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Research Article

Comparative analysis of the essential oil composition of wild and cultivated *Valeriana jatamansi* Jones. from Uttarakhand Himalaya

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Abstract

The comparative analysis of the essential oil composition of *Valeriana jatamansi* Jones. roots growing wild and cultivated in the Indian Himalayan Region of Uttarakhand (India) were studied by hydrodistillation. The yield of oil extracted from Valeriana jatamansi roots VLC (Cultivated) was 0.51% and VLW (Wild) was 0.26%. A total of Twenty-six compounds represent 93.3% and 90.07% of the oil obtained from cultivated and wild plant material respectively. The major components in the extracted oil were sesquiterpene hydrocarbons and oxygenated sesquiterpenes *viz.* Patchouli alcohol (32.11-40.56%), 8-acetoxy patchouli alcohol (0.95-8.08%), α-patchoulene (4.82-5.22%), α-bulnescene (9.70-12.57%) and α- guaiene (6.28-6.62%).

1. Introduction

The genus Valeriana, belonging to the Valerianaceae family, is represented by 16 species/subspecies, of which six, namely V. jatamansi Jones, V. himalayana Grub., V. pyrolaefolia Decne., V. mussooriensis, V. hardwickii Wall. var. hardwickii, and V. hardwickii Wall. var. arnottiana (Wt. C. B. Clarke), occur in the Indian Himalayan Region (IHR) of Uttarakhand [1]. Among these, the roots and rhizomes of valeriana (*Valeriana jatamansi)* from the Valerianaceae family are used to prepare modern phytomedical products, mild traditional sedatives, and antianxiety and digestive formulations [1-3]. Indian Valerian, *Valeriana jatamansi* Jones has been used as an ingredient in Indian herbal medicine.

The ancient Indian Ayurveda describe the medicinal properties of Tagar (*Valeriana jatamansi*) for curing various diseases like obesity, nervous disorders, epilepsy, insanity, snake poisoning and skin diseases. Today, *Valeriana* is still a highly respected medicinal plant described in many pharmacopoeia monographs [4]. Charak Samhita, an ancient Indian medical text, describes two forms of *V. wallichii* distinguishable in the field alone [5]. It has also been described as variable in general size of plants, but with no specific difference in other plant characters [6]. The major active compounds present in *Valeriana* are monoterpenoids, sesquiterpenoids, and valepotriates. Among these, the valepotriates have significant

hypotensive properties, but the total sedative activity has also been attributed to the presence of oxygenated sesquiterpenoid constituents [7-11].

Many chemical compounds of *Valeriana* species including lignoids, iridoids, valeriandoids, and valepotriates, which are used to cure a variety of illnesses, were found in the plant's roots and rhizomes. Its pharmacological properties have been assessed for their antibacterial, antioxidant, and anticancer effects in vitro as well as their neuroprotective, anxiolytic, and anti-inflammatory effects in vivo [12-15].

Due to the vast biological actions and different chemical compositions of *Valeriana* species, we tried to compare the essential oil composition of wild and cultivated *Valeriana jatamansi* and their similarities/differences at their chemotype levels.

2. Materials and methods

2.1 Plant material

The fresh roots sample (250 g) of wild *Valeriana jatamansi* (VL_W) was collected from Gangolihat village (29.714670^0 N, 80.037250^0 E) of Pithoragarh district (Uttarakhand), (Fig.1) and 250 g of root sample taken of cultivated plant material (VL_C) from the research farm (29.776236^0 N, 80.050873^0 E) of Himalayan Medicinal & Aromatic Plant Research Centre (HIMARC), Berinag (Uttarakhand) in the month of April (Fig.2). The sample, identified by Botany Department, Kumaun University, Nainital (Voucher No.: HIMARC/BSB/VAL/2023) was deposited in the HIMARC for future reference.

Figure 1. *Valeriana jatamansi* (Cultivated)

Figure 2. *Valeriana jatamansi* (Wild)

2.2 Extraction of oil

The underground parts of the plant (250 g each wild and cultivated) were submitted to hydrodistillation for 5 h, using a Clevenger-type apparatus, according to the European Pharmacopoeia [10]. The volatile distillate was collected over anhydrous sodium sulfate and refrigerated till the time of analysis.

