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Essential Oil Composition of *Artemisia scoparia* Waldst. & Kitag from Qinghai-Tibetan Plateau of China

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Abstract

The oils extracted by hydro distillation from the aerial parts of *Artemisia scoparia* waldst. & kitag growing wild in two regions on Qinghai-Tibetan Plateau were analyzed by GC-MS. Eighty-three components were identified representing 97.5% of the total components detected. The major constituents of the oil from the samples obtained in the eastern of Riyue Mountain (2700 - 3200 m) were 2-ethenyl-naphthalene (45.1%), beta-pinene (11.2%), 3-carene (8.7%), 3,7-dimethyl-1,3,6-octatriene (7.9%), limonene (5.4%), alpha-pinene (3.5%) and beta-myrcene (2.0%). Whereas the oil from the plant collected in Qilian Mountain (3300 - 3500 m) was composed mainly of thujone (21.4%), 1,8-cineole (18.9%), camphor (9.1%), 4-methyl-1-(1-methyl ethyl)-3-cyclo hexen-1-ol (7.8%), 4-methyl-1-(1-methylethyl)-bicyclo[3.1.0]hexan-3-one (5.3%) and 2-isopropyl-5-methyl-3-cyclohexen-1-one(5.0%).

Keywords

***Artemisia scoparia* Waldst. & Kitag, Essential Oil, 1,8-Cineole, Thujone, 2-Ethenyl-Naphthalene, Beta-Pinene**

1. Introduction

Artemisia scoparia waldst. & kitag, belonging to the family Compositae, is commonly known as “binhao” or

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"huanghao" and "dongbei yinchenhao" in China. The plant is found wildly in Europe and Asia. The leaves and stem are usually made into folk and modern medicine of cosmetic and pharmaceutical industries. The plants also yield essential oil that is potential to be used as a source of insecticide and antimicrobial [1].

Compositions of the essential oils from the plants grown in different locations have shown wide range of variations even in their major constituents [1]-[9]. And wild-grown *Artemisia scoparia* waldst. & kitag was found in large area on Qinghai-Tibetan Plateau. However, the information of the composition of essential oil extracted from the plant in this region remains unknown. What was new in this article was the investigation of the composition of *Artemisia scoparia* waldst. & kitag oil produced in Qinghai-Tibetan Plateau, and to observe the differences between the samples obtained from two different regions of different altitude.

2. Materials and Methods

The wild material of *Artemisia scoparia* waldst. & kitag was collected respectively from Riyue Mountain (site 1) at an altitudes of 2700 - 3200 m, which is located in a transition region between Yellow Soil Plateau and Qinghai-Tibetan Plateau, and Qilian Mountain (site 2) at an altitude of 3300 - 3600 m, which is located in the eastern of Qinghai-Tibetan Plateau. All samples used for the present experiment were collected when they are mature.

2.1. Preparation of the Extracts

Air-dried aerial parts of the plant material (100 g each) collected as above were hydro distillated in a modified Clevenger apparatus for 3 - 4 h at 100˚C. The obtained essential oil was dried over anhydrous sodium sulphate and, after filtration, stored at 4˚C for analyzing.

2.2. GC-Analysis Conditions

Compositions of volatile compounds were studied by GC-MS with an EI quadruple MS (Agilent MSD 5973N) coupled with an Agilent 6890N GC, equipped with an HP-5MS (30 m × 0.25 mm., 0.25 m film thickness) fused silica column. Oven temperature was programmed from initial 50˚C to 150˚C at a rate of 2˚C/min, then held for 20 min and finally raised to 250˚C at 5˚C/min, held for 15 min. Injector temperature was 250˚C. For GC-MS detection, an electron ionization system with ionization energy of 70 eV and scan mode from 50 to 350 amu was used. Helium was the carrier gas, at a flow rate of 0.8 ml/min. MS transfer line temperature was set at 280˚C. Diluted samples (1/50, v/v in hexane) of 1.0 ml were manual and in the split mode (1:50). Qualitative analysis was based on comparing their mass spectra with the NIST2000 database and literature data [10]. The percentage composition of the essential oils was computed from GC peak areas without using correction factor.

