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Volatile oil composition of aerial parts of *Selinum tenuifolium* Wall ex C.B. Clarke from western Himalaya of Uttrakhand, India

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Abstract
The volatile oil composition of aerial parts of *Selinum tenuifolium* was analyzed by GC and GC-MS. The chemical composition of the isolated oil was characterized by 31 components. *α*-Bisabolol (55.55%), *p*-Cymene (3.50%), Ocimene (*E*) (2.70%), *α*-Copaene (2.40%), 2-Methylbuthyl isovalerate (2.30%), *p*-Cymen-8-ol (2.23%).

Keywords: *Selinum tenuifolium*, GC–MS, *α*-Bisabolol, Ocimene

1. Introduction
Essential oils in plant are complex volatile mixtures exist at low concentrations and are commonly found in aromatic plants. Essential oils extracted from fresh leaves and flowers can be used as aroma additives in food, pharmaceuticals and cosmetics [1, 2]. *Selinum* has 35 species distributed worldwide. The plant species are of perennial, branched herbs belonging to the family Apiaceae. Plants of this genus grow in humus rich slopes of temperate to alpine zone of Himalaya, South African and Andean mountains. Commonly *Selinum* is known as Bhutkesh. In India, five species of *Selinum* have been recorded from Uttarakhand. *Selinum tenuifolium* syn. *S. wallichianum*, *S. elatum*, *S. candollii*, *S. striatum*, *S. vaginatum* from Kumaun and Garwal region of Uttrakhand [3-5]. The literature survey revealed that the roots of *Selinum* are useful for diarrhea, cuts and wounds, fever, stomachache and vomiting. The mixture of root powder and mustard oil is used to cure swelling, which develops after delivery in women [6]. In this article the leaf essential oil composition of *S. tenuifolium* collected from world famous Milam glacier is presenting.

2. Experimental
2.1 Plant collection and identification
The fresh aerial parts were collected from Milam glacier in September 2007 (Uttarakhand, India) at an altitude of 3600 mt. The identification was done from Botanical Survey of India, Dehradun. The voucher specimens (Phyto/07/05) have been banked in the Phytochemistry lab in the Chemistry Department, Kumaun University, Nainital.

2.2 Isolation of essential oil
The fresh plant materials (2.5 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 30ºC and the percentage oil content was computed along the basis of fresh weight of plant materials.

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, N_2 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 × 0.25 mm; 0.25 µm film coating). The column temperature was programmed 60^0-210 ^{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 was done on the basis of Retention Index (RI, determined with reference to a homologous series of *n*-alkanes (C9-C24, Polyscience Corp., Niles, IL) under identical experimental condition), co-injunction with standards (Sigma and known essential oil constituents (standard isolates), MS Library search (NIST and WILEY), by comparing with the MS literature data [7]. The relative amounts of individual components were calculated based on GC peak area (FID response) without using correction factor.

3. Results and discussion

The oil yield obtained from the aerial parts of *S. tenuifolium* was 0.60% (v/w). The chemical compounds present in the essential oil of *S. tenuifolium* were identified by GC and GC-MS. Thirty one (31) compounds were characterized in the oil, accounting for 95.16% of the oil (Table 1). The major compounds were *α*–Bisabolol (55.55%), *p*-Cymene (3.50%), Ocimene (*E*) (2.70%), *α*-Copaene (2.40%), 2-Methylbuthyl isovalerate (2.30%), *p*-Cymen-8-ol (2.23%) as major compounds. Literature survey of essential oil composition of *Selinum* species revealed that plants of this genus are aromatic and posses' antispasmodic and diuretic properties [8]. Coumarins and acetylenic metabolites have been isolated and identified from the roots and aerial parts of *S. tenuifolium*. The root essential oil was shown to contain limonene, elemol, terpineol, geraniol and eudesmol. 3, 5 Nonadiyne (89.7%) was reported as the major constituent of the root essential oil of *S. tenuifolium* whereas 3, 5-nonadiyne (65.4%) and ß-eudesmol (7.2%) were the major components of the leaf essential oil [9-13].Recently from root essential oil four new compounds as, nona-3,5-diyn-2-one, nona-4,6-diyn-3-one, nona-3,5-diyn-2-ol, and nona-4,6-diyn-3-ol were reported [14]. Also essential oil composition from aerial parts of the plant collected from different places of Garhwal, Uttrakahnd showed *α* -bisabolol (71.80 %) as major constituent [15].

Table 1: Volatile oil composition of aerial parts essential oil of *S. tenuifolium* from Uttrakhand Himalaya

Sr. No.	Compounds	RI	% Composition (FID)	Mode of identification
1.	α–Thujene	932	2.11	a, b
2.	α–Pinene	939	1.77	a, b
3.	Camphene	954	1.15	a, b
4.	Sabinene	978	1.87	a, b
5.	β–Pinene	981	1.50	a, b
6.	β–Myrcene	992	0.20	a, b
7.	α–Phellandrene	1006	0.10	a, b
8.	*p*-Cymene	1028	3.50	a, b
9.	β-Phellandrene	1037	1.20	a, b
10.	Limonne	1039	1.10	a, b
11.	Ocimene (*E*)	1043	2.70	a, b
12.	*cis*-Sabinene hydrate	1063	0.70	a, b
13.	γ-Terpinene	1065	0.74	a, b
14.	*trans*-Sabinene hydrate	1069	1.06	a, b
15.	Isopentenyl isovalerate	1112	1.20	a, b
16.	2-Methylbuthyl isovalerate	1118	2.30	a, b
17.	*cis*-*p*-Menth-2-en-1-ol	1120	0.10	a, b
18.	*p*-Cymen-8-ol	1177	2.23	a, b
19.	Thymol methyl ether	1226	1.21	a, b
20.	Citral (*Z*)		1.20	a, b
21.	α-Copaene	1378	2.40	a, b
22.	*trans*-Caryophyllene	1418	1.30	a, b
23.	(*Z*)-□-Farnesene	1440	1.20	a, b
24.	(*E*)-□-Farnesene	1459	1.10	a, b
25.	Germacrene D	1482	1.12	a, b
26.	α-Bisabolene	1504	1.50	a, b
27.	γ-Cadinene	1524	0.50	a, b
28.	Caryophyllene oxide	1581	1.50	a, b
29.	Nerolidol	1571	1.20	a, b
30.	*α* -Bisabolol	1667	55.50	a, b
31.	Farnesol	1679	0.50	a, b
	Total		95.16	

*Mode of identification: Retention Index (LRI, Based on homologous series of n-alkenes; C_8-C_{24}), co injection with Standards/Peak enrichment with known oil constituents, MS (GC-MS), t= trace (<0.1%); (-) = not detected, RI: Literature value (Adams, 2003)

4. Conclusion

The essential oil from aerial parts of *S. tenuifolium* collected from Milam glacier of Kumaun region of Uttarakhand Himalaya is found rich in *α*-Bisabolol. This may become the ultimate source of *α*-Bisabolol for commercial utilization form Uttrakahnd. Attempts will be made in future to isolate the huge amount of oil to use many medicinal and pharmaceutical purposes.

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