2.3 GC and GC-MS analysis

The oils were analyzed by using a Nucon 5765 gas chromatograph (Rtx-5 column, 30 m × 0.32 mm, FID), split ratio 1:48, N2 flow of 4 kg/cm2 and on Thermo Quest Trace GC 2000 interfaced with MAT Polaris Q Ion Trap Mass spectrometer fitted with a Rtx-5 (Restek Corp.) fused silica capillary column (30 m x 0.25 mm; 0.25 µm film coating). Analyses of essential oils and extracts were performed by following the method discussed by Mathela et al. [8].

2.4 Identification of constituents:

The essential oil was fractionated by column chromatography (CC), on silica gel CC (230-400 mesh, Merk, 600 x 25 cm column) packed with hexane, and eluted with hexane followed by gradient elution by Et2O/hexane (1-20%). The identification was done on the basis of Linear Retention Index (LRI), determined with reference to homologous series of n-alkanes (C9-C24, Polyscience Corp., Niles IL under identical experimental condition), co-injection with standard (Sigma and Aldrich), MS Library search (NIST version 2.1 and Wiley registry of mass spectral data 7th edition), by comparing with the MS literature data [11]

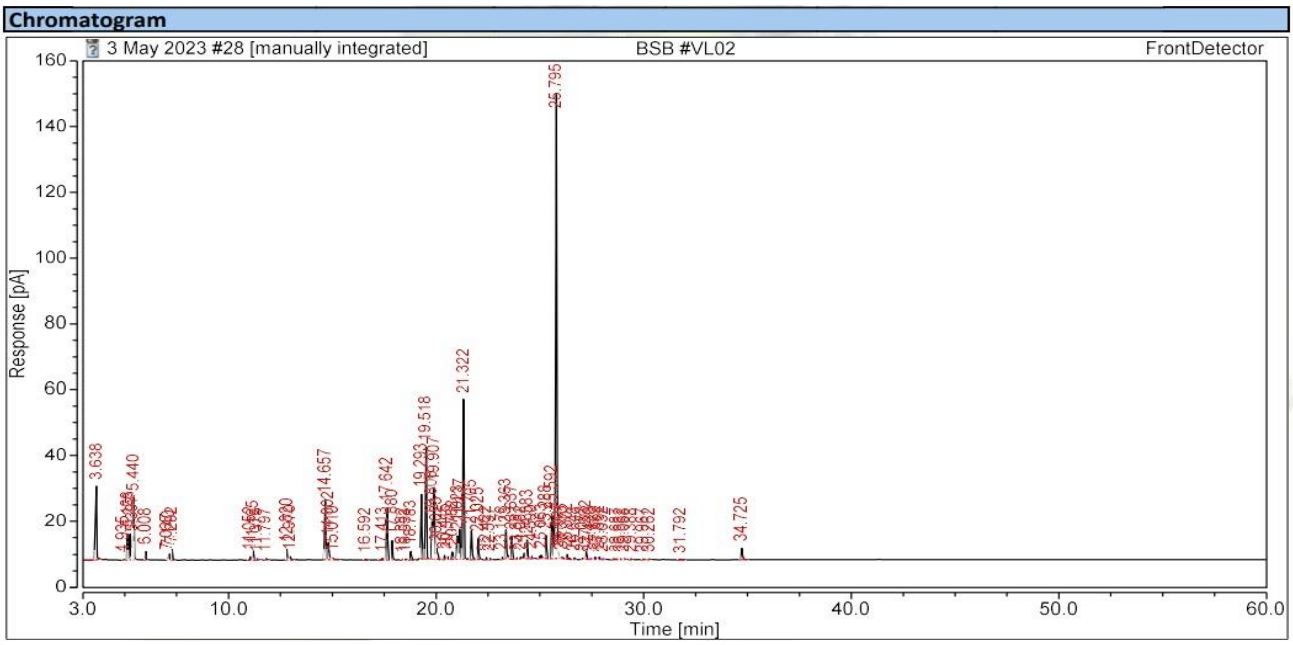

Figure 3. Gas Chromatogram of *Valeriana jatamansi* (Cultivated, VLc)

