COMPARATIVE STUDY OF *NARDOSTACHYS JATAMANSI* (VALERIANACEAE) WITH SPECIAL REFERENCE TO THREE SEASONS

A THESIS

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IN

DRAVYAGUNA VIJNANA

(AYURVEDIC PLANT SCIENCE)

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This is to present that composed accommodation in my task report entitled **"Comparative study of *Nardostachys jatamansi* (Valerianaceae) with special reference to three seasons"** It represents original ideas in my own words and where others' ideas or words have been included; I have adequately referenced the original sources. I also declare that I have stuck to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I comprehend that any infringement of the above will be cause for disciplinary action by the School and can also evoke penal action from the sources which have thus not been properly referred or from whom proper permission has not been taken when required. I guarantee and hold full obligation regarding its validity.

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LIST OF ABBREVIATIONS

S.N	Sanskrit name
C.S	Charaka Samhita
S.S	Susruta Samhita
R.N	Raj Nighantu
N.A	Nighantu Adarsh
B.N	Bhavprakash Nighantu
P.N	Priya Nighantu
Sh.N	Shankar Nighantu
D.N	Dhanvantari Nighantu
TLC	Thin Layer chromatography
HPTLC	High performance thin layer chromatography
Rf	Retention factor
E.coli	*Escherichia coli*
T.S	Transverse section
Ck	Cork
Ct	Cortex
Ph	Phloem
Xy	Xylem
Pi	Pith
U.V light	Ultra violet light

ABSTRACT

Various plants are used by individual as a source of medicine. Jatamansi (*Nardostachys jatamansi*) belongs to family Valerianaceae, is an important herb of the Ayurveda which is mainly used for nervous disorders. The plant is known by various synonyms like: jatila, krishnjata, peshi, bhootjata, krishnjata, mrigbaksha, jatavati, tapsvani etc and its properties are *medya*, *haridya*, *balya*, *keshvardhak*, *vednasthapak*, *kusthaghan* etc. Seasons play a very important role in the activity of drug and the concentration of its active constituents. The present study aims to compare the three samples of the plant *Nardostachys jatamansi* collected in three different seasons. Pharmacognostically no much difference was observed expect for xylem cells. In sample 1 they were found to be less in number. On physiochemical evaluation, sample 3 shows the better results than the sample 1 and 2. Phytochemical screening, all the samples shows the presence of alkaloids, carbohydrates, steroids and glycosides. HPTLC studies conducted with standard Jatamansone and sample 2 and 3 showed Rf close to standard. Methanolic extract of sample 2 shows maximum inhibition. This research concludes that there are differences according to seasons and sample 2 collected in the month of September (Sharad ritu) shows better results.

Key words: Jatamansi, *Nardostachys jatamansi*, Antimicrobial activity, Sharad ritu

CHAPTER 1
INTRODUCTION

1.1 Introduction to Ayurveda

Ayurveda is the oldest and traditional system or healing originated in India many years ago. Various evidences of Ayurveda are present in the ancient books, like vedas etc. The word 'Ayurveda' comprises of two words i.e. 'ayu' + 'veda'. The meaning of "ayu" is all aspects of life from birth to death and "veda" means knowledge, so the meaning of Ayurveda is science of life. Ayurveda helps to maintain the health of healthy person and also cure disease of diseased person. `Among these origins 20,000 are used for curing various disorders. Various plants commonly reported are *Withania somnifera* (Solanaceae), *Glycyrrhiza glabra* (Leguminosae), *Rauwolfia serpentina* (Apocynaceae), *Nardostachys jatamansi* (Valerianaceae).

1.2 Introduction to Dravyaguna

It is the branch of science which deals with the name, synonyms, distribution, varieties and uses of medicinal plants. The word dravyaguna comprises of two words dravya + guna. This branch gives the full information about the plant which is used for the medicinal purpose. In dravyaguna,dravya is the substance in which guna and karma shared the inseparable connection with each other and it should secure that wellbeing of individual and kill the ailments. This is also known as Ayurvedic pharmacology of plants.

द्रव्याणांनामरुपाणिगुणकर्माणिसर्वशः।
प्रयोगाश्चापिवर्ण्यन्तेयस्मिन्द्रव्यगुणंहितत्॥

1.3 Importance of Seasons for collection of plants

In Ayurveda different parts of plant are collected in different seasons because amount of chemical constituents varies in different seasons so it is important to collect the plant at specific time. Different Acharya mentioned different seasons for the collection of different parts of plants.

Table 1.1: Collection of the parts of plants according to different seasons

S. No	Plant parts	Charaka Samhita	Sushruta Samhita	Raj Nighantu	Dravyaguna Vigyan	Others
1.	Shakha (Branches)	Varsha, Vasant	-	-	Varsha, Vasant	-
2.	Patra (Leaves)	Varsha, Vasant	-	Varsha	Varsha, Vasant	Varsha
3.	Mool (Root)	Greeshma,Sishir	Pravrutta	Sishir	Greeshma, Sishir	Pravrutta
4.	Kand (Rhizome)	Sarad	-	Hemant	Sarad	-
5.	Tvak (Bark)	Sarad	Sarad	-	Sarad	Sarad
6.	Kshir (Latex)	Hemant	-	-	Sarad	Hemant
7.	Sar (Heart wood)	-	Vasant	-	Yatharitu	-
8.	Pushpa (Flower)	Yatharitu	-	Vasant	Yatharitu	-
9.	Phala (Fruit)	Yatharitu	Greeshma	-	Yatharitu	Greeshma

1.4 Endangered species and role of government for their protection

The plants having high risk to extinct by the humans or the natural environment by this the number of plant is reduced in the nature due to the destructions of plants. Today there are several of the plants are in the risk to be endangered. The protection of such plants is necessary. The endangered plants are categorized by international union for conservation of nature, such as: *Acacia catechu* (Leguminaceae), *Mesuaferra* (Guttiferae), (Mangoliaceae) *Micheliachampaka* (Mangoliaceae),*Ephedra geradiana* (Ephedraceae), *Aconitum hetrophyllum* (Runuculaceae) ,*Nardostachys jatamansi* (Valerianaceae) is also one of the endangered plant. For the protection of endangered species, the endangered species act is passed in 1973. This act protects the species worldwide. It provides the protection to the endangered flora by providing them natural habitat. The endangered species act provides the solutions government agencies and concern citizens to conserve the endangered species with their habitats. It helps us to protecting the essential habitat of the species.

CHAPTER 2

TERMINOLOGY

DravyagunaVijnana	It is the branch of Ayurveda which give the knowledge about plants, its origin, properties and effects of drugs.
Samhita	Samhita are the classical texts which are used as references.
Nighantu	Nighantus are the vocabulary which includes description of plants and other definitions
Rasa (taste)	Rasa is the taste of any dravya of gustatory sense which is located in the tongue
Guna (property)	Guna are the properties of the dravya
Virya (potency)	Effectiveness of guna is called as potency
Vipaka (metabolism)	Vipaka is the final taste which is which is obtained after digestion
Prabhav (effect)	Specific effect of dravya is prabhav
Standardization	The process of making any drug or other preparation. A set of techniques used to remove as far as possible the effects of differences in age or other confounding variables when comparing two or more populations

CHAPTER 3
REVIEW AND LITERATURE

Review of literature is very important for the research. It helps the researcher by many ways, like it helps to encouraging the deep learning and assesses the various cognitive levels etc. In this the researcher followed the chronological methods to describe the *Nardostachys jatamansi* described in various texts.

Classical literature

Jatamansi is extensively described in various literatures, such as: Charaka Samhita, Susruta Samhita, Nighantu Adarsh, Bhavpraksh Nighantu, Priya Nighantu, Shankar Nighantu, and Raj Nighantu.

3.1 Ancient literature

3.1.1 Charaka Samhita

चन्दननलकृतमालनक्तमालनिम्बकुटजसषर्पमधुकदारुहरिद्रामुस्तानीतिदशेमानिकण्डूध्नानिभवन्ति(१४)

Kandughanamahakashaya (Anti-Purities)-Chandan (safed), Nalad (jatamansi), Amaltas, Nakmal, Neem, Kutaj, Sarson. Mulethi, Darruharidra, Nagarmotha. These ten plants remove itching[1].

3.1.2 Susruta Samhita

वचांवयःस्थांगोलोमीजटिलांचापिधारयेत्।

उत्सादनंहितंचात्रस्कन्दापस्मारनाशनम्॥६॥

Vacha, vayastha:(giloye and kshirkakoli), golomi (durva) and jatamansi are tie on thread and given to children.

पुराणसर्पिर्लशुनंहिङ्गुसिद्धार्थकंवचा।

गोलोमिचाजलोमिचभूतकेशीजटातथा॥४६॥

कुक्कुटासर्वगन्धाचतथाकाणविकाणिके।

वज्रप्रोक्तावयःस्थाचशृङ्गीमोहनवल्लिका॥४७॥

अर्कमूलंत्रिकटुकंलतास्तोतोजमञ्जनम्।

नैपालीहरितालञ्चरक्षोघ्नायेचकीर्तिताः॥४८॥

Ten years old ghee, lahsun, hing, swetasarson, vacha, durva, swetadurva, jatamansi (bhootkeshi), jata (gandhmansi), kutkutshimbi, sarpgandha, kanvika (kakoli), aanika

(kshirkakoli), vajraprokta, guduchi, kakadsingi, mohanvalika, sunthi, marich, pippali, priyangupushap, strotoanjan, manshila, hartal, swetasarshap are rakshoghan dravya[2].

3.1.3 Sarangdhar Samhita

लवङ्गंशुद्धकर्पूरमेलात्वङ्नागकेशरम्॥६७॥
जातीफलमुशीरंचनागरंकृष्णजीरकम्।
कृष्णागरुस्तुगाक्षीरीमांसीनीलोत्पलंकणा॥६८॥
चन्दनंतगरंबालंकङ्कोलंचेतिचूर्णयेत्।

In which lavang, sudhakarpur, badiela, dalchini, nagkesar, jaiphal, khas, sonth, kala jeera, kala agru, vanshlochan, jatamansi, nilakamal, peepal, safedchandan, tagar, netrabala, sheetalchini, are in same quantity and half quantity of sugar is mixed that powder is known as 'lavangadi churna'[3].

3.2 Medieval literature

3.2.1 Raj Nighantu

मांसीतुजटिलापेशीक्रव्यादीपिशितामिशी।
केशिनीचजटाहिंस्त्राजटामांसीचमांसिनी॥९३॥
जटालानलदामेषीतामसीचक्रवर्तिनी।
माताभूतजटाचैवजननीचजटावती।
मृगभक्षाऽपिचेत्येताएकविंशतिधाभिधाः॥९,४॥॥

Various synonyms of jatamansi are mansi, jatila, peshi, karvyadi, pishita, mishi, keshani, jata, histra, jatamansi, mashini, jatala, nalda, maishi, tamshi, chakravartini, mata, bhootjata, janini, jatavati, and mrigbaksha.

सुरभिस्तुजटामांसीकषायाकटुशीतला।
कफहद्भूतदाहघ्नीपितघ्नीमोदकान्तिकृत्॥१५॥

Jatamansi is aromatic, kashsya and katu rasa yukta. It is sheetal and removes kaphavikar, bhutabadha, dosha and pittaj vikar[4].

3.3 Modern literature

3.3.1 Nighantu Adarsh

जटा- जटाअस्तिअस्थाः, यद्वाजटतित्रिदोषनाशकगुणसमुदायंगच्छति; 'जट्संघाते' ।

Jatamansi is having jata i.e. hair and have the property of pacifying the tridoshas and it is also a brilliant brain tonic, that's why it is called as Jata+mansi= Jatamansi[5].

3.3.2 Bhavprakash Nighantu

जटामांसीभूतजटाजटिलाचतपस्विनी।

मांसीतिक्ताकषायाचमेध्याकान्तिबलप्रदास्वाद्वीहिमात्रिदषास्त्रदाहवीसर्पकुष्ठनुत्॥८९॥

Jatamansi (balchad) has different sanskrit names such as jatamansi, bhootjata, jatila, tapsvani, mansi. It is tikta and kashaya rasa, medyajanan, kantikarak, balprad, ruchikar, sheetavirya, tridoshar and used in raktaprakopa, daha, visarp and kustha[6].

