
NARDOSTACHYS JATAMANSI: A COMPREHENSIVE REVIEW OF ITS ETHNOMEDICINAL HISTORY, PHYTOCHEMISTRY, AND MODERN PHARMACOLOGICAL POTENTIAL

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ABSTRACT

Nardostachys jatamansi, commonly referred to as Spikenard, is a rare, perennial herbaceous species indigenous to the high-altitude alpine regions of the Himalayas. Historically significant in diverse traditional medicinal frameworks—including Ayurveda, Homeopathy, and the Indian System of Medicine (ISM)—this rhizomatous plant is increasingly recognized for its multifaceted pharmacological potential in contemporary medicine. This article reviews the botanical classification, complex chemical composition, and therapeutic activities of *N. jatamansi*. The plant is rich in bioactive sesquiterpenes, such as jatamansone, nardal, and patchouli alcohol, alongside various phenols and flavonoids. Extensive experimental studies demonstrate that *N. jatamansi* extracts possess significant antioxidant, anti-stress, and anticonvulsant properties. Notably, the plant exhibits neuroprotective effects, enhancing memory function in neurodegenerative models and reducing ischemic damage in cerebral palsy simulations. Furthermore, its antiproliferative effects in breast cancer cells and its clinical efficacy in managing Stage 1 hypertension underscore its potential as a versatile therapeutic agent.

KEYWORDS: Nardostachys jatamansi, jatamansi.

INTRODUCTION

Nardostachys jatamansi is the tiniest, most primitive, dwarf, hairy, rhizomatous, herbaceous species in the Valerianaceae family. It has been utilised for a longer period of time as

homoeopathic medicine, ayurvedic medicine, ethnomedicine, and the Indian medical system. It is currently utilised in the contemporary medical field.¹ Within the Valerianaceae family, *Nardostachys jatamansi* is a small, dwarf, hairy, perennial, rhizomatous, herbaceous, rare, and oldest species. Spread throughout the Himalayas from Pakistan to India, including Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Nepal, Tibet, and China, it has been used historically for medicinal purposes in Ayurveda, ethnomedicine, homoeopathy, Indian System of Medicine (ISM), and modern medicine. *V. officinalis* is polyploid, with diploid, tetraploid, and octaploid varieties. *Nardostachys jatamansi* Dc. Known as Spikenard, this woody rootstock is tall, sturdy, and covered in fibres from the petioles of withered leaves. It grows naturally in the Himalayan alpine regions at elevations of 11–17 thousand feet, rising eastward from Punjab and Kumaon to Sikkim and Bhutan.² The plant has been shown to have hypolipidemic, hepatoprotective, and anticonvulsant properties in experiments. Extracts have been shown to enhance antioxidant and lipid peroxidation activity in rats with doxorubicin-induced heart injury, as well as learning and memory function in mice. Additionally, the plant's extracted essential oil demonstrated fungicidal action.³

Botanical Classification

Kingdom : Plantae

Division : Magnoliophyta

Class : Magnoliopsida

Order : Dipsacales

Family : Valerianaceae

Genus : *Nardostachys*

Species : *Jatamansi* ⁴

Chemical constituents

The chemical components of *Nardostachys jatamansi* are as follows: Angelicin, beta-eudesmol, beta-patchoulene, betasitosterol, calarene, calarenol, elemol, jatamansin, jatamansinol, jatamansone, n-hexacosane, n-hexacosanol, n-hexacosanyl arachidate, n-hexacosanyl isovalerate, nardol, norsechelanone, oroselinol, patchouli alcohol, seychellane, seychellene, valeranal, and valeranone.

Resins, sugar, starch, bitter extractive substance, gum, ketone, sesquiterpin ketone, spirojatamol, volatile essential oils, etc. Nardin, nardal, jatamnsic acid, b-maline, and patchouli alcohol are further sesquiterpenes. Other known sesquiterpenes include

nardostachone, dihydrojatamansin, jatamansic acid, jatamansinone, oroseolol, oroselone, seselin, nardostachyin, nardosinone, spirojatamol, and jatamol. Xanthogalin, calarenol, seychellene, seychelane, and coumarin A and B. There have also been reports of an alkaloid called actinidine. Nardal has been identified as an active ingredient.⁵

PHARMACOLOGICAL ACTIVITY

Memory Improvement

The study was conducted to evaluate *N. jatmansii*'s potential as a memory booster. Learning and memory factors were assessed using the passive avoidance paradigm and the elevated plus maze. For eight days in a row, young and old mice received three dosages (50, 100, and 200 mg/kg, p.o.) of an ethanolic extract of *N. jatmansii*. In addition to reversing the amnesia caused by diazepam (1 mg/kg, i.p.) and scopolamine (0.4 mg/kg, i.p.), a 200 mg/kg dose of *N. jatmansii* ethanolic extract greatly enhanced learning and memory in young mice. Moreover, it corrected age-related forgetfulness caused by the natural ageing process in mice. Given that scopolamine-induced amnesia was reversed, cholinergic transmission in the brain may have been facilitated, which could account for the memory enhancement. Therefore, *N. jatmansii* may be a helpful memory-restoring agent for the treatment of dementia in older adults.⁶

