracts: from extraction methods to applications. Micromachines. 2023;14(10):1882.
14. Singh TG. Phytochemical activities and pharmacology of herbal drug: Nardostachys jatamansi. Plant Archives. 2020;20(1):3842-8.
15. Chaudhary S, Chandrashekar KS, Pai KSR, Setty MM, Devkar RA, Reddy ND, et al. Evaluation of antioxidant and anticancer activity of extract and fractions of Nardostachys jatamansi DC in breast carcinoma. BMC complementary and alternative medicine. 2015;15(1):1-13.
16. Kim K-W, Yoon C-S, Park S-J, Bae G-S, Kim D-G, Kim Y-C, et al. Chemical analysis of the ingredients of 20% aqueous ethanol extract of Nardostachys jatamansi through phytochemical study and evaluation of anti-neuroinflammatory component. Evidence-Based Complementary and Alternative Medicine. 2021;2021.
17. Krishnan N, Mariappanadar V, Dhanabalan AK, Devadasan V, Gopinath SC, Raman P. Purification, identification and in silico models of alkaloids from Nardostachys jatamansi—bioactive compounds for neurodegenerative diseases. Biomass Conversion and Biorefinery. 2023;13(16):14889-900.
18. Rashid M, ur Rahman A, Ahmad QZ, Mian SS. Physicochemical Analysis of Sumbul-al–Teeb (Nardostachys jatamansi DC) Rhizome along with its HPLC Profile. Pharmacognosy Journal. 2018;10(2).
19. Muthuraman MS, Nithya S, Christena LR, Vadivel V, Subramanian NS, Anthony SP. Green synthesis of silver nanoparticles using Nardostachys jatamansi and evaluation of its anti-biofilm effect against classical colonizers. Microbial pathogenesis. 2019;126:1-5.
20. Lin S, Zhang Z-X, Chen T, Ye J, Dai W-X, Shan L, et al. Characterization of chlorinated valepotriates from Valeriana jatamansi. Phytochemistry. 2013;85:185-93.
21. Lin S, Ye J, Liang X, Zhang X, Su J, Fu P, et al. Mass spectrometric profiling of valepotriates possessing various acyloxy groups from Valeriana jatamansi. Journal of Mass Spectrometry. 2015;50(11):1294-304.
22. Bhagat M, Pandita R, Saxena A. In vitro and in vivo biological activities of Nardostachys jatamansi roots. Med Aromat Plants. 2013;2(142):2167-0412.1000142.
23. Subashini R, Ragavendran B, Gnanapragasam A, Kumar Yogeeta S, Devaki T. Biochemical study on the protective potential of Nardostachys jatamansi extract on lipid profile and lipid metabolizing enzymes in doxorubicin intoxicated rats. Die pharmazie-an international journal of pharmaceutical sciences. 2007;62(5):382-7.
24. Salim S, Ahmad M, Zafar KS, Ahmad AS, Islam F. Protective effect of Nardostachys jatamansi in rat cerebral ischemia. Pharmacology Biochemistry and Behavior. 2003;74(2):481-6.
25. Dhingra D, Goyal PK. Inhibition of MAO and GABA: probable mechanisms for antidepressant-like activity of Nardostachys jatamansi DC. in mice. 2008.
26. Subashini R. The role of Nardostachys jatamansi against doxorubicin-induced toxicity in rats. African Journal of Biotechnology. 2013;12(49):6881-6.

27. Gowda DK, Shetty L, Krishna A, Kumari SN, Sanjeev G, Naveen P. The efficacy of nardostachys jatamansi against the radiation induced haematological damage in rats. Journal of Clinical and Diagnostic Research: JCDR. 2013;7(6):982.
28. Gowda KD, Shetty L, Krishna A, Kumari NS, Sanjeev G, Naveen P. Protective Effect of Nardostachys Jatamansi Root Extract against Radiation Induced Haematological Damage in Albino Wistar Rats. Journal of Pharmacy Research. 2011;4(10):3390-3.