3.3.3 PriyaNighantu

जटामांसीभूतजटाजटिलाचपलङ्कषा।

हिमवद्गिरिप्रान्तेषुशीतलेषुप्रजायते॥३५॥

Jatamansi, bhootjata, jatila, phaldanksha are the synonyms of jatamansi and it is present in cold region of Himalayas.

मांसीमेध्यातुतिक्तास्यादनुष्णावर्णकारिणी।

रक्तवातहरीनिद्राजननीकुष्ठहारिणी॥३६॥

Jatamansi is medyavardhak, tikta, ishadushna, and beneficial for complexion. It is used for rakatchap (blood pressure), anidra (insomnia) and charmrog (skin diseases) [7].

3.3.4 Shankar Nighantu

The text contains various synonyms of jatamansi (balchad) like jatamansi, bhootjata, (Sanskrit), sanbultib (Arabia) spikenard (English) etc. Various properties are kadvi, medyajanan, kantikarak, baldayak, sheetal, rudhirvikar and it removes bhootbadha, visarp and kusthroga[8].

3.3.5 DhanvantariNighantu

मांसीकृष्णजटाहिंस्त्रानलदाजटिलामिशी।

जटाचपिशितापेशीकव्यादीचतपस्विनी॥४३॥

मांसीस्वादुकषायास्यात्कफपित्तास्त्रनाशिनी।

विषमारुतहृद्दूबल्यात्वच्याकान्तिप्रसादनी॥४४॥

Synonyms-hinstra, nalda, jatila, mishi, jata, kavyadi, tapasvani, krishnajata, pishita, peshi**Properties and actions**- Jatamansi is madhurkashya, kapha-pitta, raktavikar, cures visha and vayu, balavardhak, twagroganashak and kantivardhak[9]

3.3.6 Introduction of plant

Botanical name: *Nardostachys jatamansi*

Family Valerianaceae

Fig: 3.1 Whole plant of *Nardostachys jatamansi*

Fig: 3.2 Rhizome of *Nardostachys jatamansi*

Table 3.1: Vernacular names of *Nardostachys jatamansi*

Language or place	Name
Sanskrit	mamsi[10,13,14], jaa[10], jaila[10], bhytajata[11,12,13], jatamansi[4,5,7,8,11,12,13,15], mansi[4,5], jatila[4,5,7,9], pishita[4], mishi[4,9], kravyadi[4,9], paishi[4,9], kaishini[4], jata[4,9], hinsha[4], mata[4], nalda[4,9,14,15], maishi[4], jatavati[4], tamsi[4,5], sugandhmansi[5], sulomsa[5,15], akash mansi[5], bhootjata[7,8,15], kaishini, jata[14], mansini[4], jtala[4], chakarvartani[4], phalkasha[7], tapasvani[9,11,12,13,14,15], krishnajata[9], pishita[9,14], vilomasa[14], mura[14], bhootjata[4], janni[4], mrigbaksha[4].
Hindi	balchara[5,6,12,13], bal-chir[11], jatamansi[5,6,11,12,14]
English	nardus root[10], musk root[11,12,13], Indian spikenard[11,12,13], Indian nard[11,12], spike nard[5,8,14,15]
Bengali	jatamamsi[5,6,10,11,12,13], balchara[5]
Guajarati	baalchad[10,13], kalichad[10], jatamansi[6,11,14,15]
Kannada	bhootajata[10,13], ganagila maste[10], jatamansi[14,15]
Kashmiri	bhutijata[10,12,13]
Malayalam	manchi[10,13], jatamanchi[10], jatamansi[5,6,8,15], balchara[5]
Marathi	jatamansi[8,10,13,14], jatamavshi[11,12]
Oriya	jatamansi[10,13]
Punjabi	billilotan[6,10,12,13], balchhar[10], chharguddi[10], jatamansi[11]
Assamese	jatamamsi[10,12], jatamangshi[10], jatamansi[13]
Telugu	jatamansi[5,13,15], jatamams[10], balchara[5], jatamanshi[6], jatamanis[14]
Urdu	sambul-ut-teeb[10,15]
Tamil	jatamashi, jatamanji[10,12,13], jatamansi[14,15]

Table 3.2: Sanskrit Names of *Nardostachys jatamansi* in various literatures

S.N	C.S	S.S	R.N	N.A	B.N	P.N	Sh. N	D.N
Mamsi	-	-	-	-	-	-	-	-
Jatila	-	-	+	+	+	+	-	+
Jaa	-	-	+	-	-	-	-	-
Jatamansi	+	+	+	+	+	+	+	-
Bhytajata	-	-	-	-	-	-	-	-
Jaila	-	-	-	-	-	-	-	-
Mansi	-	-	+	+	+	-	-	-
Kravyadi	-	-	+	-	-	-	-	+
Pishita	-	-	+	-	-	-	-	+
Mishi	-	-	+	-	-	-	-	+
Jata	-	-	-	-	-	-	-	+
Kaishini	-	-	+	-	-	-	-	-
Mata	-	-	+	-	-	-	-	-
Hinshtra	-	-	+	-	-	-	-	+
Maishi	-	-	+	-	-	-	-	-
Tamshi	-	-	+	+	-	-	-	-
Jatavati	-	-	+	-	-	-	-	-
Sulomsa	-	-	-	+	-	-	-	-
Sugandhmansi	-	-	-	+	-	-	-	-
Akash mansi	-	-	-	+	-	-	-	-
Kaishini	-	-	+	-	-	-	-	-
Bhootjata	-	-	+	-	+	+	+	-
Jatala	-	-	+	-	-	-	-	-
Mansini	-	-	+	-	-	-	-	-
Chakarvartani	-	-	+	-	-	-	-	-

Jata	-	-	+	-	-	-	-	-
Phaldanksha	-	-	-	-	-	+	-	-
Tapasvani	-	-	-	-	+	-	-	+
Krishnajata	-	-	-	-	-	-	-	+
Peshi	-	-	+	-	-	-	-	+
Mura	-	-	-	-	-	-	-	-
Vilomasa	-	-	-	-	-	-	-	-
Mrigbaksha	-	-	+	-	-	-	-	-
Janini	-	-	+	-	-	-	-	-
Nalda	+	-	+	-	-	-	-	+
Balchad	-	-	-	+	+	-	+	-

S.N: Sanskrit Name, C.S: Charaka Samhita, S.S: Susruta Samhita, R.N: Raj Nighantu, N.A: Nighantu Adarsh, B.N: Bhavprakash Nighantu, P.N: PriyaNighantu, Sh.N: Shankar Nighantu, D.N: Dhanvantari Nighantu

3.3.7 Taxonomic classification

Kingdom: Planate

Division: Mangnoliophyta

Class: Mangnoliopsida

Order: Dipsacales

Family: Valerianaceae

Genus: Nardostachys

Species: jatamansi[11, 12, 16]

3.3.8 Habitat

It is perennial herb propagated by its underground parts. It is distributed throughout the alpine and a sub alpine region of India at the height of 3300-5000m.The plant grows on the open stony and the grassy slope. It is also distributed in South West China, Sikkim, Afghanistan, Nepal, and Pakistan[12, 17, 18].

3.3.9 Morphological characters

Leaves are long pink or blue, rosy in dense cymes, ovate and sessile.

Flowers are usually oblong, bracts having white creamy sometimes rosy or slightly pink in color present in clusters. Corolla is 4 in number and having 5 lobes capitate stigma, acuminate apex. Calyx is present a top of the ovary.

Rhizomes of the plant are dark grey in color, covered with brown hairs. Internally it is reddish brown in color.

Fruit of the plant is shaggy small up 4mm in length[12, 13, 14, 16, 19].

3.3.10 Microscopical characters

The transverse section of the rhizome shows the several layers of flattened polyhedral cells. It also contains the prismatic crystals with it. Oil cells with the brown color are prominent, it also contains vascular bundles, in periphery number of spiral vessels, endosperm, parenchymatous cells and idoblasts and starch grains are present[10, 20].

3.3.11 Ayurvedic properties

- Rasa (taste) : Tikta (pungent)[14,15], Kashya (astringent)[14,15], Madhur (sweet)[14,15], Katu(bitter)[16]
- Guna (properties) : Laghu (lightness)[14,15,16], Snigdha (unctuousness)[14,15,16]
- Virya (potency) : Sheeta (cold)[14,15,16]
- Vipak (metabolism) : Katu (bitter)[14,15]
- Doshkarma : Tridoshahar[15]

3.3.12 Different actions of *Nardostachys jatamansi*

The plant *Nardostachys jatamansi* posses various actions which is mentioned in table 2.3.

Table 3.3: Different actions of *Nardostachys jatamansi*

Sr. No	Karma (Actions)	English meanings
1.	Dahaprasmanan	Which subsides the burning sensation
2.	Vednasthapan	Analgesics

3.	Vranya	Which improves the color and complexion
4.	Sangyasthapan	Which restoring the consciousness
5.	Medya	Brain tonic
6.	Nidrajanan	Which induce sedation
7.	Balya	Which improves the muscular strength
8.	Deepan	Stomachic (promoting the appetite)
9.	Pachan	Digestives (help in digestion)
10.	Anuloman	Carminative (which prevent the formation of gas in GIT
11.	Yakritutejak	Which stimulate the liver
12.	Haridya	Cardio-protective
13.	Vajikaran	Aphrodisiac
14.	Jwarghan	Anti-pyretic
15.	Artavjanan	Which encourages menstrual bleeding
16.	Swedjanan	Which promoting sweat
17.	Kusthaghan	Which prevent the skin diseases
18.	Keshvardhak	Which promote hair growth

3.3.13 Part used

Root, rhizome[12, 14, 15]

2.3.14 Dose

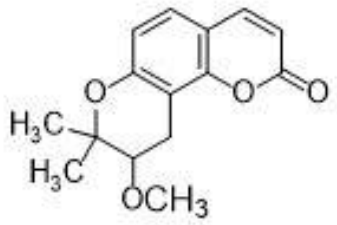
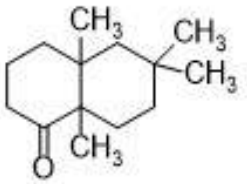
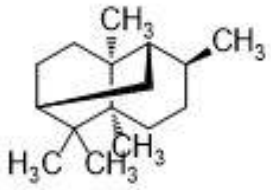
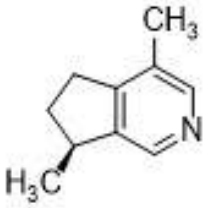
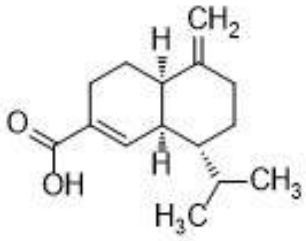
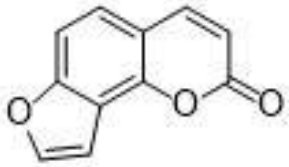
1-3gm or 2-4gm [14, 15]

3.3.15 Chemical constituents

Rhizomes and roots of the plant contains number of chemicals such as essential oil which is pale yellow in color and having pleasant odour i.e. rich in coumarins and sesquiterpines (jatamansone, valerone, jatamansol, jatamansic acid, dihydrojatamansin, nardosatchone). Some other

constituents are jatamol A, jatamol, nardosinone, spirojatamol, jatamansinone, oreoseoloi, oroseolol, oreselone, valeranal, seselinnardostachyins, seychelane, sugar, resins, starch etc. volatile essential oil (0.5%) (oleumjatamansi),gum, sugar, resin, starch, bitter extractive matter[21].

Table 3.4: Chemical structure of chemical constituents

 Valeranol	 Jatamansone
 Patcholi alcohol	 Nardostachone
 Jatamansic acid	 Angelicin

3.3.16 Adulterant

This plant is adulterated with rhizomes of *Selinum vaginatum* (Apiaceae) which contains a volatile oil[12].