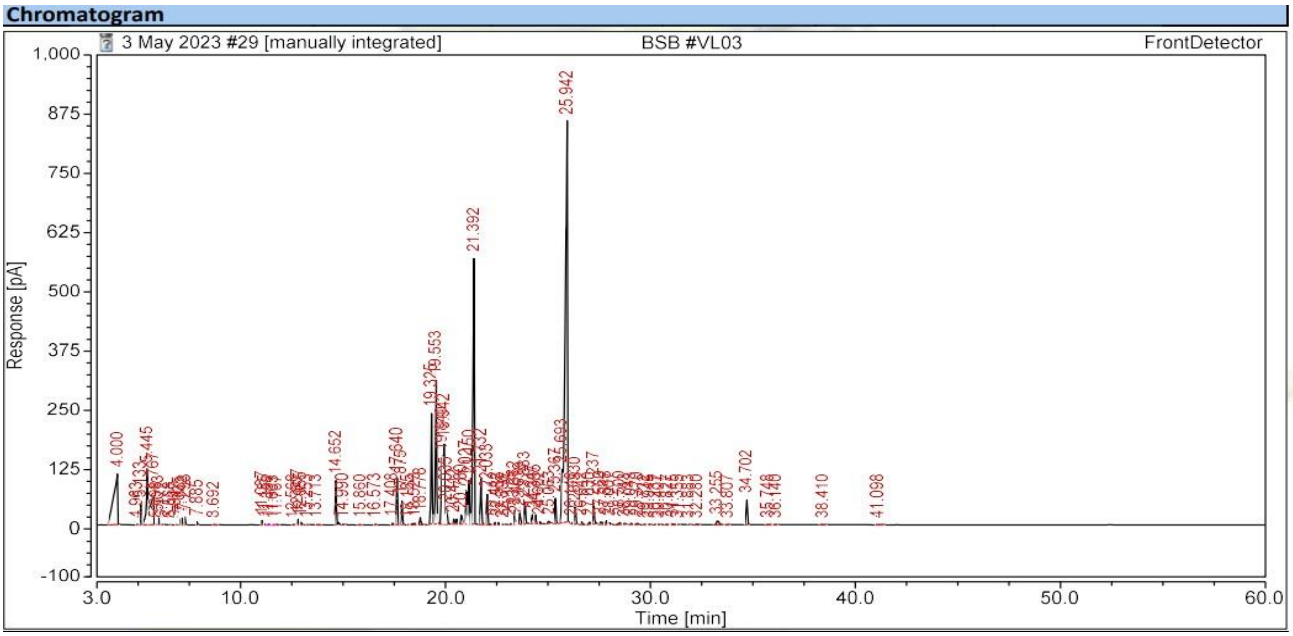

Figure 4. Gas Chromatogram of *Valeriana jatamansi* (Wild, VLw)

and by NMR (1H, 13C NMR) of major isolates. The relative amounts of individual components were calculated based on GC peak area (FID response) without using correction factor.

3. Results and discussion

Based on the dry root, the oil extracted by hydrodistillation from *Valeriana jatamansi* roots VLc was 0.51% and VLw was 0.26%. The results of the present work are summarized in Table 1. GC and GC/MS analyses indicated more than 25 distinct compounds in the essential oil from the roots of *Valeriana jatamansi*. The essential oil composition of cultivated plant material (VLc) was to be found rich in Patchouli alcohol (40.56%), α-Bulnesene (9.70%), α-guaiene (6.62%) and α-Patchoulene (4.82%) as major constituents (Fig. 3), while wild plant material (VLw) contains Patchouli alcohol (32.11%), α-Bulnesene (12.57%), α–guaiene (6.28%), α-Patchoulene (5.22%) and 8-acetoxy patchouli alcohol (8.08%) (Fig. 4). Numerous compounds, including valerenic acid, isovaleric acid, valeranone, α -pinene, camphene,

Table 1. Chemical constituents of *Valeriana jatamansi* VLc (Cultivated) and VLw (Wild)

