IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals
ISSN 2349-7203
HUMAN

Human Journals
**Review Article**
September 2023 Vol.:28, Issue:2
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# A Review on Antioxidant and Antibacterial Activity of *Nardostachys jatamansi* Roots Extract

IJPPR
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An official Publication of Human Journals
ISSN 2349-7203
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**Submitted:** 18 August 2023
**Accepted:** 20 September 2023
**Published:** 30 September 2023

**Keywords:** Antibacterial, Antioxidant, *Nardostachys jatamansi*

**ABSTRACT**

The Plants are known for their diverse pharmacological activities including antioxidant and antibacterial activity. In the present work an attempt has been made to find the antioxidant and antibacterial activity of *Nardostachys jatamansi* root extract by using the different solvents petroleum ether, chloroform, ethyl acetate, ethanol and water were used to extract the root.

HUMAN JOURNALS
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## 1. INTRODUCTION

### 1.1 Antibacterial activity

Today's, microbial infections, and resistance to antibiotic drugs have been the biggest challenges, which threaten the health of societies. Microbial infections are responsible for millions of deaths every year worldwide. In 2013, 9.2 million deaths were reported because of infections i.e. about 17% of total deaths (1,2). The occurrence of the evolution of resistance has caused the existing antibacterial drugs to become less effective or even ineffective (3).

In recent years, various strategies have been suggested to overcome the resistance of antibiotics. One of the recommended strategies to achieve this goal has involved the combination of other molecules with the failing antibiotics, which apparently restores the desirable antibacterial activity(4,5). These molecules can be non-antibiotic drugs with potential antibacterial properties that can create opportunities for innovative therapeutic approaches(6). In regards to this case, phytochemicals have exhibited potent activities while many researchers have used natural products to act against bacterial resistance(7–9). These agents can act alone or in combination with antibiotics to enhance the antibacterial activity against a wide range of bacteria (10–12). However, up to this date, the structure-activity relationships and mechanisms of action of natural compounds have largely remained elusive.

#### 1.1.1 Mechanisms of antibacterial activity and resistance

The antibacterial activity of an agent is mainly attributed to two mechanisms, which include interfering chemically with the synthesis or function of vital components of bacteria, and/or circumventing the conventional mechanisms of antibacterial resistance. These mechanisms and as it can be observed, there are multiple targets for the antibacterial agents that comprise (I) bacterial protein biosynthesis; (II) bacterial cell-wall biosynthesis; (III) bacterial cell membrane destruction; (IV) bacterial DNA replication and repair, and (V) inhibition of a metabolic pathway.

In addition, bacteria may show resistance to antibacterial agents through a variety of mechanisms. Some bacterial species are innately resistant to one or more classes of antimicrobial agents. In these cases, all strains of that bacterial species exhibit resistance to all the members of those antibacterial classes. A major concern is that the bacteria acquire resistance, where initially susceptible bacterial populations become resistant to the

antibacterial agent (13). So, one of the key factors in finding the solutions for slowing the development of antibiotic-resistant is knowing about the mechanisms of antibacterial resistance (13), which mainly include the activation of the efflux pump, destroying the antibacterial agents through the destruction enzymes, modification of antibiotics by the means of modifying enzymes, and the alteration of target structures in the bacterium which have lower affinity for antibacterial recognition. It should be also noted that the resistance to antibacterial agents can be related to one kind of mechanism or different types together. The main mechanism for spreading the resistance of antibiotics through bacterial populations is plasmids in the role of genetic material, which are capable of being independently replicated and passed between bacterial cells and species.

The widespread use of antibiotics has led to an increase in the incidence of bacteria that are resistant to them. As a result, at least some bacterial infections cannot be controlled by current antibiotic medicines (14). Diseases are treated with plants, and new medications are constantly being created thanks to plant research. More than 20,000 plant species are employed in traditional medicine, and they could serve as potential sources of novel drugs. Traditional medicinal plants have drawn a lot of interest since their phytochemicals could result in the development of novel drugs (15).

The investigation of various extracts taken from traditional medicinal plants as possible sources of novel antimicrobial agents has drawn more attention in recent years. Due to the resistance developed by many harmful microbes, the quest for novel antimicrobial drugs is a crucial area of research (14). This study will discuss the many secondary metabolites produced by plants and their potential antibacterial activity because several secondary metabolites have been identified from prior research investigations as potential antibacterial agents.

Plant products are reported to be employed as traditional medicines in a number of underdeveloped nations. There is a dearth of medical care in these nations.

Plants thus become an easily available and affordable resource for the treatment of numerous illnesses and disorders. In recent years, pharmaceutical firms and the scientific community have begun to take an increased interest in medicinal plants. This was because there is evidence that these chemicals from plants have the potential for a wide range of biological actions, including antibacterial activity(16). Since plants have offered high-activity profile

medications, scientists' goal is to extract and describe active phytocompounds found in plants (17).

Due to the usage of these medicinal plants to treat infectious diseases, ethno pharmacology has recently gained attention. The basic elements from a plant are gathered and subsequently examined in this study to find the bioactive components demonstrating biological activity.