3.3.17 Few formulations

Rakshoghan ghrit, sarvoshadhisanan, mansyadi kwath, madhuparnyadi taila, cangeri ghrta, trutyadi yoga, kuluthadi ghrta, hriberadighrta, khadiradi gutika, padmataila, amrtaditaila. madhuparnyaditaila, tapaswinivati, chandsnadicurana, jestalabangadi, rachhognaghrit, jatamansi ark, madhuparnyaditaila and mansi churan[5,14,15,22].

3.3.18 Recent studies

3.3.18.1 Pharmacognostical study

Various investigations on *Nardostachys jatamansi* like morphological characters, microscopical, physicochemical evaluation, phytochemical screening and TLC profile of powdered crude drug were carried out and salient qualitative and quantitative parameter were reported[22].

3.2.18.2 Analytical studies

Different 29 compounds are identified in the essence of *Nardostachys jatamansi*; the essence was prepared in clevenger apparatus by hydro-distillation. Gas chromatography-mass spectroscopy method is used to identify the essence compounds[24]. Essential oil from the two species of *Nardostachys jatamansi* determined by GC-MS technique for the analysis of essential oils. Both the oils contain high amount of sesquiterpenes in which jatamansone were the major sesquiterpine and α-gurjunene. Physical and chemical parameters are also done on both species such as refractive index, specification rotation, iodine number, specific gravity, saponofication value, acid number etc[22]. New sesquiterpene acid, pyranocoumarin and nardin were isolated from the rhizomes of *Nardostachys jatamansi* which were characterized by spectral studies. X-ray crystallographic studies are used for the stereochemistry of nardin[25.] RP-HPLC GMS used to analyze the metabolite profile of *Nardostachys jatamansi*, the 70 % ethanolic extract showed the presence of polyphenols and flavoinds and hexane extract showed fatty acids, sesquiterpines etc. Ethanolic extract had showed more potent reducing anti-oxidant activity then hexane extract[26].

3.3.18.3 Pharmacological studies

3.3.18.3.1 Hepatoprotective activity

Ethanolic root extract of *Nardostachys jatamansi* posses the hepato protective activity by reducing the serum level alkaline phosphatase and transaminase[12, 16, 18, 27]. Ethanolic extract of *Nardostachys jatamansi* is evaluated for the hepatoprotective activity by using D-galactosamine

induced hepatoprotective model. The activity was evaluated by using different biochemical parameters like alanine aminotransferase (ALT), albumin (ALB), aspartate aminotransferase (AST), lactate dehydroginase (LDH), total protein (TP) and serum cholesterol (CHL).[28]

3.3.18.3.2 Cardio protective activity

When the doxorubicin is given to the rats shows the myocardial damage which is demonstrated by the elevation of serum enzymes. Then the treatment of plant extract is given which restores the antioxidant enzyme activity and lowers the lipid peroxides level to the normal[12, 17].

3.3.18.3.3 Antifungal activity

The essential oil which is present in the plant shows the activity against the *Aspergillus niger*, *Aspergillus flavus*, and *Fusariumoxysporum* etc[12, 16, 27].

3.3.18.3.4 Nootropic activity

When the ethanolic extract of the plant is given to the young and aged mice it improves the learning as well as the memory and also reversed the amnesia which is induced by the diazepam and scopolamine. So the plant has proved that memory restorative activity. Ethanolic extract of plant show the activity by improving the memory and learning of the young mice[16, 27].

3.3.18.3.5 Anti-inflammatory activity

The methanolic extract of plant shows anti-inflammatory activity by inhibiting the endotoxin shock and reducing the production of IL-1, IL-6, TNF, and IFN. Extract of *Nardostachys jatamansi* shows anti- inflammatory activity against LPS induced inflammatory responses[29, 30].

3.3.18.3.6 Neuroprotective activity

Alcoholic extract of *N. jatamansi* in the dose of 250mg/kg (for 15 days) protected rats against focal ischemia. It improving the inhibiting the lipid peroxidation, glutathione content and activity on the Na+/K+ATPase and catalase enzyme systems[13, 16].

3.3.18.3.7Antidepressant activity

Root extract of jatamansi shows antidepressant activity which is indicated as the increased levels of inhibitory amino acids, central monoamines, serotonin, gamma-amino butaric acid, taurine and 5-hydroxyindoleacetic acid. Alcoholic root extract of *Nardostachys jatamansi* shows the anti-depressant activity by increasing the inhibitory amino acids, levels of serotonin, central monoamines[12, 27].

3.3.18.3.8 Antioxidant activity

Antioxidant activity is showed by the aqueous root extract of the plant in haloperidol-induced catalepsy rat model. Activity is investigated by number of biochemical and behavioral parameter. Ethanolic extract of jatamansi were given to the Wister rats in two doses. Study show the radical scavenging activity showed by low IC_{50} value. Pre-treatment with the extract decrease the nitrite level and lipid peroxidation level. Aqueous root extract of jatamansiposses the anti-oxidant activity by measuring biochemical parameters and behavioral parameters and provide protection against the lipid peroxidation. Hydro-alcoholic extract of *Nardostachysjatamsnsi* for the antioxidant property in wistar rats. The extract also shows the anti-stress activity due to is anti-oxidant activity[10, 12, 16, 3].

3.3.18.3.9 Anti-Parkinson activity

Hydro-alcoholic root extract of jatamansi is investigated for the activity in haloperidol induced Parkinsonism which is compared with combination of L-dopa and carvidopa. The altered levels were restored[27].

CHAPTER 4

RATIONALE AND SCOPE OF STUDY

4.1 Rationale of study

Calculation of maximum active constituents in a plant is laborious task as various factors like climate, light, rain fall, soil, temperature, humidity etc plays an important role in evaluation of active constituents in a particular plant. It is reported that seasons play an important role in the activity of drug. It is well explained in the classical literature like Charak Samhita, Susruta Samhita etc. The present work deals comparative pharmacognostic, analytical and in-vitro anti-microbial study of *Nardostachys jatamansi* collected in three different seasons.

CHAPTER 5

OBJECTIVE OF THE STUDY

5.1 Aim and objective

5.1.1 Aim

Comparative study of *Nardostachys jatamansi* (Valerinaceae) with special reference to three seasons.

5.1.2 Objectives

1. Collection of plant according to seasons
2. Authentication of plant from Guru Nanak Dev University, Amritsar
3. Pharmacognostic study (macroscopic characters, microscopic characters, powder characters)
4. Preliminary phytochemical investigation
5. Identity, Purity and Strength (extractive value, ash value etc)
6. TLC and HPTLC study
7. Anti-microbial activity

CHAPTER 6

MATERIALS AND RESEARCH METHODOLOGY

6.1 Equipment used

Table 6.1 List of equipments

Sr. No.	Material
1.	Weighing balance
2.	Grinder
3.	Sieves
4.	Plastic containers
5.	Beakers
6.	Crucible
7.	China dish
8.	Simple Microscope
9.	Dissecting Microscope
10.	Electronic Microscope
11.	Hot plate
12.	Water bath
13.	Hot air oven
14.	Magnetic stirrer
15.	UV
16.	Measuring cylinders
17.	TLC Plates
18.	TLC Chamber
19.	HPTLC
20.	UV Chamber
21.	Micropipettes
22.	Volumetric flasks

6.2 Chemical used

Table 6.2 List of Chemicals

S. No.	Material	S. No.	Material
1.	*Nardostachys jatamansi* (jatamansi)	**20.**	Sodium picrate
2.	Methanol	**21.**	Pyridine
3.	Petroleum ether	**22.**	Sodium nitroprusside
4.	Chloroform	**23.**	Glacial acetic acid
5.	Hydrochloric acid	**24.**	Phloroglucinol
6.	Ferric chloride	**25.**	Bromine
7.	Lead acetate	**26.**	Acetic acid
8.	Sodium hydroxide	**27.**	Potassium permanganate
9.	Copper sulphate	**28.**	Potassium dichromate
10.	Ninhydrin	**29.**	Fehling's A & Fehling's B
11.	Gallic acid	**30.**	Benedict's reagent
12.	Tannic acid	**31.**	Magnesium turnings
13.	Gelatin	**32.**	Sodium bicarbonate
14.	Hager's reagent	**33.**	Wagnar' reagent
15.	Dragandroff's reagent	**34.**	Mayers reagent
16.	Conc. Sulphuric acid	**35.**	Silica gel g
17.	Sudan III	**36.**	Nutrient Agar
18.	Iodine	**37.**	Ethanol
19.	E coli	**38.**	Di ethylamine

6.3 Research Methodology

Table 6.3: Research Methodology

Sr. No.	Methodology
1.	**Selection of crude drug**
2.	**Literature review**
3.	**Collection of crude drug** The sample of *Nardostachys jatamansi* will be collected from Barot valley of Himachal Pradesh Distt. Mandi.
4	**Authentication** The authentication of the rhizome sample of *Nardostachys jatamansi* will be done from Department of Botanical & Environmental Sciences Guru Nanak Dev University, Amritsar (India)
5	**Pharmacognostical work** • Macroscopic study • Microscopic study • Powder characters
6	**Analytical study** • Foreign matter • LOD • Ash value Acid insoluble ash value Water soluble ash value • Extractive values Water soluble extractive values Alcohol soluble extractive values
7.	**Chromatographic studies** • Performance of TLC & HPTLC study
8.	**Pharmacological activity** • Antimicrobial study

CHAPTER 7

EXPERIMENTAL WORK

7.1 Material and Methods:

7.1.1 Identification of plants

Nardostachys jatamansi is identified by referring the morphological and microscopical characters in different nighantus and books related to medicinal plants.

7.1.2 Collection of plant

Nardostachys jatamansi is collected according to seasons (in the month of August, September and October) from Barot valley, Distt. Mandi, Himachal Pradesh

7.1.3 Authentication of plant

The collected drugs are submitted in Guru Nanak Dev University, Department of Botanical and Environmental sciences, Amritsar for authentication purpose.

7.1.4 Preparation of powder

Dried samples of *Nardostachys jatamansi* is coarsely powdered using mixture grinder.

7.1.5 Storage of plant material

The dried samples are stored in air- tight plastic containers.

7.2 Pharmacognostic study

7.2.1 Macroscopic characters

Size: The measurement of the sample is measured with the help of a graduated ruler.

Color: Samples is examined under diffused day light.

Surface: The material is touched to determine if it is smooth or rough.

Fracture: The material is bending or ruptured.

Odor: The plant material is powdered then its odor is determined.

7.2.2 Microscopic characters

Entire material:

Transverse section of sample is taken and mounted on slides and the stained with reagent phloroglucinol and conc. HCL and examined under binocular microscope under 10x and 45x and then images are taken with the help of micromax A107, 8 megapixel camera.

Powdered material:

For evaluation the powder characters of the samples sufficient amount of powder is mounted on microscopic slides and stained with phloroglucinol and conc. HCL and examined under

binocular microscope under 10x and 45x and images are taken with the help of micromax A107, 8 megapixel cameras.

7.3 Identity, Purity and Strength

7.3.1 Determination of Foreign matter

Foreign matter is determined by weighing the sample about 100-500 mg or the amount which is specified in the monograph and spread in the thin layer. The unwanted material is identified by means of lens (6x) or naked eye. Separated material is collected and calculated the percentage of foreign matter.

7.3.2 Determination of Total ash

Incinerate 2 to 3 gm of drug in tarred silica dish at a temperature not above 450^0 C till it become free from carbon, cool and weigh. Then determination of the percentage of ash is done with reference to the air dried drug.

7.3.3 Determination of Acid insoluble ash

Acid insoluble ash is determine by boiling the ash which is obtained in (7.3.2) with 25 ml of HCL for 5 minutes. Then collect the insoluble material on filter paper (ash less filter paper). After that it is washed with warm water and ignition is done to the constant weight. Then calculate the percentage of ash.