Sl. no	Compound name	Retention time	RIR (Reported)	RIO (Observed)	VLc	VLw
1.	α -Pinene	5.067	932	935	0.27	0.43
2.	3-methyl valeric acid	5.440	940	944	2.60	2.51
3.	β -Pinene	6.008	974	979	0.30	0.51
4.	p-cymene	7.140	1020	1021	0.14	0.20
5.	Bornyl acetate	14.657	1275	1277	3.27	1.54
6.	α-copaene	17.642	1374	1373	3.21	1.83
7.	β-elemene	17.880	1389	1392	1.10	0.90
8.	β -Caryophyllene	18.783	1412	1416	0.53	0.31
9.	β -Gurjunene	19.293	1420	1425	3.65	4.27
10.	**α -Guaiene**	**19.518**	**1437**	**1442**	**6.62**	**6.28**
11.	**Seychellene**	**19.808**	**1447**	**1451**	**2.32**	**2.39**
12.	**α-Patchoulene**	**19.907**	**1450**	**1453**	**4.82**	**5.22**
13.	γ-Gurjunene	20.023	1468	1473	0.95	0.80
14.	γ-Muurolene	20.415	1474	1477	0.28	0.47
15.	Germacerene-D	20.782	1476	1480	0.59	0.61
16.	β-guaiene	21.023	1485	1489	1.75	-
17.	**γ-Patchoulene**	**21.137**	**1493**	**1496**	**1.79**	**3.62**
18.	**α-Bulnesene**	**21.322**	**1512**	**1516**	**9.70**	**12.57**
19.	δ-Cadinene	21.705	1413	1418	1.87	1.86
20.	Kessane	22.025	1519	1524	1.28	1.24
21.	α-Cadinene	22.597	1532	1538	0.10	0.09
22.	Viridifloral	24.383	1587	1594	1.18	0.41
23.	Pogostol	25.592	1610	1615	3.05	1.12
24.	**Patchouli alcohol**	**25.795**	**1661**	**1665**	**40.56**	**32.11**
25.	Bulnesol	26.302	1672	1676	0.42	0.70
26.	**8-acetoxy patchouli alcohol**	**34.725**	**1999**	**2004**	**0.95**	**8.08**
	Compound Classes					
	Monoterpene Hydrocarbons (%)				*0.71*	*1.14*
	Oxygenated Monoterpenes (%)				*5.87*	*4.05*
	Sesquiterpene Hydrocarbons (%)				*40.56*	*42.46*
	Oxygenated Sesquiterpenes (%)				*40.16*	*42.42*
	Total identified compound (%)				**93.3**	**90.07**

α-santalene, ar-curcumene, xanthorrhizol, α-terpineol, bornyl isovalerate, maaliol, valtrate, didrovaltrate, patchouli alcohol, 8-acetoxy patchouli alcohol, and α, β, and γ-patchoulene have been identified in previous studies on *Valeriana* species rhizome and root essential oil [16-20]. Further 115 samples collected from the Champawat, Ukhimath & Pithoragarh regions of Uttarakhand Himalaya were found to rich in patchouli alcohol and 8-acetoxy-patchouli alcohol [8, 12-14]. A similar composition was found in our investigated samples indicating the resemblance of our samples to that chemotype.

From Table 1, it is clearly found that there are significant differences in the essential oil composition isolated by wild and plant material cultivated in Indian Himalayan Region and the variation in the % composition of the constituents. Both cultivated and wild plant material represent the Patchouli alcohol chemotype of *Valeriana jatamansi* reported earlier [8, 12-14]. But the significant variation in the % composition of Patchouli alcohol and 8-acetoxy patchouli alcohols are notable, hence their environmental factors can be further tested to determine which are responsible for generating similar/different essential oil compositions.

4. Conclusions

The current study's findings showed that growing circumstances associated with domesticating wild *Valeriana* raise the percentage of patchouli alcohol as

the output of essential oils while decreasing the amount of 8-acetoxy patchouli alcohol. Patchouli alcohol has multiple biological qualities that are advantageous in a range of circumstances. These characteristics include those that are aphrodisiac, insecticidal, antioxidant, antibacterial, anti-inflammatory, and antithrombotic. Numerous products, such as soap, body lotions, fragrances, detergents, and cosmetics, are made using these qualities. The primary characteristic of this mutation was a significant increase in patchouli alcohol and decrease in 8-acetoxy patchouli alcohol. However, research is still being done to assess how certain environmental elements and cultural techniques affect the agronomic characteristics, phytochemical makeup, and other biological activities of the essential oil extracted from *Valeriana jatamansi* in oasis habitats.

Authors' contributions

Conceptualization, B.S.B.; Methodology, B.S.B. and G.K.; Formal analysis, B.S.B., G.K. and R.C.P.; Plant material collection, B.S.B.; Original draft preparation, B.S.B.; Reviewing and editing, R.C.P.

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Availability of data and materials

All data will be made available on request, according to the journal policy.

Conflicts of interest

There is no conflict of interest.

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