3. Results and Discussion

The aerial parts of *Artemisia scoparia* waldst. & kitag yielded oil from 0.65% to 0.80% (w/w) on a dried weight basis; there was no significant difference between the samples gathered from the two sites in oil yield.

Eighty-three different compounds were identified totally in this work; 44 and 66 compounds, which accounted for about 99.6% and 99.8%, were identified in the oils from site 1 and site 2, respectively; and 26 of them were present in both. Constituents identified in the oils of *Artemisia scoparia* waldst. & kitag from two sites are listed according to the elution order (**Table 1**). The major components of the analyzed sample are beta-pinene in site 1 (11.2%), while it is thujone in site 2 (21.4%).

Even though most of the components presented in both oil samples, there were significant differences in major components between the samples from two sites. The oil from site 1 (lower altitude) was characterized by the presence of large amount of hydrocarbons, monoterpenes and sesquiterpene hydrocarbons; 2-ethenyl-naphthalene, beta- and alpha-pinene, 3-Carene, limonene, 3,7-dimethyl-1,3,6-octatriene and beta-myrcene were the major components. Whereas the major components in the oil from site 2 (higher altitude) were oxygenated hydrocarbons; thujone, 1,8-cineole and camphor, along with 4-methyl-1-(1-methylethyl)-3-cyclohexen-1-ol and 2-isopropyl-5-methyl-3-cyclohexen-1-one. 2,4-Pentadiynyl-benzen, which was reported as the major constituent of *Artemisia scoparia* waldst. & kitag in previous works [4] [6], was found only in negligible quantities in this study. These differences may be mainly due to the special geographical and environmental conditions on Qinghai-Tibetan Plateau.

Table 1. Chemical composition (%) of the essential oils of *Artemisia scoparia* waldst. & kitag wild-growing in Qinghai-Tibetan Plateau of China.

No.	Components	Site 1	Site 2
1	2-Methyl furan	-	t
2	1-Octene	-	t
3	Cyclopropane, 1,1-dimethyl-2-(2-methyl-2-propenyl)-	-	0.1
4	1-Hexanol	-	t
5	1-Nonene	t	t
6	Tricyclo[2.2.1.0(2,6)]heptane, 1,7,7-trimethyl-	-	t
7	Bicyclo[3.1.0]hex-2-ene, 2-methyl-5-(1-methylethyl)-	0.1	0.1
8	1R-.alpha.-Pinene	3.5	0.2
9	Bicyclo[3.1.0]hex-2-ene, 4-methyl-1-(1-methylethyl)-	-	t
10	Camphene	t	1.1
11	Benzaldehyde	t	-
12	beta.- Phelladrene	-	1.3
13	.beta.-Pinene	11.2	0.5
14	1-Octen-3-ol	-	0.1
15	2,3-Dehydro-1,8-cineole	-	0.2
16	beta.-Myrcene	2.0	1.5
17	alpha.-Phelladrene	t	0.6
18	[+]-4-Carene	0.2	2.7
19	p-Cymene	1.8	3.3
20	Limonene	5.4	-
21	1,8-Cineole	1.1	18.9
22	Z-4-Octene-2,7-diol,2,7-dimethyl	-	0.6
23	E-1,3,6- Octatriene, 3,7-dimethyl	0.7	-
24	Z-1,3,6- Octatriene, 3,7-dimethyl	7.2	-
25	3-Carene	8.7	3.3
26	1,5-Heptadien-e-one, 3,3,6-trimethyl	t	3.0
27	Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5- (1-methylethyl)	-	0.5
28	1-Nonen-3-ol	-	0.1
29	Cyclohexene, 1-methyl-4- (1-methylethylidene)	1.1	0.8
30	Thujone	0.9	21.4
31	Bicyclo[3.1.0]hexan-3-one, 4-methyl-1- (1-methylethyl)	0.4	5.3
32	Bicyclo[3.1.0]hex-3-en-2-one,5-methyl-2- (1-methylethyl)	-	0.3
33	Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5- (1-methylethyl)	t	1.1
34	Trans-pinocarveol	t	0.4
35	Camphor	t	9.1
36	2-Cyclohexen-1-ol, 2-methyl-5-(methylethyl)	-	0.2
37	Bicyclo[3.1.0]hexan-2-one,5- (1-methylethyl)	-	0.2
38	2(10)-pinen-3-one[.+/-.]	-	0.2
39	Borneol	-	0.4
40	p-Menth-1-en-8-ol	-	0.3
41	3-Cyclohexen-1-ol, 4-methyl-1- (1-methylethyl)	0.2	7.8