7.3.4 Determination of Water soluble ash

The obtained ash is boiled for 5 minutes by adding 25 ml of water and then collects the insoluble material in gooch crucible, and then washing is given with warm water and ignites for 15 minutes at 450^0C temperature. Deduct the weight of insoluble material from the weight of ash and calculate the percentage.

7.3.5 Determination of Alcohol soluble extractive value

5g of powder is macerate with 100 ml alcohol in the closed flask of specified strength for 24 hours. The shaking of flask repeatedly throughout six hours and then it is placed undisturbed for 18 hours. Filter it quickly and evaporate to dryness in flat bottom dish and dry at the temperature of 105^0C. Then calculation of extractive matter is done.

7.3.6 Determination of Water soluble extractive value

For water soluble extractive value, maceration of 5 g drug is done with chloroform water in closed flask for 24 hours. Shaking of flask is done repeatedly for 6 hours. Then it is placed for 18

hours untouched. Evaporate off the 25 ml filtrate in a dish, and dry at the temperature of 105^0C. Then calculation of extractive matter is done.

7.3.7 Determination of Ether soluble extractive value

Transfer the appropriate quantity of drug in the thimble for extraction. Extraction is done with the help of ether. The process is continued for 6 hrs. The extract is filtered quantitatively in evaporating dish. Vaporization of solvent is with the help of water bath. Residue which is obtained is dry at 105^0C to constant weigh. Calculate the ether soluble extractive value.

7.3.8 Determination of Moisture content (Loss on drying)

For determination of moisture content, 1.5 g of powder drug is taken in porcelain dish and dry it at the temperature of 105^0C for 5 hours. The process of weighing and drying is continued for1 hour till the difference of two weighing is less than 0.25%. After the constant weight is reached dry it in desiccators.

7.4 Preliminary phytochemical investigation

7.4.1 Test for alkaloids: The ethanolic extracts is dissolved in dilute Hydrochloric acid and filtered. These filtrates are used for following tests:

- **Mayer's test**: When extracts is treated with Mayer's reagent (potassium mercuric iodide). Development of cream colored precipitate indicates the existence of alkaloids.
- **Wagner's test**: When extracts is treated with Wagner's reagent (iodine in potassium iodide), there is formation of reddish brown precipitate which indicates the presence of alkaloids.
- **Dragendroff's tes**t: Extracts are treated with Dragendroff's reagent (solution of potassium bismuth iodide). Reddish brown precipitate is obtained which indicates the presence of alkaloids.
- **Hager's test**: When extracts are treated with Hager's reagent (saturated picric acid solution). Yellow colored precipitate is obtained which identifies the presence of alkaloids.

7.4.2 Test for carbohydrates: Ethanolic extract are treated with following tests:

- **Molisch's test**: Extracts are treated with 2 drops of alcoholic alpha napthol solution in a test tube. If there is the formation of violet ring at the junction it indicates the existence of carbohydrates.

- **Benedict's test**: Benedict's reagent is treated with extracts and heated gently formation of orange red precipitate indicates the presence of reducing sugars.
- **Fehling's test**: Extracts are hydrolyzed with dil. HCL, and neutralized with alkali and then heated with Fehling's A and B solution formations of red precipitate indicate the presence of reducing sugars.

7.4.3 Test for glycosides

7.4.3.1 Test for cardiac glycosides

- **Baljet's test:** Thick section shows yellow to orange color with sodium picrate.
- **Legal's test**: 1ml pyridine and 1ml sodium nitroprusside is added to alcoholic or aqueous extract gives red to Pink color.
- **Test for deoxysugars (Keller-Killiani test)**: To the extract add one drop of 5% $FeCl_3$, glacial acetic acid and conc. H_2SO_4. Gives reddish brown color at the junction of two layers. Upper layer appear to bluish green color. .

7.4.3.2 Test for anthraquinone glycosides

- **Borntrager's test:**

  Take 3 ml of extract and add dil. H_2SO_4 in to it and then boil and filter. When the filtrate is become cool, then add equal volume benzene or chloroform in to it and shake well and then separate the organic solvent and add ammonia in to it then ammonical layer turns pink or red. Then shake it well. Separate organic layer, add equal volume dilute ammonia. Ammonical layer shows pinkish red color.
- **Modified Borntrager's test for C-glycosides:** Take 5 ml extract and add 5 ml 5% $FeCl_3$ and 5 ml dil. HCL then heat it for 5 min in boiling water bath. After cooling add benzene or any organic solvent.

7.4.3.3Test for saponin glycosides

- **Foam test:** Drug extract or dry powder is shaking vigorously with water. Persistent foam observed.
- **Heamolytic test:** To the drug extract or dry powder add one drop of blood on glycolsidal slide. Heamolytic zone appears.

7.4.3.4 Test for cynogenetic glycoside

- **Guidnard reaction or sodium picrate test**: Firstly soak a filter paper strip in 10% picric and then in 10% sodium carbohydrate, dry. Moistened powdered is placed in a conical

flask drug and cork it, and then place the above filter paper strip in the slit in cork. Then the filter paper turns brick red or maroon color

- 3% aqueous mercurous nitrate solution is adding in the dry powder or extract then metallic mercury forms.
- A piece of filter paper dips in guaiacum resin and moist it with dilute copper sulphate solution and then expose it to freshly cut surface of the drug, then blue stain is produced.

7.4.3.5 Test for coumarin glycosides

- Coumarin glycosides have aromatic odor.
- When alcoholic extract is made alkaline, then it shows blue or green fluorescence.
- Dry powder is taken in test tube and cover with filter paper and then soaked in dilute NaOH add keep in water bath. After sometimes it shows yellowish-green fluorescence when exposed to ultra violet light.

7.4.4 Test for tannins and phenolic compound

- To 2-3ml of aqueous or alcoholic extract, add few drops of following reagents:

1. 5% $FeCl_3$ solution: deep blue-black color.
2. Lead acetate solution: White ppt.
3. Gelatin solution: White ppt.
4. Bromine water: discoloration of bromine water.
5. Acetic acid solution: red color solution.
6. Potassium dichromatic: red ppt.
7. Dilute iodine solution: transient red color.
8. Dilute HNO_3: reddish to yellow color.
9. Dilute NH_4OH: and potassium ferricyanide solution: red color solution.
10. One drop NH_4OH, excess 10% $AgNO_3$ solution. Heat for 20 min. in boiling water bath. White ppt. observed then dark silver mirror deposits on wall on test tube.
11. Dil. Potassium permanganate solution: discoloration.

- **Shinoda test:** To dry powder or extract and add 5ml 95% ethanol, 0.5g magnesium turnings and few drops of conc.HCL added. Orange, pink, red to purple color appears. Add ethanol before adding the acid to avoid accidents from a violent reaction and to dissolve the colored compounds into the upper phase. Zinc instead of magnesium is used, only flavanols give weak pink to magnetic color or no color.

- **Sulphuric acid test:** When sulphuric acid (66% or 80%) is added to flavones and flavonol or dissolve into it they give a deep yellow solution. Chalcones and aurones show red or bluish solutions. Flavanes give orange to red colors.

7.5 Thin Layer Chromatography

Preparation of test sample: Coarse powder of different samples of *Nardostachysjatamansi* are extracted separately in soxhlet apparatus with ethanol for 6 hours and then these extracts are concentrated using water bath evaporator.

Saturation of TLC chamber: The TLC chamber is saturated with solvent system for 30 min.

TLC plates:

Application of spots:

Single spot and band spots

Development of plates: The plates are development in TLC jar and development for 7cm and allowed to air dry.

Visualization: TLC plates are observed under visible or UV light.

Calculation of retardation factor (Rf) value:

Formula for using Rf value:

$$Rf = \frac{\text{Distance travelled by spot}}{\text{Distance travelled by mobile phase}}$$

7.6 High performance Thin layer Chromatography

Examination of HPTLC is performed on aluminum pre coated plates with silica gel $60F_{234.}$ Samples are placed on the plates and then air dried. Plates are developed with petroleum ether: acetone which is prepared in vapor equilibrated Desaga chamber. Equilibration time of vapor was 25 min. After development, the plates are air dried for 5 min. The samples are scanned at 254 nm with DesagaProquant software.

7.7 Antimicrobial activity

Preparation of extract: 250 ml of ethanol is used for theextraction of air dried drug with the help of Soxhlet apparatus. The extracts are collected in sterile bottles.

Collection of Test Microorganisms:

The pathogenic micro-organisms are collected from Biotechnology lab in Lovely Professional University, Punjab. The micro-organisms are:

Staphylococcus aureus

Staphylococcus epidrmidis

Escherichia coli

Pseudomonas aeruginosa

Antimicrobial Assay:

The anti- microbial activity of different samples of Nardostachys jatamansi is examined with the help of agar well diffusion method. The sterilize agar media is poured into the petri-plates and allowed for solidification. After solidification, wells are made in to the petri-plate with the help of sterile cork borer (6mm). After that pathogenic cultures are swabbed on the respective agar plates using sterilized cotton swabs. The ethanolic extract are loaded into the respective wells and incubated at 37^0C for 24hrs. After incubation the diameter of inhibition zones formed around each wells is measured and expressed in millimeter (mm) to evaluate the antimicrobial activity.

CHAPTER 8
RESULTS AND DISCUSSIONS

8.1 Authentication

The sample of *Nardostachys jatamansi* (Valerianceae) is authenticated by Guru Nanak Dev University, Department of Botanical and Environmental Sciences, Amritsar.

8.2 Review of literature

Review of literature of *Nardostachys jatamansi* suggested that it is found in the ancient, medieval and modern period. Various synonyms of *Nardostachys jatamansi* are mentioned in classical texts are mansi, jatila, mata, bhootjata, tapsvani, krishnjata, pishita, peshi, janini, jatavati, mrigbaksha, jatamansi etc.

According to rasa-panchak, the rasa of the plant is tikta (bitter), kashaya (astringent) and madhur (sweet), guna is laghu (lightness) and snigdha (unctuousness), virya is sheeta (cold) and vipak (metabolism) is katu and doshkarma is tridoshahar. Due to its snigdhaguna, it is vatashamak, pittashamak is due to tikta and kaphashamak by kashaya and madhur rasa. So, it is tridoshshamak but mostly it is kapha-pittashamak. It contains number of chemical constituents such as volatile oil, coumarins and sesquiterpines etc. The rhizomes of the plant is used to cure the various disease like: *vednasthapan* (analgesics), *sangyasthapan* (which restoring the consciousness), *medya* (brain tonic), *balya* (strengthen body), *haridya* (cardio-protective), *jwarghan* (anti-pyretic),*kusthaghan* (prevent skin diseases), *keshvardhak* (promote hair growth). It is also investigated for various activities like: hepatoprotective, cardio protective, anti-fungal,anti-depressant and anti-oxidant activity. Few formulations reported for plant are rakashoghnaghrit, mansyadikwath, tapaswinivati, madhuparnyaditaila, madhuparnyaditaila madhuparnyaditaila, jatamansi ark, mansichuran etc.

8.3 Pharmacognostic studies

8.3.1 Macroscopic characters of rhizomes

Table 8.1: Macroscopical characters of rhizomes of *Nardostachys jatamansi* of sample 1, 2 and 3

S. No	Macroscopical character	Sample 1	Sample 2	Sample 3
1.	Color	Black	Brown	Brown
2.	Odor	Characteristic	Characteristic	Characteristic
3.	Dimension	7x1cm	6x2cm	6x2cm
4.	Shape	Longitudinal	Longitudinal	Longitudinal
5.	Striation	Present	Absent	Absent
6.	Rootlets	Absent	Absent	Absent
7.	Surface	Rough and consist of hairs	Rough and consist of hairs	Rough and consist of hairs
8.	Fracture	Short	Short	Short

8.3.1.1 Dried samples

Fig 8.1: Rhizome of *Nardostachys jatamansi* of sample 1 (collected in August)

Fig 8.2: Rhizome of *Nardostachys jatamansi* of sample 2 (collected in September)

Fig 8.3: Rhizome of *Nardostachys jatamansi* of sample 3 (collected in October)

8.3.2 Microscopic characters of rhizomes of *Nardostachys jatamansi*

The microscopical characters of three samples are moreover similar such as cork, cortex, cambium, phloem, xylem and pith region. Difference is in the layers of xylem cells which are less in sample 1 as compared to sample 2 and 3.