29. Janardhanan A, Sadanand A, Vanisree AJ. Nardostachys jatamansi Targets BDNF-TrkB to Alleviate Ketamine-Induced Schizophrenia-Like Symptoms in Rats. Neuropsychobiology. 2017;74(2).
30. Naveen P, Kumar N, Sanjeev G, Gowda KD, Madhu L. Radioprotective effect of Nardostachys jatamansi against whole body electron beam induced oxidative stress and tissue injury in rats. J Phar Res. 2011;4:2197-200.
31. Sharma N, Sharma AR, Patel BD, Shrestha K. Investigation on phytochemical, antimicrobial activity and essential oil constituents of Nardostachys jatamansi DC. in different regions of Nepal. J Coast Life Med. 2016;4(1):56-60.
32. Ali S, Ansari KA, Jafry M, Kabeer H, Diwakar G. Nardostachys jatamansi protects against liver damage induced by thioacetamide in rats. Journal of ethnopharmacology. 2000;71(3):359-63.
33. Singh RK, Vaishali PS, Murthy PN, Panigrahi G, Sharma P. Evaluation of anti-inflammatory potential of Nardostachys jatamansi rhizome in experimental rodents. Jcoastlife med. 2014;2:38-43.
34. Rezaie A, Pashazadeh M, Ahmadizadeh C, Jafari B, Jalilzadeh HM. Study of sedative and anxiolytic effect of herbal extract of Nardostachys jatamansi in comparison with diazepam in Rats. Journal of Medicinal Plants. 2010;9(36):169-74.
35. Aleem M, Asad BS, Mohammed T, Khan RA, Ahmed MF, Anjum A, et al. Antidiabetic activity of hydroalcoholic extracts of Nardostachys jatamansi in alloxan-induced diabetic rats. British Journal of Medicine and Medical Research. 2014;4(28):4665-73.
36. KM DG, Shetty L, Krishna A, Sanjeev G, Naveen P, Sharada V. Ethanolic extract of Nardostachys jatamansi potentiates haematopoietic system in albino Wistar rats. Journal of Health and Allied Sciences NU. 2013;3(01):25-9.
37. Pokhriyal AC, Juyal D, Mukhopadhyay S, Rathaur H. Extraction and Phytochemical Investigation of Nardostachys Jatamansi and its Antioxidant Potential. Tuijin Jishu/Journal of Propulsion Technology.44(3):2023.
38. Krishna IMY, Nagar J, City RF. Effect of Hydro-Alcoholic Root Extract of ardostachys Jatamansi on Haloperidol Induced Parkinsonism in Wistar Rats.
39. Liu QF, Jeon Y, Sung Y-w, Lee JH, Jeong H, Kim Y-M, et al. Nardostachys jatamansi ethanol extract ameliorates Aβ42 cytotoxicity. Biological and Pharmaceutical Bulletin. 2018;41(4):470-7.
40. Etebari M, Zolfaghari B, Jafarian-Dehkordi A, Rakian R. Evaluation of DNA damage of hydro-alcoholic and aqueous extract of Echium amoenum and Nardostachys jatamansi. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences. 2012;17(8):782.
41. Jash R, Choudary KA, Prasanth D. Evaluation of antipsychotic activity of ethanolic extract of Nardostachys jatamansi on wistar albino rat. International Journal of Pharmaceutical Sciences and Research. 2013;4(7):2730.
42. Arya A, Chahal R, Almutairi MH, Kaushik D, Aleya L, Kamel M, et al. Green approach for the recovery of secondary metabolites from the roots of Nardostachys Jatamansi (D. Don) DC using microwave radiations: Process optimization and anti-alzheimer evaluation. Frontiers in Plant Science. 2022;13:987986.