Continued

42	alpha.-Thujenal	-	0.2
43	3-Cyclohexen-1-methanol, .alpha., .alpha., 4-trimethyl-,(S)-	t	0.5
44	Bicyclo[3.1.1]hept-2-ene-2-carboxaldehyde, 6,6-dimethyl-	-	0.2
45	Bicyclo[3. Bicyclo[3.1.1]hept-2-ene-2- methanol, 6,6-dimethyl	-	0.4
46	1,4-cyclohexadiene, 1-methyl-4- (1-methylethyl)	-	0.2
47	henol, 3- (1-methylethyl)	-	t
48	Benzaldehyde, 4-(1-methylethyl)	-	0.3
49	n-Valeric acid cis-3-hexenyl ester	t	-
50	2-Cyclohexen-1-one, 3-methyl-6-(1-methylethyl)	t	0.4
51	3-Cyclohexen-1-one, 2-isopropyl-5-methyl	-	5.0
52	Benzene, 2,4-pentadiynyl	1.0	-
53	Bornyl acetate	-	0.1
54	Cyclohexene, 1- methyl-4-(1-methylethylidene)	-	0.2
55	Eugenol	1.0	-
56	Copaene	-	0.1
57	Bicyclo[2.2.1]hept-2-ene, 1,7,7- trimethyl	0.2	-
58	Isobornyl propionate	-	0.1
59	Benzene, 2,5-cyclohexadien-1-yl	0.2	-
60	2-isopropenyl, 4a,8- dimethyl	0.1	-
61	2-cyclopenten-1-one, 3-methyl-2-(2-pentenyl)-	-	0.1
62	Benzene, 1,2-dimethoxyl-4-(2-propenyl)	1.1	-
63	Caryophyllene	1.8	0.2
64	Butanoic acid, 1,7,7- trimethylbicyclo[2.2.1]hept-2-yl ester	-	0.2
65	Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene	t	-
66	alpha.-Caryophyllene	t	t
67	1,6,10-dodecatriene, 7,11-dimethyl-3-methlene	0.3	-
68	Aristolene	-	0.7
69	Cycloisolongifolene	-	0.2
70	[+]-Epi-bicyclosesquiphellandrene	0.5	1.2
71	Di-epi-.alpha.-cadrene-(1)	1.1	-
72	Eudesma-4[14],11-diene	-	0.7
73	Naphthalene, 1,2,3,5,6,7,8,8a-octadehyro-1, 8-dimethyl-7-(1- methylethylidene)	-	0.2
74	Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl	0.4	-
75	gamma- Elemene	0.3	0.4
76	Naphthalene , 2-ethenyl	45.1	0.3
77	Butanoic acid, 3-methyl-, 1,7,7-trimethyl bicyclo[2.2.1]hept-2-yl ester	-	0.6
78	1,6,10-dodecatrien-3-ol, 3,7,11-trimethyl	0.1	-
79	Spathulenol	0.8	-
80	Caryophyllene, oxide	t	0.5
81	5-Hepten-3-one,2-(5-ethenyltetrahydro-5-methyl-2-furanyl)-6-methyl	-	0.2
82	2-Naphthalenemethanol, decahydro-.alpha., .alpha.,4a-trimethyl-8-methylene-	0.1	t
83	2(1H)Naphthalenone,3,5,6,7,8,8a-hexadehydro-4,8a-dimethyl-6-(1-methylethenyl)	-	0.2
total		98.6	98.8

t[a], ttraces(<0.01%); -[b], not found.

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