Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2015; 3(5): 96-97
Received: 11-10-2014
Accepted: 23-11-2014

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Volatile oil composition of *Artemisia japonica* Thunb. from Western Himalaya of Uttarakhand

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Abstract
The chemical profile of the hydro distilled essential oil obtained from the aerial parts of *Artemisia japonica* Thunb. (Syn. *Artemisia parviflora* Buch.-Ham. ex D. Don) from Kumaun Himalaya was analyzed by capillary GC-FID and GC-MS. A total of eighteen compounds were identified, accounting for 93.1% of total composition. The volatile oil was dominated by linalool (27.5%), Germacrene D (11.2%), (*E*)-β-ocimene (6.5%), 1, 8-Cineole (5.5%), (*Z*)-β-ocimene (5.5%).

Keywords: Volatile oil, *Artemisia*, GC, GC-MS, Asteraceae.

1. Introduction
The genus *Artemisia* (Family: Asteraceae) is a source of valuable drugs and essential oils because of its intricate chemical composition comprising several chemotypes. Reports on chemical composition of various *Artemisia* species from different origins show the presence of 1, 8-cineole, α-thujone, β-thujone, chamazulene, davanone, artemisia ketone, germacrene D, β-caryophyllene and caryophyllene oxide [1, 2]. In recent years, there has been increasing interest in healthy lifestyles and healthy aging. As a result, many people are involved in searches for natural compounds that can improve health, especially those of plant origins. A great number of aromatic, spicy, medicinal, and other plants belonging to the family Asteraceae contain chemical compounds exhibiting antimicrobial and antioxidant properties [3]. The genus *Artemisia* L., commonly known as wormwood, is one of the largest genera in the Asteraceae family (tribe Anthemideae). It comprises more than 400 species widely distributed throughout the world, especially, in South-West of Asia and Central Europe. About 30 species of *Artemisia* are documented in the flora of western Himalaya [4-5]. In traditional medicine, various parts of *Artemisia japonica* (leaves, stem, seeds and fruits) have been widely used by tribal people for its wound healing properties, treatment of skin diseases, and febrifuge, depurative properties, digestive and in ethnoveterinary medicine [6]. Previously we have reported photochemical study of *A. capillaris* [7-9]. This article presenting volatile oil composition of *A. japonica* from Western Himalaya of Uttarakhand.

2. Materials and methods
2.1 Plant collection and Identification
The fresh aerial parts of *Artemisia japonica* Thunb. (Syn. *Artemisia parviflora* Buch.-Ham. ex D. Don) were collected from Milam glacier (Uttarakhand, India) at an altitude of 3400 m in the month of August 2006. The identification was from Botanical Survey of India, Dehradun. The voucher specimen (Phyto/06/02) has been deposited in the Department of Chemistry, Kumaun University, Nainital.

2.2 Oil Isolation
The fresh plant materials (1.5 kg) were subjected to steam distillation using a copper electric still, fitted with spiral glass condensers. The distillates were saturated with NaCl and extracted with *n*-hexane and dichloromethane. The organic phase was dried over anhydrous sodium sulfate and the solvents were distilled off in a rotary vacuum evaporator at 30 ^{0}C and the percentage oil content was calculated on the basis of fresh weight of plant materials.

2.3 GC, GC/MS analysis
The oils were analyzed by using a Nucon 5765 gas chromatograph (Rtx-5 column, 30 m X 0.32 mm, FID), split ratio 1: 48, N_2 flow of 4 kg/cm^2 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). The column temperature was programmed 60-210 ^{0}C at 3 ^{0}C/min using He as carrier gas at 1.0 mL/min. The injector temperature was 210 ^{0}C, injection size 0.1µL prepared in hexane, split ratio 1:40. MS were taken at 70 eV with a mass range of 40-450 amu.

2.4 Identification of the components

Identification of constituents were done on the basis of Retention Index (RI, determined with reference to homologous series of n-alkanes (C_9-C_{24}, Polyscience Corp., Niles IL) under identical experimental condition), co injection with standards (Sigma and known essential oil constituents (standard isolates), MS Library search (NIST and WILEY), by comparing with the MS literature data [10]. The relative amounts of individual components were calculated based on GC peak area (FID response) without using correction factor.

3. Results & Discussion

The chemical profile of the hydro distilled essential oil obtained from the aerial parts of *Artemisia japonica* Thunb. (Syn. *Artemisia parviflora* Buch.-Ham. ex D. Don) from Kumaun Himalaya was analyzed by capillary GC-FID and GC-MS. The volatile oil was dominated by linalool (27.5%), Germacrene D (11.2%), (*E*)-β-ocimene (6.5%), 1,8-Cineole (5.5%), (*Z*)-β-ocimene (5.5%) with α-Phellandrene (4.2%), γ-terpinene (4.6%) shown in table 1. Some acetylenic compounds also reported from *A. japonica from* Koriya [11]. The previous study of *Artemisia japonica* showed dominance presence of linalool (70.4%), caryophyllene oxide (6.7%), *trans*-linalool oxide (4.5%), p-cymene (3.4%) and 1, 8-cineole (2.3%). Results also have significant antioxidant potentialities were displayed in terms of DPPH scavenging, beta carotene bleaching, total antioxidant activity [12]. Spathulenol (12 %), Germacrene D (7.5 %), β-elemene (2.8 %), and caryophyllene (2.4%) were reported from *A. japonica* collected from Kerala [13].

Table 1: Volatile oil composition of *A. japonica* from Uttarakhand Himalaya

Sr. No.	Compounds	RI	% Composition (FID)	Mode of Identification
1.	α-Pinene	939	2.3	a,b
2.	Sabinene	968	1.8	a,b
3.	β-Pinene	981	3.2	a,b
4.	α-Phellandrene	1006	4.2	a,b
5.	α-Tepinene	1020	1.6	a,b
6.	1,8-Cineole	1038	5.5	a,b
7.	(*Z*)-β-ocimene	1041	5.5	a,b
8.	(*E*)-β-ocimene	1050	6.5	a,b
9.	γ-terpinene	1065	4.6	a,b
10.	linalool	1101	**27.5**	a,b
11.	Artemisia alcohol	1110	2.4	a,b
12.	Borneol	1167	3.6	a,b
13.	β-Caryophyllene	1424	4.6	a,b
14.	(*E*)-β-Farnesene	1459	2.7	a,b
15.	Germacrene D	1484	**11.2**	a,b
16.	γ-Cadinene	1520	3.3	a,b
17.	α-Muurolol	1640	1.9	a,b
18.	α-Eudesmol	1648	1.7	a,b
Total			**93.1**	

*Mode of identification: Retention Index (LRI, Based on homologous series of n-alkanes; C_8-C_{24}), co-injection with standards/peak enrichment with known oil constituents, MS (GC-MS), t= trace (<0.1%); (-) = not detected, [a]RI: Retention index on Rtx-5 column (30 m × 0.25 mm; 0.25 µm film coating); [b]RI: Literature value (Adams, 2007)

4. Conclusion

The present investigation reveals that the volatile oil of *Artemisia japonica* is found to be has different compounds reported previously. As volatile oil of *Artemisia* species have seen good natural bioactivities. Attempts will be made in future to isolate the huge amount of oil to use many purposes.

5. Acknowledgment

The author is grateful to Head of Department, Chemistry, DSB Campus, Kumaun University Nainital for GC-MS analysis. Also thankful to BSI, Dehradun for the identification of the plant.

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