43. Wang M, Yang T-T, Rao Y, Wang Z-M, Dong X, Zhang L-H, et al. A review on traditional uses, phytochemistry, pharmacology, toxicology and the analytical methods of the genus Nardostachys. Journal of Ethnopharmacology. 2021;280:114446.
44. Mehta A, Rana R, Sharma YP, Thakur P. Physico-chemical analysis of some temperate Himalayan Swertia species. Journal of Pharmacognosy and Phytochemistry. 2018;7(3):156-9.
45. Sasidharan S, Kaveri AN, Sithara M, Nair J H. Pharmacological Evaluation of the Anesthetic and Analgesic Potential of Injection Harsha 22: A Novel Polyherbal Local Anesthetic Formulation Intended for Parenteral Administration in Wistar Albino Rats. Journal of Experimental Pharmacology. 2023:149-61.
46. Mustarichie R, Wicaksono IA, Gozali D. Anti-alopecia activity of DADAP (Erythrina variegata L.) leaves ethanol extract. Journal of Pharmaceutical Sciences and Research. 2017;9(10):1849-54.
47. Balderrama-Carmona AP, Silva-Beltrán NP, Gálvez-Ruiz J-C, Ruíz-Cruz S, Chaidez-Quiroz C, Morán-Palacio EF. Antiviral, antioxidant, and antihemolytic effect of Annona muricata L. leaves extracts. Plants. 2020;9(12):1650.
48. Nataraj G, Velmurgan P, Jagadeesan G, Manoharan AL, Thangaraj P. A comparative study of solvent extraction methods for a weed Sphaeranthus amaranthoides Burm. f.: phytocompound evaluation using chromatography (GC/MS and HPLC) and in vitro anti-diabetic activity. Biomass Conversion and Biorefinery. 2023:1-20.
49. Ahmad S, Hassan A, Rehman T, Basit A, Tahir A, Arshad MA. In vitro bioactivity of extracts from seeds of Cassia absus L. growing in Pakistan. Journal of Herbal Medicine. 2019;16:100258.
50. Witter S, Witter R, Vilu R, Samoson A. Medical plants and nutraceuticals for amyloid-β fibrillation inhibition. Journal of Alzheimer's Disease Reports. 2018;2(1):239-52.
51. Vijayalakshmi P. Pharmacognostical, Phytochemical and Anti Alzhiemer Activity for the Peels of Citrus Maxima (burm.) Merr. (rutaceae) Using Various Approaches: College of Pharmacy, Madras Medical College, Chennai; 2016.
52. Nandhini S. Pharmacognostical, Phytochemical and Memory Strengthening Activity on the Seeds of Abelmoschus Moschatus Medic: College of Pharmacy, Madras Medical College, Chennai; 2014.
53. Shah VV, Shah VK, Santani DD. Pharmacognostical and preliminary phytochemical screening of Nardostachys jatamansi Dc Rhizome, Achyranthus aspera Linn plant and Trachyspermum ammi Linn fruit. Journal of Drug Delivery and Therapeutics. 2019;9(3-s):345-55.
54. Sharma V, Hussain S, Bakshi M, Bhat N, Saxena AK. In vitro cytotoxic activity of leaves extracts of Holarrhena antidysenterica against some human cancer cell lines. 2014.
55. Namjoyan F, Azemi ME, Abdollahi E, Goudarzi N, Nikan K. Angiotensin I converting enzyme inhibitory activities of hydroalcoholic extract of Nardostachys jatamansi, Prangos ferulacea and Marrubium vulgare. Jundishapur Journal of Natural Pharmaceutical Products. 2015;10(2).
56. Santosh M, Shaila D, Chandrakumar T, Rajyalakshmi I, Rao IS. Physicochemical and phytochemical examination of medicinal plants used in indigenous system of medicine. E-Journal of Chemistry. 2005;2(2):142-51.

57. Selvan A, Suresh R, Subramanian NS, Devi MR. Evaluation of Acute and Subacute Toxicity Studies of Polyherbal Extract on Rodents. Research Journal of Pharmacology and Pharmacodynamics. 2014;6(2):94-100.