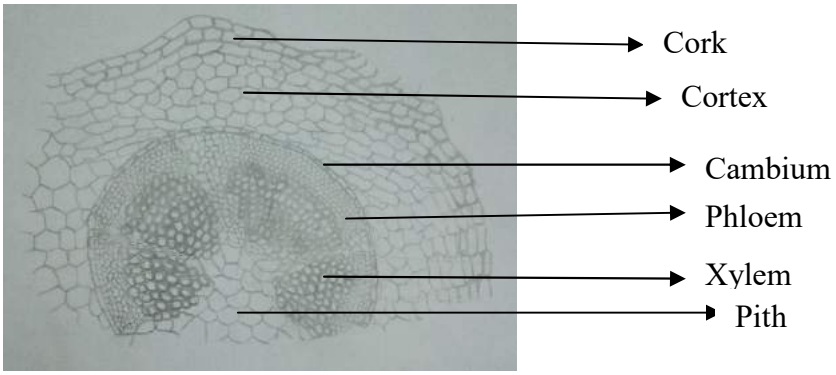


Fig 8.4: Schematic diagram of T.S of rhizomes of *Nardostachys jatamansi*

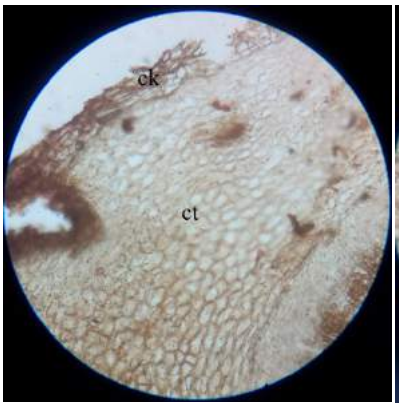


Fig 8.5: Cork (ck) and cortex (ct) of sample 1

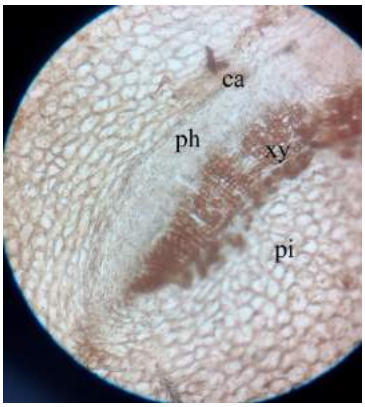


Fig 8.6: Cambium (ca), phloem (ph), xylem (xy) and pith (pi) of sample 1

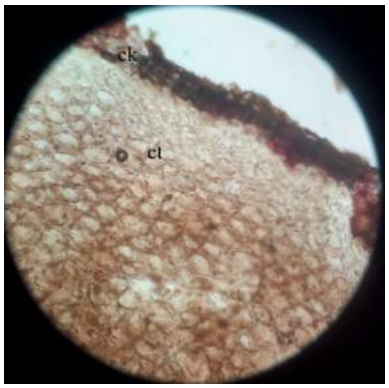


Fig 8.7: Cork (ck) and cortex (ct) of sample 2

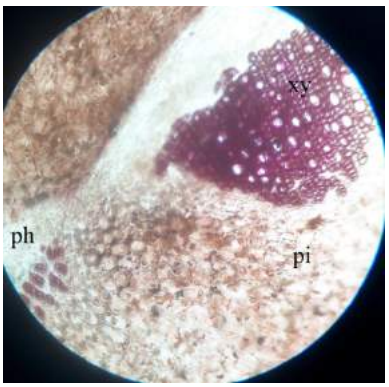


Fig 8.8: Phloem (ph), xylem (xy) and pith (pi) of sample

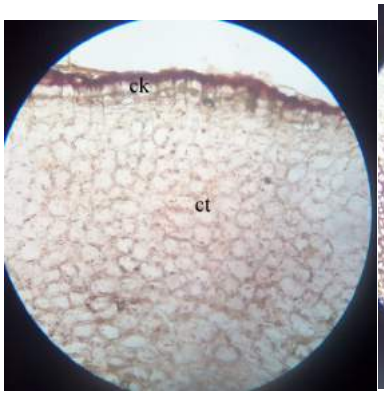


Fig 8.9: Cork (ck) and cortex (ct) of sample 3

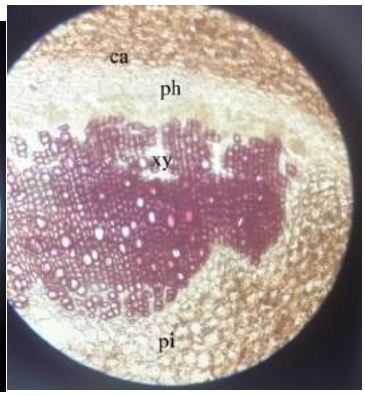


Fig 8.10: Cambium (ca), phloem (ph), xylem (xy) and pith (pi) of sample 3

8.3.2.1 Powder Character

Fig 8.11: a) Spiral vessels b) Parenchymatous cells c) Fiber observed in sample 1

Fig 8.12: a) Spiral b) Bundle of spiral vessels of sample 2

Fig 8.13: a) Cork cells b) Pitted vessels c) Spiral vessels of sample 3

8.4 Identity, purity and strength

8.4.1 Determination of Total ash

Table 8.2: Determination of Total ash of sample 1

S. No	Weight of drug	Wt. of empty crucible (Before ignition)	Drug + crucible (After ignition)	Weight of ash obtained	Total ash	Mean	Std. value
1.	2.003g	23.846g	23.744g	0.102g	5.0%	6.23%	Not more than 9 %
2.	2.006g	22.884g	22.734g	0.150g	7.4%		
3.	2.005g	22.884g	22.756g	0.128g	6.3%		

Table 8.3: Determination of Total ash of sample 2

S. No	Weight of drug	Wt. of empty crucible (Before ignition)	Drug +crucible (After ignition)	Weight of ash obtained	Total ash	Mean	Std. value
1.	2.190g	20.128g	19.967g	0.161g	7.3%	6.63%	Not more than 9 %
2.	2.005g	21.561g	21.408g	0.153g	7.6%		
3.	2.102g	21.095g	20.988g	0.107g	5.09%		

Table 8.4: Determination of Total ash of sample 3

S. No	Weight of drug	Wt. of empty crucible (Before ignition)	Wt. of crucible + drug (after ignition)	Weight of ash obtained	Total ash	Mean	Std. Value
1.	2.02g	22.23g	22.39g	0.16g	7.9%	8.3%	Not more than 9 %
2.	2.08g	21.20g	21.38g	0.18g	8.6%		
3.	2.01g	19.97g	20.14g	0.17g	8.4%		

All the three samples lie within the standards which are mentioned in the Ayurvedic Pharmacopoeia of India. The ash value is found to be less in sample 1 than sample 2 and 3.

8.4.2 Determination of Acid insoluble ash

Table 8.5: Determination of Acid insoluble ash of sample 1

S. No	Wt. of drug	Wt. of empty crucible	Wt. of crucible + drug (acid treatment)	Total acid insoluble ash	% age	Mean	Std. Value
1.	2.003g	23.846g	23.907g	0.061g	3.04%	4.1%	Not more than 5%
2.	2.006g	22.884g	22.987g	0.103g	5.1%		
3.	2.005g	19.864g	19.95g	0.086g	4.2%		

Table 8.6: Determination of Acid insoluble ash of sample 2

S. No	Wt. of drug	Wt. of empty crucible	Wt. of crucible + drug (acid treatment)	Total acid insoluble ash	% age	Mean	Std. Value
1.	2.190g	20.128g	20.218g	0.09g	4.10%	4.6%	Not more than 5%
2.	2.005g	21.561g	21.663g	0.102g	5.08%		
3.	2.102g	21.095g	21.195g	0.1g	4.98%		

Table 8.7: Determination of Acid insoluble ash of sample 3

S. No	Wt. of drug	Wt. of empty crucible	Wt. of crucible + drug (acid treatment)	Total acid insoluble ash	% age	Mean	Std. Value
1.	2.02g	22.23g	22.31g	0.08g	3.9%	4.0%	Not more than 5%
2.	2.08g	21.20g	21.30g	0.1g	4.8%		
3.	2.01g	19.97g	20.04g	0.07g	3.4%		

All the samples lie within the standard which is given in Ayurvedic Pharmacopoeia of India. It is almost same in all samples.

8.4.3 Determination of Moisture content (Loss on drying)

Table 8.8: Determination of moisture content (Loss on drying) of sample 1

S. No	Weight of drug	Weight of Petri dish+ drug (Before drying)	Weight of Petri dish+ drug (After drying)	Loss on drying	%age	Mean
1.	3.329g	31.477g	31.162g	0.315g	9.4%	8.5%
2.	3.720g	35.560g	35.271g	0.289g	7.7%	
3.	3.527g	31.665g	31.36g	0.305g	8.6%	

Table 8.9: Determination of moisture content (Loss on drying) of sample 2

S. No	Weight of drug	Weight of Petri dish+ drug (Before drying)	Weight of Petri dish+ drug (After drying)	Loss on drying	%age	Mean
1.	3.329g	31.439g	31.162g	0.277g	8.3%	8.5%
2.	3.720g	32.776g	32.436g	0.34g	9.1%	
3.	3.569g	35.09g	34.792g	0.298g	8.3%	

Table 8.10: Determination of moisture content (Loss on drying) of sample 3

S. No	Weight of drug	Weight of Petri dish+ drug (Before drying)	Weight of Petri dish+ drug(After drying)	Loss on drying	%age	Mean
1.	3.125g	32.246g	32.081g	0.165g	5.28%	6.3%
2.	3.130g	33.236g	32.996g	0.240g	7.66%	
3.	3.154g	32.114g	32.312g	0.198g	6.2%	

Value of loss on drying is not given in standards but the moisture content is found to be least in sample 3 as compared to other two samples**.**

8.4.4 Determination of Water soluble extractive value

Table 8.11: Determination of water soluble extractive value of sample 1

S. No	Weight of drug	Weight of empty dish	Evaporating dish+ extractable matter	Extractable matter	%age	Mean	Std. value
1.	1.832g	51.240g	51.541g	0.301g	16.4%	7.9%	Not less than 5%
2.	2.795g	52.115g	52.201g	0.086g	3.33%		
3	2.513g	50.984g	51.086g	0.102g	4.05%		

Table 8.12: Determination of water soluble extractive value of sample 2

S. No	Weight of drug	Weight of empty dish	Evaporating dish+ extractable matter	Extractable matter	%age	Mean	Std. value
1.	2.579g	52.029g	52.169g	0.140g	5.42%	5.6%	Not less than 5%
2.	2.507g	57.519g	57.672g	0.153g	5.9%		
3.	2.554g	52.123g	52.269g	0.146g	5.7%		

Table 8.13: Determination of water soluble extractive value of sample 3

S. No	Wt. of drug	Weight of empty dish	Evaporating dish + extractable matter	Extractable matter	% age	Mean	Std. value
1.	2.00g	52.02g	52.16g	0.14g	7%	5.8%	Not less than 5%
2.	2.00g	43.31g	43.43g	0.12g	6%		
3.	2.00g	51.96g	52.05g	0.09g	4.5%		

All the samples lie within the standard limits and sample 1 contains more water soluble content in it.