Consequently, they can be utilized as pharmaceuticals in the future (16). These natural products are made up of chemical elements that can come from any type of living thing, including plants. Primary metabolites, which include carbohydrates, proteins, and lipids, are substances created by the plant that are essential for development and metabolism. However, secondary metabolites are substances that result from primary metabolism and are recognized to be part of a plant's defense mechanisms (18). Secondary metabolites and their derivatives are typically the ingredients in medicines made from natural materials. Numerous bioactive substances have been discovered through phytochemical screening of various plants, including alkaloids, tannins, flavonoids, glycosides, and saponins. In order to protect themselves from various microbes, insects, and herbivores, plants produce secondary metabolites (18)**.**

**1.2 Antioxidant activity of medicinal plant**

The free radicals may be either Oxygen derived (ROS) or Nitrogen derived (RNS). The most common reactive oxygen species include superoxide anion ($O_2$), hydrogen peroxide ($H_2O_2$), peroxyl radicals (ROO) and reactive hydroxyl radicals (OH). The nitrogen-derived free radicals are nitric oxide (NO), peroxy nitrite anion (ONOO), Nitrogen dioxide (NO2) and Dinitrogen trioxide ($N_2O_3$). The exogenous sources of ROS include electromagnetic radiation, cosmic radiation, UV-light, ozone, cigarette smoke and low wave length electromagnetic radiations and endogenous sources are mitochondrial electron transport chain, β-oxidation of fat. Chemical compounds and reaction capable of generating potential toxic oxygen species/free radicals are referred to as ‘pro-oxidants’. They attack macromolecules including protein, DNA and lipid causing cellular/tissue damage on the other hand, compounds and reactions disposing of these species, scavenging them suppressing their formation or opposing their actions are called antioxidants. In a normal cell there is an appropriate pro-oxidant: antioxidant balance. However, this balance can be shifted towards the pro-oxidant when the production of oxygen species is increased or when levels of antioxidants are diminished. This state is called ‘oxidative stress’ and can result in serious

cell damage if the stress is massive or prolonged. Herbal antioxidants have been successfully employed as rejuvenators, for several centuries in the Indian systems of alternative medicine (19).

### 1.2.1 Method to determine the antioxidant activity

Although many methods are available to determine antioxidant activity, it is important to employ a consistent and rapid method. While each method has its own merits and drawbacks, it has been found that the most common and reliable methods are the ABTS and DPPH methods; these have been modified and improved in recent years.

## 2. Plant profile

### 2.1 *Nardostachys Jatamansi* (20)

*Nardostachys jatamansi* is a flowering plant of the valerian family that grows in the Himalayas. It is a source of a type of intensely aromatic amber-colored essential oil, spikenard. The oil has, since ancient times, been used as a perfume, as a traditional medicine, and in religious ceremonies. It is also called spikenard, nard, nardin, or muskroot. It is considered endangered due to overharvesting for folk medicine, overgrazing, loss of habitats, and forest degradation.

### 2.1.1 Scientific classification

- Kingdom: Plantae
- Clade: Tracheophytes
- Clade: Angiosperms
- Clade: Eudicots
- Clade: Asterids
- Order: Dipsacales
- Family: Caprifoliaceae
- Genus: Nardostachys
- Species: N. jatamansi

### 2.1.2 Description

*Nardostachys jatamansi* is a flowering plant of the honeysuckle family that grows in the eastern Himalayas, primarily in a belt through Kumaon, Nepal, Sikkim and Bhutan. The plant grows 10–50 cm (4–20 in) in height and has pink, bell-shaped flowers. It is found at an altitude of 3,000–5,000 m (9,800–16,400 ft). Rhizomes (underground stems) can be crushed and distilled into an intensely aromatic amber-colored essential oil, which is very thick in consistency. Nard oil is used as a perfume, an incense, a sedative, and an herbal medicine said to fight insomnia, birth difficulties, and other minor ailments.

### 2.1.3 Phytochemistry

Preliminary research on the chemical components of *Nardostachys jatamansi* indicates the plant contains:

- Acaciin
- Ursolic acid
- Octacosanol
- Kanshone A
- Nardosinonediol
- Nardosinone
- Aristolen-9beta-ol
- Oleanolic acid
- Beta-sitosterol

### 2.1.4 Medicinal Properties

*Nardostachys Jatamansi* has many similar medicinal properties to Bacopa Monnieri (Water hyssop) including anti-stress, anti-convulsive, and cognitive-enhancing abilities. However, unlike Bacopa, the research related to its medicinal value is still in its preliminary stage. It is an aromatic herb, which exerts cooling action in the body. Let’s have a quick look at the medicinal properties that are responsible for its medicinal uses:

- Neuroprotective
- Anti-stress
- Anti-depressant
- Anxiolytic
- Anti-cataleptic
- Anti-seizure (Anticonvulsant)
- Antispasmodic
- Anti-inflammatory
- Antihypertensive
- Deodorant
- Antibacterial
- Antifungal (Jatamansi oil)
- Carminative
- Stomachic
- Heart Tonic
- Mild Diuretic (by exerting stimulant action on kidneys)
- Anti-histaminic
- Mild laxative

**2.1.5 Benefits & Uses**

The amazing benefits of Jatamansi are attributed to its medicinal properties stated above.

- It acts as a natural nervine tonic and a memory booster.
- It relieves stress by inducing calming and relaxation effects.

- It prevents neurological degeneration due to its neuroprotective action.
- It provides a soothing sensation to the skin and promotes hair growth.
- In Ayurveda, it is commonly prescribed to relieve stress, spasms, convulsions, epilepsy, and hysteria. In fact, it is one of the most commonly used and an effective herbs to treat epilepsy.

## 3. CONCLUSION

*Nardostachys jatamansi* root extract shows antibacterial and antioxidant properties by using five different solvents using the soxhlet apparatus.

## 4. ACKNOWLEDGEMENT

We would like to thank all the faculty of the School of Pharmacy, Abhilashi University for their constant support.

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