58. Tamilselvi L. Development and Standardisation of Poly Herbal Transdermal Patch for the treatment of Rheumatoid Arthritis: Periyar College of Pharmaceutical Sciences, Tiruchirappalli; 2021.
59. Eugine Leo Prakash S. Designa and Evaluation of Microsponge Drug Delivery of Psoralen-Isolated from Psoralea Corylifolia: Periyar College of Pharmaceutical Sciences for Girls, Trichy; 2008.
60. Sharma S, Rana AK, Rahmatkar SN, Patial V, Singh D. Protective effect of Nardostachys jatamansi extract against lithium-pilocarpine-induced spontaneous recurrent seizures and associated cardiac irregularities in a rat model. Journal of Ethnopharmacology. 2023;308:116280.
61. Lyle N, Chakrabarti S, Sur T, Gomes A, Bhattacharyya D. Nardostachys jatamansi protects against cold restraint stress induced central monoaminergic and oxidative changes in rats. Neurochemical research. 2012;37:2748-57.
62. Yadav AK, Yadav R, Garg A, Hussain T. Hepatoprotective Effect Of Ethanolic Rhizome Extract Of Nardostachys Jatamansi Against Acute Alcohol-Induced Liver Injury In Wistar Rats.
63. Garg Nk, Katara A, Mathur M. Antihypertensive Activity of Polyherboceutical Formulation in Different Composition and Each Ingredients on Albino Wistar Rats. International Journal of Pharmaceutical Research (09752366). 2021;13(2).
64. Saranya V. Biological Screening Methods of Ethanol and Aqueous Extracts of Leaves of Albizia Lebbeck (L.) Benth. in Albino Mice: JKK Nattraja College of Pharmacy, Kumarapalayam; 2021.
65. Yaligar K, Singhai AK. IN-VITRO ANTIOXIDANT ACTIVITY OF HERBAL DRUGS. 2023.
66. Raj R, Awan MT, Kumari K, Navis S. Analysis of phytoconstituents of medicinal plants for the treatment (management) of type 2 diabetes mellitus (T2DM): A review. Journal of Pharmacognosy and Phytochemistry. 2018;7(2):3657-64.
67. Arya A, Mittal V, Kaushik D, Kumar M, Alotaibi SS, Albogami SM, et al. Mutivariate optimization strategy for the sonication-based extraction of Nardostachys jatamansi roots and analysis for chemical composition, antioxidant and acetylcholinesterase inhibitory potential. Ultrasonics Sonochemistry. 2022;89:106133.
68. Bhatt M, Kothiyal P. A review article on phytochemistry and pharmacological profiles of Nardostachys jatamansi DC-medicinal herb. Journal of pharmacognosy and phytochemistry. 2015;3(5):102-6.
69. Panara K, Nariya M, Karra N. Central nervous system depressant activity of Jatamansi (Nardostachys jatamansi DC.) rhizome. Ayu. 2020;41(4):250.
70. Pathrikar AA. Clinical assessment of mind relaxation effect of jatamansi oil shirodhara on chittodvega psychological distress in tnbc triple negative breast cancer patients: Tilak Maharashtra Vidyapeeth; 2020.
71. Jain PK, Das D, Das C. Prospect of herbs as hair growth potential. Innovare Journals of Medical Sciences. 2017;5(1):25-33.
72. Disket J, Mann S, Gupta RK. A review on spikenard (Nardostachys jatamansi DC.)-an 'endangered'essential herb of India. Int J Pharm Chem. 2012;2:52-60.
73. Bhat MD, Malik R. Pharmacological profile and uses of sumbul-ut-teeb (Nardostachys jatamansi) in Unani system of medicine. International Journal of Advanced Complementary and Traditional Medicine. 2017;3:51-8.