8.4.5 Determination of Alcohol soluble extractive value

Table 8.14: Determination of alcohol soluble extractive value of sample 1

S. No	Wt. of drug	Weight of empty dish	Evaporating dish + extractable matter	Extractable matter	% age	Mean	Std. value
1.	2.00g	51.03g	51.08g	0.05g	2.5%	2.6%	Not less than 2%
2.	2.00g	53.45g	53.51g	0.06g	3%		
3.	2.00g	51.49g	51.54g	0.05g	2.5%		

Table 8.15: Determination of alcohol soluble extractive value of sample 2

S. No	Wt. of drug	Weight of empty dish	Evaporating dish + extractable matter	Extractable matter	% age	Mean	Std. value
1.	2.00g	45.36g	45.40g	0.04g	2%	2.3%	Not less than 2%
2.	2.00g	45.35g	45.40g	0.05g	2.5%		
3.	2.00g	45.32g	45.36g	0.04g	2%		

Table 8.16: Determination of alcohol soluble extractive value of sample 3

S. No	Wt. of drug	Wt. of empty dish	Evaporating dish + extractable matter	Extractable matter	% age	Mean	Std. value
1.	2.00g	41.34g	41.41g	0.07g	3.5%	3.6%	Not less than 2%
2.	2.00g	42.31g	42.38g	0.07g	3.5%		
3.	2.00g	41.96g	42.04	0.08g	4%		

All the samples lie within the standard limits but sample 3 shows better result than sample 1 and 2.

8.5 Preliminary phytochemical investigation

Table 8.17: Preliminary phytochemical investigation

Water extract of *Nardostachys jatamansi*				**Methanolic extract of *Nardostachys jatamansi***			
Name of test	Sample 1	Sample 2	Sample 3	Name of test	Sample 1	Sample 2	Sample 3
Test for carbohydrates				**Test for carbohydrates**			
Benedict' test	+	+	+	Benedict' test	+	+	+
Barfoed' test	-	-	-	Barfoed' test	-	-	-
Bial's test	-	-	-	Bial's test	-	-	-
Tollen's test	+	+	+	Tollen's test	+	+	+
Iodine test	-	-	-	Iodine test	-	-	-
Molish'test	+	+	+	Molish'test	+	+	+
Fehling's test	+	+	+	Fehling's test	+	+	+
Selwinoff's test	-	-	-	Selwinoff's test	-	-	-
Cobalt-chloride test	+	+	+	Cobalt-chloride test	+	+	+

Iodine test	-	-	-	Iodine test	-	-	-
Tannic acid test	+	+	+	Tannic acid test	+	+	+
Test for proteins				**Test for proteins**			
Biuret test	-	-	-	Biuret test	-	-	-
Million'test	-	-	-	Million'test	+	+	+
Xanthoprotein test	-	-	-	Xanthoprotein test	-	-	-
Test for proteins containing sulphur	-	-	-	Test for proteins containing sulphur	-	-	-
5 % $CuSO_4$	+	-	+	5 % $CuSO_4$	+	+	+
5 % Lead acetate	+	+	+	5 % Lead acetate	+	+	+
Test for amino acids				**Test for amino acids**			
Ninhydrin test	-	-	-	Ninhydrin test	+	+	+
Test for tyrosine	-	-	-	Test for tyrosine	-	-	-
Test for cysteine	-	-	-	Test for cysteine	-	-	-
Test for steroid				**Test for steroid**			
Salkowski reaction	+	_	_	Salkowski reaction	-	+	-
Liebermann-reaction	-	-	-	Liebermann-reaction	+	+	+
Liebermann-burchard reaction	+	+	+	Liebermann-burchard reaction	+	+	+
Test for glycosides				**Test for glycosides**			
Killer-killiani test	-	+	-	Killer-killiani test	+	+	+

Modified Borntrager'test	+	+	+	Modified Borntrager'test	+	+	+
Foam test	-	-	-	Foam test	-	-	-
Legal's test	-	-	-	Legal's test	-	-	-
Borntrager'test	+	-	+	Borntrager'test	-	-	-
Test for alkaloids				**Test for alkaloids**			
Dragenedroff's test	+	+	+	Dragenedroff's test	+	+	+
Mayer's test	+	+	+	Mayer's test	+	+	+
Hager's test	+	+	+	Hager's test	+	+	+
Wagener's test	+	+	+	Wagener's test	+	+	+
Murexide test for purine alkaloids	-	-	-	Murexide test for purine alkaloids	-	-	-
Test for tannins and phenolic compounds				**Test for tannins and phenolic compounds**			
Dilute iodine solution	+	+	+	Dilute iodine solution	+	+	+
Lead acetate solution	+	-	+	Lead acetate solution	+	+	+
Bromine water	-	-	-	Bromine water	+	+	+
Acetic acid solution	-	-	-	Acetic acid solution	-	-	-
Potassium dichromate	-	-	-	Potassium dichromate	-	-	-

Phytochemical investigations were done for water and methanolic extract and it was found that alkaloids, tannins and phenolic compounds are present in all the samples. Few tests are positive for carbohydrates, steroids and glycosides. Proteins and amino acids are more present in methanolic extracts as compared to water extracts.

8.6 Thin layer chromatography (TLC)

Table 8.18: Rf values of sample 1, 2, 3

Extract	Solvent system	Rf in day light			Rf in UV light			Rf in Iodine chamber		
		1	2	3	1	2	3	1	2	3
Methanol	Petroleum ether: Acetone (9:1)	-	-	-	0.1, 0.20, 0.27, 0.30, 0.94, 0.99	0.04, 0.18, 0.27, 0.66, 0.93, 0.9	0.03, 0.18, 0.3, 0.7, 0.9, 0.9	0.1, 0.20, 0.27, 0.30, 0.94, 0.99	0.04, 0.18, 0.27, 0.66, 0.93, 0.9	0.03, 0.18, 0.3, 0.7, 0.9, 0.9

Fig 8.14: TLC of methanolic extract of *Nardostachys jatamansi* of three samples in U.V light

8.7 HPTLC

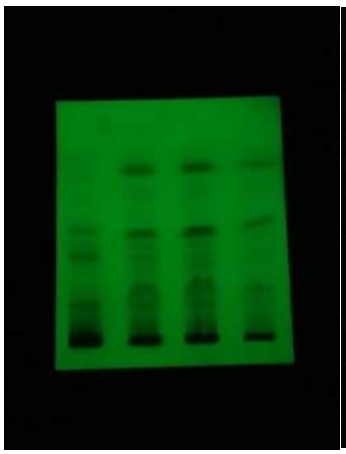


Fig 8.15: HPTLC under 254 nm

Fig 8.16: HPTLC under 366 nm

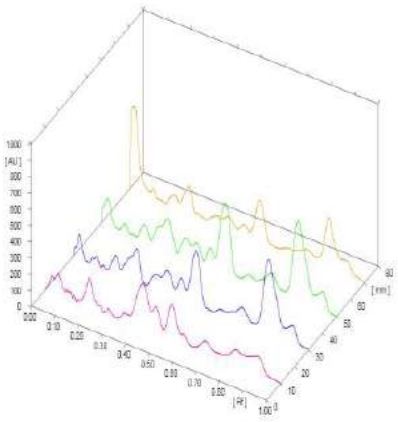


Fig 8.17: Graph of samples 1, 2, 3 with standard

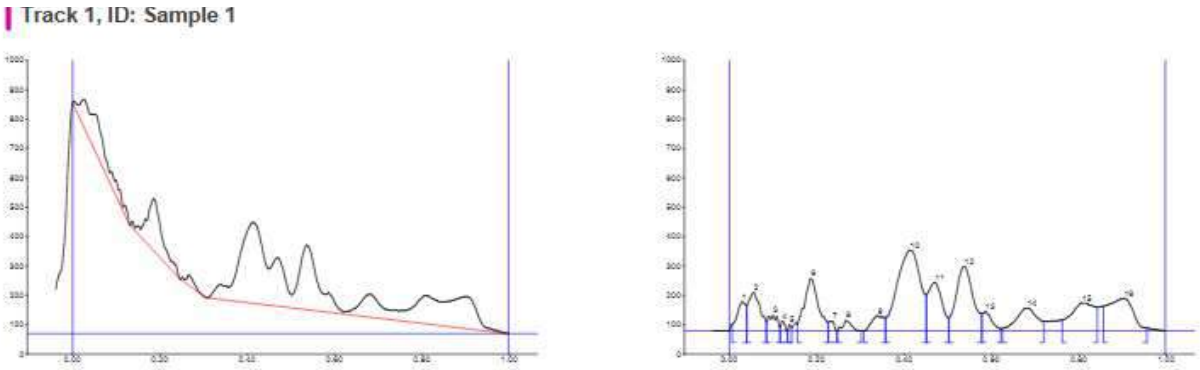


Fig 8.18: Graph of sample 1 at 254 nm

Table 8.19: HPTLC Interpretation of sample 1

Peak	Start Rf	Start Height	Max Rf	Max Height	Max %	End Rf	End Height	Area	Area %	Assigned substance
1	0.01	22.9	0.03	99.3	6.00	0.04	87.3	1779.8	3.31	unknown *
2	0.04	89.0	0.06	131.7	7.95	0.08	31.9	3154.1	5.87	unknown *
3	0.09	32.9	0.10	53.9	3.25	0.12	13.6	977.4	1.82	unknown *
4	0.12	16.6	0.12	34.3	2.07	0.13	0.9	256.3	0.48	unknown *
5	0.13	6.9	0.14	22.5	1.36	0.14	9.9	120.5	0.22	unknown *
6	0.16	24.1	0.19	178.4	10.77	0.23	28.6	5044.7	9.39	unknown *
7	0.23	29.8	0.24	33.7	2.04	0.25	0.6	359.4	0.67	unknown *
8	0.25	1.0	0.27	37.4	2.26	0.30	0.1	609.9	1.13	unknown *
9	0.31	0.1	0.34	52.2	3.15	0.36	45.3	1282.0	2.39	unknown *
10	0.36	45.6	0.41	275.4	16.63	0.45	123.5	12871.4	23.95	unknown *
11	0.45	124.4	0.47	165.4	9.99	0.50	44.6	4757.6	8.85	unknown *
12	0.50	45.4	0.54	219.9	13.28	0.58	59.8	7521.8	14.00	unknown *
13	0.58	59.9	0.59	67.2	4.06	0.62	7.6	1293.5	2.41	unknown *
14	0.63	8.4	0.68	78.6	4.75	0.72	33.1	3316.1	6.17	unknown *
15	0.76	37.4	0.81	95.9	5.79	0.84	80.6	4683.7	8.72	unknown *
16	0.86	84.0	0.91	110.1	6.65	0.96	9.8	5707.9	10.62	unknown *

Table 8.20: Interpretation of sample 1

Peak	Rf	Area
10	0.36	12871.4
12	0.50	7521.8
16	0.86	5707.9

Sample 1 shows its highest peak at Rf 0.36 with area 12871.4. The other peaks are obserbed at Rf 0.50 and 0.86 with area 7521.8 and 5707.9.