Stress Modulator

The study was conducted to evaluate the antioxidant activity of *N. jatmansii* (NJE) hydroethanolic extract (70%) was used to assess the anti-stress effect. Four groups of Wistar rats were created: naïve, stressed, and T-200 and T-500 stressed with oral pre-treatment of NJE 200 and 500 mg/kg, respectively. After rats were restrained in metallic chambers for four hours at 4°C, they were sacrificed, and the occurrence and severity of ulcers as well as changes in metabolic parameters brought on by stress were evaluated. Measurements were made of the stomach's lipid peroxidation (LPO) and NO levels, the brain's LPO, NO levels, and catalase activity, as well as the plasma corticosterone level and adrenal ascorbic acid. The free radical scavenging activity of NJE was measured in order to investigate its in vitro antioxidant potential. Strong antioxidant action was demonstrated by NJE, which also dramatically reversed the rise in LPO and NO levels and fall in catalase activity in the brain brought on by stress. It corrected the changes in biochemical parameters/markers of stress-induced stomach ulceration and reduced the frequency of gastric ulcerations. Additionally,

NJE considerably reduced the amount of ascorbic acid in the adrenal gland and prevented stress-induced increases in the weights of the spleen and adrenal glands. The amount of plasma corticosterone was neutralised in a dose-dependent manner. The results imply that the NJE has strong anti-stress properties, possibly as a result of its antioxidant activity.⁷

Antioxidant Activity

The phosphomolybdenum method, total antioxidant activity in linoleic acid emulsion systems, 1,1-diphenyl-2-picrylhydrazyl (DPPH), superoxide, hydroxyl radicals, nitric oxide (NO) scavenging, metal chelating, and reducing power activity were among the antioxidant assays used in this study to assess the antioxidative potential of a hydroalcoholic extract of *Nardostachys jatamansi* (NJE) rhizomes. Standard antioxidants such butylated hydroxytoluene, tocopherol, catechin, and L-ascorbic acid were used to compare these different antioxidant properties. A colorimetric approach was also used to determine the total phenolic and flavonoid content of NJE. The extract had a moderate impact on NO and shown strong free radical scavenging and significant reduction capabilities, particularly against DPPH and superoxide anions. Additionally, NJE's ability to suppress peroxidation was shown in the linoleic acid emulsion system. The current study's findings unequivocally demonstrated NJE's antioxidative potency, which could explain some of the plant's purported health benefits.⁸

Anticonvulsant Activity

The anticonvulsant and neurotoxic properties of an ethanol extract of the roots of *Nardostachys jatamansi* DC. (Valerianaceae) were investigated in rats both on its own and in conjunction with phenytoin. As evidenced by a drop in the extension/flexion (E/F) ratio, the results showed that *Nardostachys jatamansi* root extract significantly raised the seizure threshold versus the maximal electroshock seizure (MES) model. Nevertheless, the extract had no effect on seizures brought on by pentylenetetrazole (PTZ). In the rotarod test, *nardostachys jatamansi* root extract likewise demonstrated negligible neurotoxicity at doses that raised the seizure threshold. Additionally, the protective index (PI) of phenytoin increased significantly from 3.63 to 13.18 when rats were pretreated with phenytoin at doses of 12.5, 25, 50, and 75 mg/kg combined with 50 mg/kg of *Nardostachys jatamansi* root extract. The synergistic activity of both medications was amply confirmed by the dose response trials of phenytoin alone and in combination with *Nardostachys jatamansi* extract on serum levels of phenytoin.⁹

Cerebral Palsy

In a middle cerebral artery (MCA) occlusion model of acute cerebral ischaemia in rats, the protective effect of *Nardostachys jatamansi* (NJ) on neurobehavioral activities, thiobarbituric acid reactive substance (TBARS), reduced glutathione (GSH), thiol group, catalase, and sodium–potassium ATPase activities was investigated. Intraluminal 4-0 monofilament was used to occlude the right MCA of male Wistar rats for two hours, and reperfusion was permitted for twenty-two hours. TBARS levels significantly increased while glutathione and thiol group contents significantly decreased as a result of MCA occlusion. MCA occlusion considerably reduced the activities of catalase and Na⁺K⁺ ATPase. The MCA occlusion group also showed a significant reduction in neurobehavioral activities, such as motor coordination and spontaneous motor activity. By reducing the neuronal cell death after MCA occlusion and reperfusion, a 15-day pretreatment of NJ (250 mg/kg po) considerably reduced all the alternations caused by ischaemia and corresponded well with histology. The study offers the first proof of NJ's efficacy in localised ischaemia, most likely due to its antioxidant characteristics.¹⁰