74. Castillo MA, Carrero Y, Urdaneta KE, Renouf M, Lubin C, Nola M, et al. Essential oils as modifiers of human behavior. Tropical and Subtropical Agroecosystems. 2018;21(1).
75. Gowda KD, Shetty L, Krishna A, Kumari NS, Sanjeev G, Naveen P. Protective effect of Nardostachys Jatamansi root extract against radiation induced damage on liver and kidney functions in albino Wistar rats. Journal of Pharmacy Research. 2011;4(8):2462-5.
76. Nath S, Mukherjee AK. Ethnomedicines for the treatment of scorpion stings: A perspective study. Journal of ethnopharmacology. 2023;305:116078.
77. Kaur A, Pareek R. An insight of Nardostachys jatamansi (Valerianaceae): A Review. Journal of Emerging Technologies and Innovative Research (JETIR). 2018;5(11).
78. Jugran AK, Rawat S, Bhatt ID, Rawal RS. Valeriana jatamansi: An herbaceous plant with multiple medicinal uses. Phytotherapy Research. 2019;33(3):482-503.
79. Vyawahare N, Deshmukh V, Gadkari M, Kagathara V. Plants with antiulcer activity. Pharmacognosy Reviews. 2009;3(5):118.
80. Bhat MDA, Malik SA. Efficacy of Nardostachys jatamansi (D. Don) DC in essential hypertension: A randomized controlled study. Complementary Therapies in Medicine. 2020;53:102532.
81. Ma L-M, Wang K, Meng X-H, Zheng Y-D, Wang C-B, Chai T, et al. Terpenoids from Nardostachys jatamansi and their cytotoxic activity against human pancreatic cancer cell lines. Phytochemistry. 2022;200:113228.
82. Toolika E, Ravi M, Bhat N, Shetty SK, Ravishankar B, Savitha H. A comparative pharmacological study on the effect of Tagara (Valeriana wallichii) AND Jatamansi (Nardostachys jatamansi) in the management of Anidra WSR to primary insomnia. J Phytopharmacol. 2015;4:147-51.
83. Biswajit Bose BB, Debabrata Tripathy DT, Anupam Chatterjee AC, Pramod Tandon PT, Suman Kumaria SK. Secondary metabolite profiling, cytotoxicity, anti-inflammatory potential and in vitro inhibitory activities of Nardostachys jatamansi on key enzymes linked to hyperglycemia, hypertension and cognitive disorders. 2019.
84. Nakoti SS, Juyal D, Josh AK. A review on pharmacognostic and phytochemical study of a plant Nardostachys Jatamansi. The Pharma Innovation. 2017;6(7, Part G):936.
85. Liu XC, Liu ZL. Evaluation of insecticidal activity of Nardostachys jatamansi essential oil against some grain storage insects. Journal of Entomology and Zoology Studies. 2014;2(4):335-40.
86. Gu R-R, Meng X-H, Zhang Y, Xu H-Y, Zhan L, Gao Z-B, et al. (−)-Naringenin 4′, 7-dimethyl Ether Isolated from Nardostachys jatamansi Relieves Pain through Inhibition of Multiple Channels. Molecules. 2022;27(5):1735.
87. Garg P, Alambayan J, Garg V. Herbal Approaches in the Management of Mental Depression. CNS & Neurological Disorders-Drug Targets (Formerly Current Drug Targets-CNS & Neurological Disorders). 2023;22(1):98-124.
88. Kapoor H, Yadav N, Chopra M, Mahapatra SC, Agrawal V. Strong anti-tumorous potential of nardostachys jatamansi rhizome extract on glioblastoma and in silico analysis of its molecular drug targets. Current Cancer Drug Targets. 2017;17(1):74-88.
89. Madhu L, Kumari NS, Naveen P, Sanjeev G. Protective effect of Nardostachys jatamansi against radiation-induced damage at biochemical and chromosomal levels in swiss albino mice. Indian

journal of pharmaceutical sciences. 2012;74(5):460.