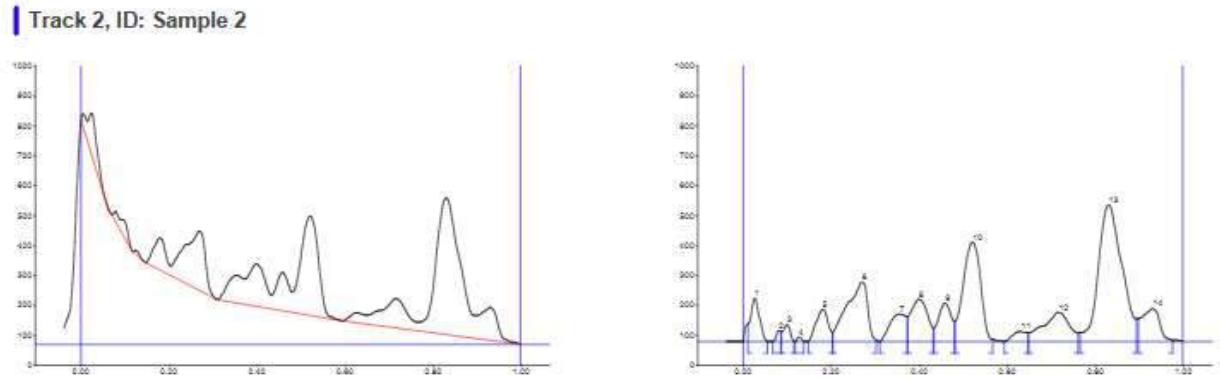


Fig 8.19: Graph of sample 2 at 254 nm

Table 8.21: Interpretation of sample 2

Peak	Start Rf	Start Height	Max Rf	Max Height	Max %	End Rf	End Height	Area	Area %	Assigned substance
1	0.01	59.7	0.03	145.6	7.45	0.05	0.2	2593.2	3.72	unknown *
2	0.07	1.0	0.08	37.5	1.92	0.09	33.1	329.3	0.47	unknown *
3	0.09	33.1	0.10	56.8	2.90	0.12	0.2	795.4	1.14	unknown *
4	0.12	0.0	0.13	14.3	0.73	0.14	0.4	134.5	0.19	unknown *
5	0.15	0.4	0.18	107.3	5.49	0.20	30.6	2644.7	3.79	unknown *
6	0.20	31.0	0.27	198.8	10.17	0.30	5.2	8359.3	11.98	unknown *
7	0.31	0.3	0.36	92.7	4.74	0.37	84.0	3017.5	4.33	unknown *
8	0.37	84.2	0.40	141.6	7.24	0.43	44.9	4846.1	6.95	unknown *
9	0.43	45.4	0.46	128.7	6.58	0.48	67.4	3408.5	4.89	unknown *
10	0.48	68.7	0.52	331.6	16.97	0.57	6.7	11725.4	16.81	unknown *
11	0.59	0.2	0.63	34.6	1.77	0.65	29.1	954.4	1.37	unknown *
12	0.65	29.3	0.72	97.7	5.00	0.76	28.7	5206.3	7.46	unknown *
13	0.77	29.4	0.83	456.7	23.36	0.89	75.8	21757.3	31.19	unknown *
14	0.90	77.4	0.93	110.7	5.66	0.98	4.0	3990.9	5.72	unknown *

Table 8.22: Interpretation of sample 2

Peak	Rf	Area
6	0.20	8359.3
10	0.48	11725.4
13	0.77	21757.3

Sample 2 shows highest Rf at 0.77 with area of 21757.3

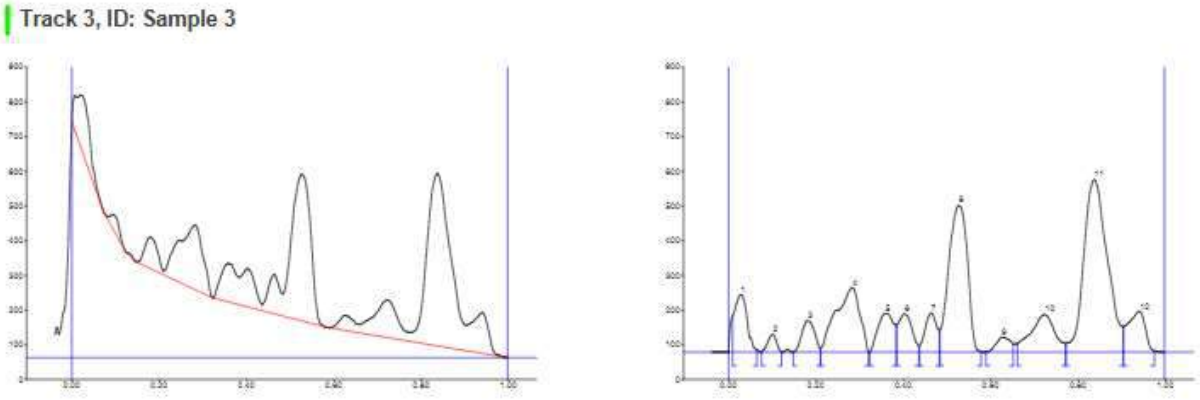


Fig 8.20: Graph of sample 3 at 254 nm

Table 8.23: Interpretation of sample 3

Peak	Start Rf	Start Height	Max Rf	Max Height	Max %	End Rf	End Height	Area	Area %	Assigned substance
1	0.01	105.2	0.03	165.4	8.20	0.06	5.6	4205.3	5.49	unknown *
2	0.08	0.5	0.10	51.6	2.56	0.12	0.6	902.1	1.18	unknown *
3	0.15	0.4	0.18	90.7	4.50	0.21	10.9	2366.4	3.09	unknown *
4	0.21	11.8	0.28	186.0	9.21	0.32	0.4	9049.5	11.81	unknown *
5	0.32	0.7	0.36	111.1	5.50	0.38	78.4	3614.8	4.72	unknown *
6	0.39	79.0	0.40	110.5	5.47	0.44	17.2	3056.0	3.99	unknown *
7	0.44	18.5	0.46	113.0	5.60	0.48	63.5	2702.1	3.53	unknown *
8	0.48	64.3	0.53	422.9	20.96	0.58	0.1	16167.6	21.10	unknown *
9	0.59	0.1	0.63	42.9	2.12	0.65	23.2	1256.7	1.64	unknown *
10	0.66	24.3	0.73	108.8	5.39	0.77	25.0	5308.2	6.93	unknown *
11	0.77	25.3	0.84	497.4	24.65	0.91	73.3	23928.4	31.22	unknown *
12	0.91	73.7	0.94	117.9	5.84	0.98	3.1	4083.9	5.33	unknown *

Table 8.24: Interpretation of sample 3

Peak	Rf	Area
4	0.21	9049.5
8	0.48	16167.6
11	0.77	23928.4

Sample 3 shows its highest Rf on 0.77 with area 23928.4

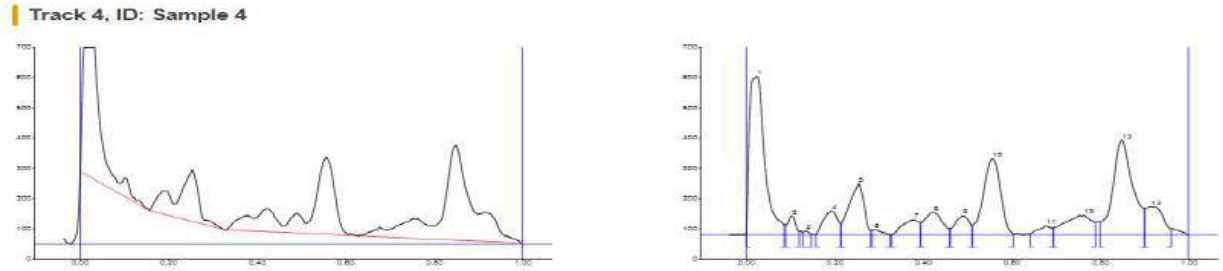


Fig 8.21: Graph of sample 4 (Standard) at 254 nm

Table 8.25: Interpretation of sample 4 (Standard)

Peak	Start Rf	Start Height	Max Rf	Max Height	Max %	End Rf	End Height	Area	Area %	Assigned substance
1	0.00	0.0	0.02	524.1	28.86	0.09	33.7	16170.1	26.81	unknown *
2	0.09	34.5	0.10	63.2	3.48	0.12	12.3	1041.3	1.73	unknown *
3	0.13	8.4	0.13	13.7	0.75	0.15	0.0	141.8	0.24	unknown *
4	0.16	1.4	0.19	79.1	4.36	0.21	39.7	2279.1	3.78	unknown *
5	0.21	40.5	0.25	169.8	9.35	0.28	15.5	5077.2	8.42	unknown *
6	0.28	16.4	0.29	17.3	0.95	0.32	0.1	326.7	0.54	unknown *
7	0.33	0.2	0.38	50.8	2.80	0.39	41.1	1697.8	2.82	unknown *
8	0.39	41.5	0.42	75.7	4.17	0.46	20.5	2696.2	4.47	unknown *
9	0.46	21.1	0.49	64.3	3.54	0.51	32.8	1800.6	2.99	unknown *
10	0.51	33.0	0.56	252.9	13.93	0.60	4.7	8782.2	14.56	unknown *
11	0.64	3.6	0.68	30.8	1.70	0.69	23.4	793.7	1.32	unknown *
12	0.69	23.7	0.76	66.4	3.66	0.79	42.2	3551.2	5.89	unknown *
13	0.80	45.0	0.85	313.5	17.26	0.90	87.9	12637.6	20.96	unknown *
14	0.90	87.9	0.92	94.3	5.19	0.96	19.4	3311.3	5.49	unknown *

Table 8.26: Interpretation of sample 4 (Standard)

Peak	Rf	Area
13	0.80	12637.6

The highest Rf of standard is 0.80 with area 1267.6. On comparison with three samples, 2 and 3 shows highest Rf at 0.77. This can be the Rf of standard jatamansone. The third highest peak of sample 1 at Rf 0.86 is close to Rf 0.80 of standard. It can be the peak of jatamansone.

8.8 Anti-microbial study

Table 8.27: Inhibition zone for aqueous and alcoholic extracts of *Nardostachys jatamansi* on *E.coli*

S. No	Extract	Control	Result		
			Sample 1	Sample 2	Sample 3
1.	Water Extract	8mm	0	0	0
2.	Methanol Extract		18mm	19mm	15mm

Water and methanolic extract are taken for the investigation of the anti-microbial activity. Only methanolic extract of the three samples shows the positive results after 48 hours. Sample 1 has 18mm inhibition, sample 2 has 19mm inhibition and sample 3 has 15 mm inhibition. Sample 2 shows maximum inhibition.

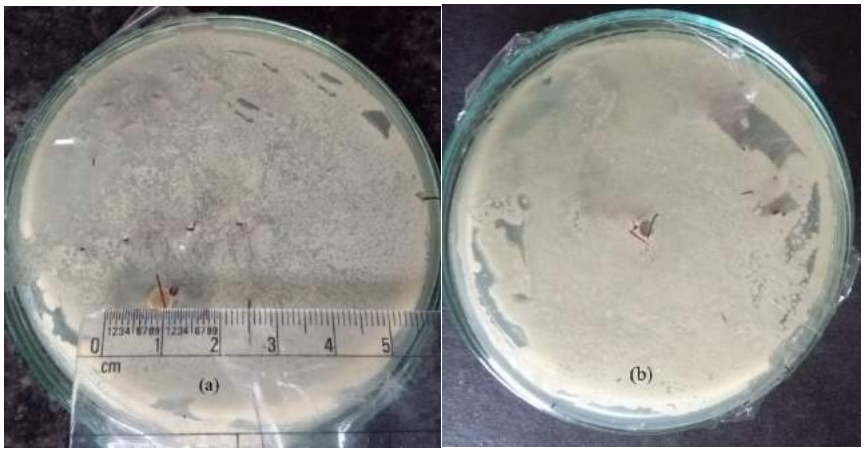


Fig 8.22: (a) Methanolic and (b) water extract of sample 1

Fig 8.23: (a) Methanolic and (b) water extract of sample 2

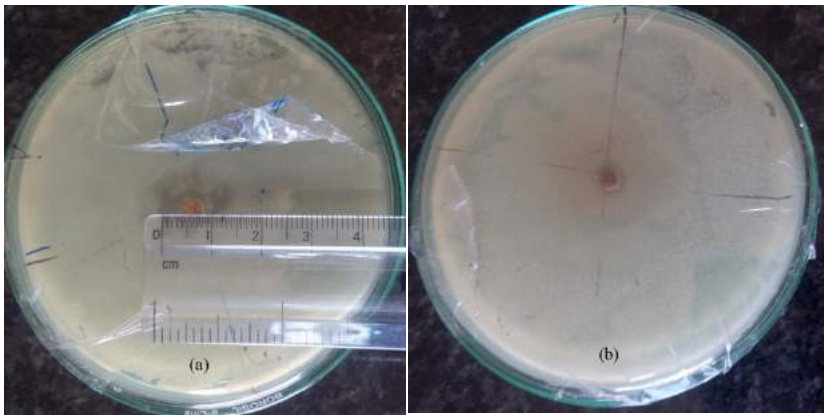


Fig 8.24: (a) Methanolic and (b) water extract of sample 3

CHAPTER 9

CONCLUSION AND FUTURE SCOPE

The plant *Nardostachys jatamansi* is a reputed Ayurvedic herb and it is the major ingredient in Ayurvedic formulations for treatment of various disorders mainly central nervous disorders. The plant is reported in various classical literatures like Charaka Samhita, Sushruta Samhita, Sarangdhar Samhita etc. Review of literature of the plant discloses the various synonyms and the important properties of the plant. Bhootjata, keshani, mansi, tamshi, nalda, phaldanksha, jatila, pishita, krishnajata and peshi are some of the synonyms of jatamansi and the properties like *medyajanan*, *ruchikar*, *tridoshahar*, *kustha*, *anidra*, *raktachap*, *balprad* etc, are reported in the classics.`

The samples of *Nardostachys jatamans*i is collected in three different seasons such as: varsha, hemant and sarad ritu and investigated for morphological, microscopical, analytical parameters and in-vitro antimicrobial activity. Pharmacognostically they are almost similar except for xylem cells. They are less in sample 1 as compared to sample 2 and 3. On physiochemical evaluation, sample 3 shows the better results than the sample 1 and 2. Phytochemical screening, all the samples shows the presence of alkaloids, carbohydrates, steroids and glycosides. TLC studies shows six Rf values for all samples when observed in UV light and in iodine chamber. HPTLC studies conducted with three samples and their comparison done with standard component "Jatamansone" and sample 2 and 3 showed Rf close to standard (0.80). Methanolic extract of sample 2 shows maximum inhibition (19 mm). This research concludes that three samples have almost similar results but sample 2 collected in the month of September (Sharad ritu) shows better results.