Anticancer Activity in Breast Cancer

N. jatamansi roots and rhizomes were extracted using petroleum ether (NJPE), methanol extract (NJM), and then diethyl ether (NJDE), ethyl acetate (NJEA), and aqueous (NJAQ). Using appropriate techniques, the total phenolic content, flavonoid content, and antioxidant activity were assessed. MTT and SRB assays were used to measure antiproliferative activity in ER-positive (MCF-7) and ER-negative (MDA-MB-231) breast cancer cells. To ascertain the mechanism of antiproliferative and pro-apoptotic action in MDA-MB-231 cells, cell cycle analysis, Hoechst staining, and clonogenic test were utilised. With a strong association between phenolic content and ABTS (IC₅₀) scavenging ($R = -0.9680$, $P < 0.05$) and overall antioxidant capacity ($R = 0.8396$, $P > 0.05$), NJM/fractions demonstrated strong antioxidant activity. NJM demonstrated the strongest antiproliferative effect in the MTT experiment (IC₅₀: 58.01 ± 6.13 and 23.83 ± 0.69 $\mu\text{g/mL}$ in MCF-7 and MDA-MB-231, respectively). NJPE and NJDE were shown to be the most effective portions in MCF-7 (IC₅₀: 60.59 ± 4.78 $\mu\text{g/mL}$) and MDA-MB-231 (IC₅₀: 25.04 ± 0.90 $\mu\text{g/mL}$) cells, respectively. NJM and NJDE showed significantly increased ($P < 0.05$) cytotoxicity in MDA-MB-231 cells, according to statistical analysis. In MDA-MB-231 cells, cell cycle studies showed that NJDE produced G₀/G₁ phase arrest while NJM, NJPE, and NJEA caused G₂/M arrest. Additionally, NJM/fractions significantly ($P < 0.001$) reduced the long-term proliferation ($P < 0.001$) of

MDA-MB-231 cells in the clonogenic experiment and caused apoptosis, which was indicated by apoptotic morphological alterations in Hoechst staining. Using HPTLC, luteol and β -sitosterol were found to be anticancer principles in NJM/fractions. The findings indicate that NJM/fractions have strong antiproliferative potential, which is mediated by pro-apoptotic effects and cell cycle disruption in MDA-MB-231 cells.¹¹

Anti Dipressant Activity

The purpose of this study was to ascertain whether the rhizome of Jatamansi (*N. jatamansi*) depressed the central nervous system (CNS) in experimental mice. Charle's foster albino rats were used for the gross behaviour study and open field test (locomotor activity), whereas Swiss albino mice were used for the rota-rod test and pentobarbital-induced sleep test. The animals were split up into three groups, each consisting of six individuals (per model). Water was given to the control group, diazepam to the standard group, and powdered *N. jatamansi* rhizome to the test drug. One-way ANOVA and a post hoc test were used to calculate the results, with $P < 0.05$ being considered significant. According to this study, rats' gross behaviour and motor coordination are unaffected by the CNS depressive activity of Jatamansi rhizome powder.¹²

Anti hypertensive

The study was conducted to examine the efficacy of *Nardostachys jatamansi* in reducing blood pressure in hypertensive patients. Forty participants between the ages of 35 and 70 participated in the single blind, randomised, placebo-controlled research. For four weeks, the subjects were randomised to receive either a placebo or a total of three grams of *N. Jatamansi* (one capsule three times a day). The study comprised patients with stage 1 hypertension who were taking ≤ 2 antihypertensive medications. For four weeks, baseline and weekly systolic and diastolic blood pressure readings were taken. Both at baseline and at the conclusion of the study, the MINICHAL score (for quality of life) was recorded. The present findings suggest that *N. Jatamansi* is effective in reducing both systolic and diastolic blood pressure in essential hypertension.¹³

CONCLUSION

The comprehensive pharmacological profile of *Nardostachys jatamansi* validates its long-standing traditional use and highlights its relevance in modern clinical applications. The evidence synthesized in this article confirms several key therapeutic attributes:

Neuroprotective and Cognitive Enhancement: The ethanolic extract of the plant facilitates cholinergic transmission, effectively reversing amnesia and age-related forgetfulness, which positions it as a viable candidate for treating dementia.

Antioxidant and Stress Modulation: Through strong free radical scavenging and the regulation of lipid peroxidation and corticosterone levels, *N. jatamansi* serves as a potent anti-stress agent.

Anticonvulsant Synergie: The plant not only raises the seizure threshold in electroshock models but also demonstrates a significant synergistic effect when combined with conventional treatments like phenytoin.

Oncological and Cardiovascular Utility: Specific fractions of the rhizome induce cell cycle arrest and apoptosis in breast cancer lineages (MCF-7 and MDA-MB-231), while clinical trials indicate its safety and efficacy in lowering systolic and diastolic blood pressure in hypertensive patients.

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