90. Rasheed A, Venkataraman S, Jayaveera K, Fazil AM, Yasodha K, Aleem M, et al. Evaluation of toxicological and antioxidant potential of Nardostachys jatamansi in reversing haloperidol-induced catalepsy in rats. International journal of general medicine. 2010:127-36.
91. Venkatachalapathy V, Balakrishnan S, Musthafa M, Natarajan A. A clinical evaluation of Nardostachys jatamansi in the management of essential hypertension. Int J Pharm Phytopharmacol Res. 2012;2:96-100.
92. Gulati K. Pharmacological Activity of Dawa-ul-Kurkum. EC Pharmacology and Toxicology. 2022;10:58-68.
93. Razack S, Kandikattu HK, Amruta N, Khanum F. Neuroprotective Effects of Nardostachys jatamansi Against BSO Induced Anxiety via its Antioxidant Machinery and by Elevating Catecholamines and GABA levels in Mice. Current Traditional Medicine. 2021;7(2):222-45.
94. Subashini R, Gnanapragasam A, Senthilkumar S, Yogeeta SK, Devaki T. Protective efficacy of Nardostachys jatamansi (Rhizomes) on mitochondrial respiration and lysosomal hydrolases during doxorubicin induced myocardial injury in rats. Journal of health science. 2007;53(1):67-76.
95. Kalangutkar D, Patekar R. Arjunadi Anubhoot Yog in Hypertension: A Review Study.
96. Krishnan N, Singh PK, Devadasan V, Mariappanadar V, Gopinath SC, Chinni SV, et al. Enhanced production of actinidine and glaziovine alkaloids from Nardostachys jatamansi (D. Don) DC. through cell suspension culture with elicitors treatment. Process Biochemistry. 2024.
97. Lakhe D, Aher S, Bachhav R. Herbal Cosmetic: An Best Approach For Treating Skin Disorders.
98. Satyal P, Chhetri BK, Dosoky NS, Poudel A, Setzer WN. Chemical composition of Nardostachys grandiflora rhizome oil from Nepal–A contribution to the chemotaxonomy and bioactivity of Nardostachys. Natural Product Communications. 2015;10(6):1934578X1501000668.
99. Anupama KP, Shilpa O, Antony A, Gurushankara HP. Jatamansinol from Nardostachys jatamansi: A multi-targeted neuroprotective agent for Alzheimer's disease. Journal of Biomolecular Structure and Dynamics. 2023;41(1):200-20.
100. King AH. Commodities of Further Asia and the Islamic World. Scent from the Garden of Paradise Musk and the Medieval Islamic World: Brill; 2017. p. 37-84.
101. Pandey MM, Katara A, Pandey G, Rastogi S, Rawat A. An important Indian traditional drug of ayurveda jatamansi and its substitute bhootkeshi: chemical profiling and antioxidant activity. Evidence-Based Complementary and Alternative Medicine. 2013;2013.
102. Anupama KP, Shilpa O, Antony A, Raghu SV, Gurushankara HP. Jatamansinol from Nardostachys jatamansi (D. Don) DC. protects Aβ42-induced neurotoxicity in alzheimer's disease Drosophila model. Neurotoxicology. 2022;90:62-78.
103. Mohammad E, Kushwaha AK. Jatamansi (nardostachys jatamansi): insight of its morphological, Ethno-pharmacological and therapeutical aspect. World Journal of Current Medical and Pharmaceutical Research. 2021:127-30.
104. Amit P, Jadhav V. Development of validated HPTLC method for quantification of jatamansone in jatamansi oil. Journal of Pharmacy Research. 2009;2(5):975-7.
105. Sahu R, Dhongade H, Pandey A, Sahu P, Sahu V, Patel D, et al. Medicinal properties of Nardostachys jatamansi (a review). Oriental journal of chemistry. 2016;32(2):859-66.