Future scope: In vivo studies are required to further explore the variation of constituents according to seasons which affects therapeutic efficacy of plant.

CHAPTER 10

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CHAPTER 11

APPENDIXES

LOVELY PROFESSIONAL UNIVERSITY

TOPIC APPROVAL PERFORMA

LIT (Pharmacy)/Department of Pharmaceutical Sciences

Program : P570-NN7::M.Pharm. (Ayurveda)

COURSE CODE : APH623 **REGULAR/BACKLOG :** Regular **GROUP NUMBER :** PHRRGD0034

Supervisor Name : Amrinder Kaur **UID :** 11662 **Designation :** Assistant Professor

Qualification : _____ **Research Experience :** _____

SR.NO.	NAME OF STUDENT	REGISTRATION NO	BATCH	SECTION	CONTACT NUMBER
1	Preeti Kalsi	11508418	2015	Y1553	9459638653

SPECIALIZATION AREA : Ayurvedic Pharmacy **Supervisor Signature:** _____

PROPOSED TOPIC : Comparative study of Nardostachys jatamansi (Valerinaceae) with special reference to three seasons

Qualitative Assessment of Proposed Topic by PAC		
Sr.No.	Parameter	Rating (out of 10)
1	Project Novelty: Potential of the project to create new knowledge	6.00
2	Project Feasibility: Project can be timely carried out in-house with low-cost and available resources in the University by the students.	7.00
3	Project Academic Inputs: Project topic is relevant and makes extensive use of academic inputs in UG program and serves as a culminating effort for core study area of the degree program.	6.40
4	Project Supervision: Project supervisor's is technically competent to guide students, resolve any issues, and impart necessary skills.	6.80
5	Social Applicability: Project work intends to solve a practical problem.	6.40
6	Future Scope: Project has potential to become basis of future research work, publication or patent.	6.40

PAC Committee Members		
PAC Member 1 Name: Dr. Amit Mittal	UID: 13145	Recommended (Y/N): Yes
PAC Member 2 Name: Saurabh Singh	UID: 12208	Recommended (Y/N): Yes
PAC Member 3 Name: Dr. S. Tamilvanan	UID: 16391	Recommended (Y/N): Yes
PAC Member 4 Name: Dr. Navneet Khurana	UID: 18252	Recommended (Y/N): Yes
DAA Nominee Name: Dr. Sazal Patyar	UID: 17050	Recommended (Y/N): Yes

Final Topic Approved by PAC: **Comparative study of Nardostachys jatamansi (Valerinaceae) with special reference to three seasons**

Overall Remarks: Approved

PAC CHAIRPERSON Name: 11045::Dr. Monica Gulati **Approval Date:** 27 Apr 2017

4/27/2017 10:37:00 AM

ਬੋਟੈਨੀਕਲ ਐਂਡ ਐਨਵਾਇਰਨਮੈਂਟਲ ਸਾਇੰਸਿਜ਼ ਵਿਭਾਗ
ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ - 143 005
Department of Botanical & Environmental Sciences
Guru Nanak Dev University, Amritsar - 143 005, India
(Established by the State Legislature Act No. 21 of 1969)
Accredited at "A" grade level by NAAC and awarded "University with Potential for Excellence" status by UGC

Ref. No. 1336 Bot. & Env. Sc.
Dated 24-11-2016

To Whom It May Concern

The plant specimen(s) brought by Ms. Preeti Kalsi
Regn. No 11508418 student of M.Pharmacy.(Ayurveda) L.P.U. PHAGWARA
belongs to the following species.

1. Nardostachys jatamansi
2.
3. Valerianaceae.

Signature of Student Kalsi

Herbarium Assistant

Teachers Incharge

Head
Deptt. of Botanical & Environmental Sciences
Guru Nanak Dev University
Amritsar-143005.

Phone: +91-183-2451048, PABX: 0183-2258802-09, 2450601-14 Extn. 3193, Fax : 0183-2258819-20 and 2255711
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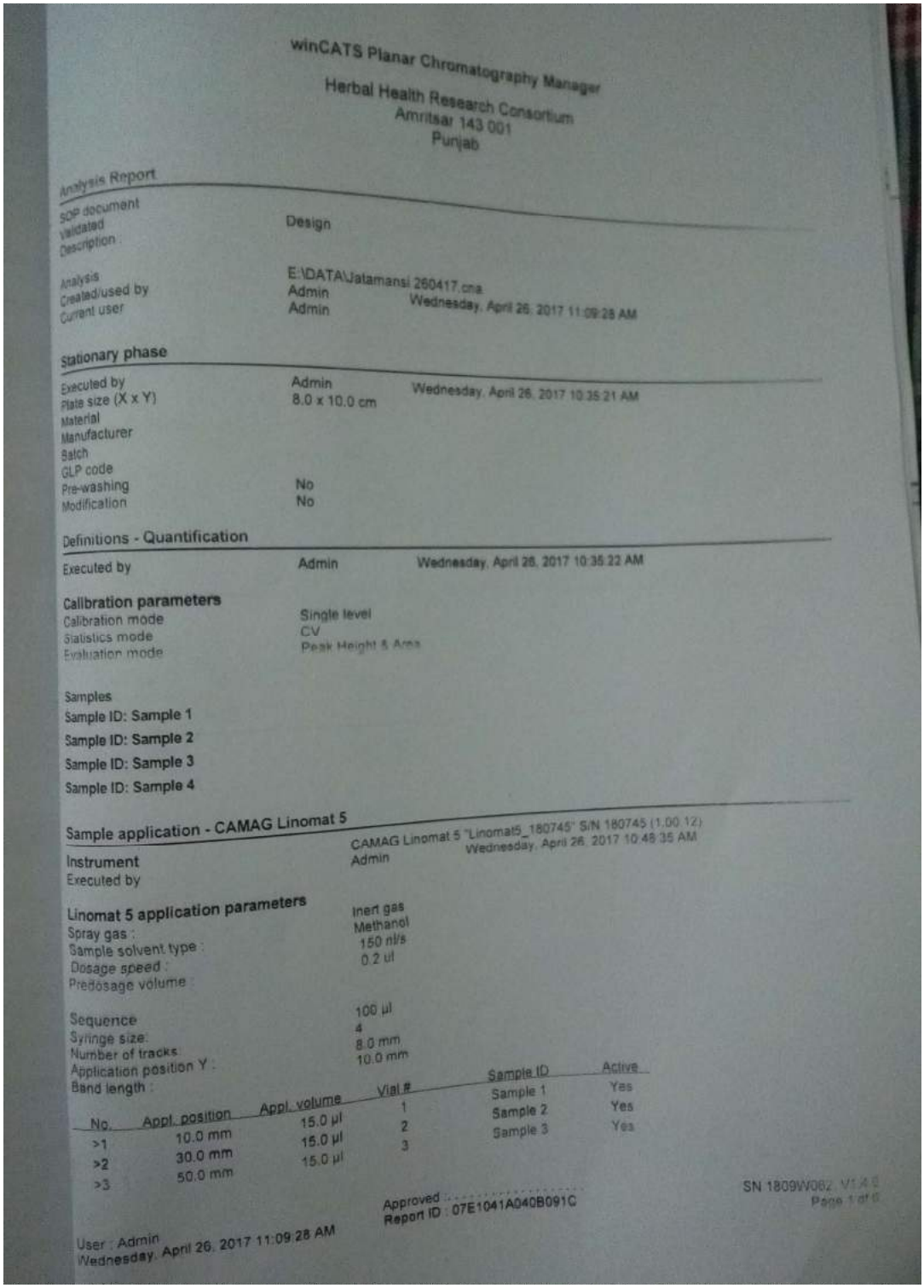

winCATS Planar Chromatography Manager

Herbal Health Research Consortium
Amritsar 143 001
Punjab

Analysis Report

SOP document		
Validated		
Description	Design	
Analysis	E:\DATA\Jatamansi 260417.cna	
Created/used by	Admin	Wednesday, April 26, 2017 11:09:28 AM
Current user	Admin	

Stationary phase

Executed by	Admin	Wednesday, April 26, 2017 10:35:21 AM
Plate size (X x Y)	8.0 x 10.0 cm	
Material		
Manufacturer		
Batch		
GLP code		
Pre-washing	No	
Modification	No	

Definitions - Quantification

Executed by	Admin	Wednesday, April 26, 2017 10:35:22 AM

Calibration parameters

Calibration mode	Single level
Statistics mode	CV
Evaluation mode	Peak Height & Area

Samples
Sample ID: Sample 1
Sample ID: Sample 2
Sample ID: Sample 3
Sample ID: Sample 4

Sample application - CAMAG Linomat 5

Instrument	CAMAG Linomat 5 "Linomat5_180745" S/N 180745 (1.00.12)	
Executed by	Admin	Wednesday, April 26, 2017 10:48:35 AM

Linomat 5 application parameters

Spray gas :	Inert gas
Sample solvent type :	Methanol
Dosage speed :	150 nl/s
Predosage volume :	0.2 ul
Sequence	
Syringe size:	100 µl
Number of tracks	4
Application position Y :	8.0 mm
Band length :	10.0 mm

No.	Appl. position	Appl. volume	Vial #	Sample ID	Active
>1	10.0 mm	15.0 µl	1	Sample 1	Yes
>2	30.0 mm	15.0 µl	2	Sample 2	Yes
>3	50.0 mm	15.0 µl	3	Sample 3	Yes

Approved .....
Report ID : 07E1041A040B091C

SN 1809W062, V1.4.0
Page 1 of 6

User : Admin
Wednesday, April 26, 2017 11:09:28 AM

>4	70.0 mm	15.0 µl	4	Sample 4	Yes

Detection - CAMAG TLC Scanner

Information

Application position	8.0 mm
Solvent front position	85.0 mm

Instrument

Executed by	CAMAG TLC Scanner "Scanner_180710" S/N 180710 (2.01.02)
Number of tracks	Admin Wednesday, April 26, 2017 11:09:12 AM
Position of first track X	4
Distance between tracks	10.0 mm
Scan start pos. Y	20.0 mm
Scan end pos. Y	5.0 mm
Slit dimensions	85.0 mm
Optimize optical system	4.00 x 0.30 mm, Micro
Scanning speed:	Light
Data resolution:	20 mm/s
	100 µm/step

Measurement Table

Wavelength	254
Lamp	D2 & W
Measurement Type	Remission
Measurement Mode	Absorption
Optical filter	Second order
Detector mode	*Automatic*
PM high voltage	304 V

Integration

Properties

Data filtering	Savitsky-Golay 7
Baseline correction	Lowest Slope
Peak threshold min. slope	5
Peak threshold min. height	10 AU
Peak threshold min. area	50
Peak threshold max. height	990 AU
Track start position	8.1 mm
Track end position	85.0 mm
Display scaling	Automatic