106. Singh A, Kumar A, Duggal S. Nardostachys jatamansi DC. potential herb with CNS effects. Asian Journal of Pharmaceutical Research and Health Care. 2009:276-90.
107. Maurya B, Rana M, Kumar S, Singh J, PS A, Tiwari R, et al. Standarization & Identification of Jatamansi (Nardostachys Jatamansi DC.). Korean Journal of Physiology and Pharmacology. 2023;27(3):353-8.
108. Pallavi, Jain J, Kumar P. Targeting Oxidative Stress in Epilepsy: Study of Effect of Antioxidants on Anticonvulsant Profile of Jatamansone. Journal of Biologically Active Products from Nature. 2012;2(5):292-301.
109. Pal G. A Clinical Study in Management of Garbhini Shotha with an Indigenous Compound: Rajiv Gandhi University of Health Sciences (India); 2014.
110. Zhang W, Nan G, Wu H-H, Jiang M, Li T-X, Wang M, et al. A simple and rapid UPLC-PDA method for quality control of Nardostachys jatamansi. Planta Medica. 2018;84(08):536-43.
111. Devhare LD and Gokhale N. Antioxidant and antiulcer property of different solvent extracts of cassia tora linn. Research journal of pharmacy and technology. 2022, 15(3): 1109-1113..
112. Joshi H, Parle M. Nardostachys jatamansi improves learning and memory in mice. Journal of medicinal food. 2006;9(1):113-8.
113. Singh M, Khan MA, Khan MS, Ansari S, Ahmad S. Standardization and in vitro antioxidant activity of jatamansi rhizome. Journal of pharmacy & bioallied sciences. 2015;7(4):275.
114. Gnana RPM, Devhare LD, Dharmamoorthy G, Khairnar MV, Prasidha R. Synthesis, Characterisation, Molecular Docking Studies and Biological Evaluation of Novel Benzothiazole Derivatives as EGFR Inhibitors for Anti-breast Cancer Agents. International Journal of Pharmaceutical Quality Assurance. 2023;14(3):475-480.
115. Srivastava A, Tiwari SS, Srivastava S, Rawat A. HPTLC method for quantification of valerenic acid in Ayurvedic drug jatamansi and its substitutes. Journal of liquid chromatography & related technologies. 2010;33(18):1679-88.
116. Singh M, Khan MA, YT K, Ahmad J, Fahmy UA, Kotta S, et al. Effect of Nardostachys jatamansi DC. on apoptosis, inflammation and oxidative stress induced by doxorubicin in wistar rats. Plants. 2020;9(11):1579.
117. Chawla A, Devhare LD, Dharmamoorthy G, Ritika, Tyagi S. Synthesis and In-vivo Anticancer Evaluation of N-(4-oxo-2-(4-((5-aryl-1,3,4 thiadiazole-2yl) amino) Phenyl thiazolidine-3-yl) Benzamide derivative. International Journal of Pharmaceutical Quality Assurance. 2023;14(3):470-474.
118. Shukla JK, Dhakal P, Thapa S, Kharlyngdoh E, Thorat SS, Bhardwaj PK, et al. Growth, yield and metabolite substantiated, eco-physiological evaluation of overcoming accessional and agro-climatic differences in ex-situ raised Valeriana jatamansi Jones. at lower altitude of Sikkim Himalayan region. Industrial Crops and Products. 2024;207:117730.
119. Sonule M, Devhare LD, Babu MN, Gunjal SD, Varalaxmi S. Microemulgel-based Hydrogel of Diclofenac Sodium using Lipidium sativum as a Gelling Agent. International Journal of Drug Delivery Technology. 2023;13(4):1235-1239.
120. Shriram BK, Devhare LD, Mehrotra A, Deokar SS, Singh SP. Formulation and Evaluation of Mosquito Repellent Stick. International Journal of Drug Delivery Technology. 2023;13(4):1283-1286.