American-Eurasian J. Agric. & Environ. Sci., 5 (1): 78-81, 2009
ISSN 1818-6769

Chemical Composition of Hydrodistillation Essential Oil of Rosemary in Different Origins in Iran and Comparison with Other Countries

[1]*R. Jamshidi,* [1]*Z. Afzali and* [2]*D. Afzali*

[1]Islamic Azad University, Bardsir Branch, Bardsir, Iran
[2]International Center for Science, High Technology and Environmental Sciences, Kerman, Iran

Abstract: In the present work, chemical composition of essential oils of rosemary (*Rosmarinus officinalis* L.) from various geographic origins (Kerman and Lalehzar) were determined by GC/MS. Rosemary leaves oil was isolated by hydrodistillation. The 49 components were identified in Lalehzar oil and 31 components were identified in Kerman oil. The hydrodistillation of Lalehzar oil was found to be rich in α-pinene (43.9%), 1, 8-cineole (11.1%), camphene (8.6%), β-myrcene (3.9%), broneol (3.4%), camphor (2.4%) and Verbenol (2.3%). 31 components were identified in hydrodistillation of Kerman oil and main component as follow; α-pinene (46.1%), 1, 8-cineole (11.1%), camphene (9.6%), camphor (5.3%), sabinene (4.6%), β-myrcene (3.9), broneol (3.4%), bornyl acetates (2.8%), verbenone (2.3%) and linalool (2.1%).

Key words: Rosemary · *Rosmarinus officinalis* L · Essential oil composition · Hydrodistillation

INTRODUCTION

Rosemary (Rosmarinus officinalis L) leaves are a very common spice and its oil is used in fragrance flavor industry aromatherapy [1], antioxidant activity [2-4], antimiccrobial and antitumour properties [5-7]. Among herbs and spices, rosemary (*Rosmarinus officinalis* L.) is a common household plant grown in many parts of the world. It is used for flavoring food, in cosmetic and in traditional medicine for choretics, hepatoprotective and antimorigenic activity [8]. Thus rosemary extracts have great interest for the food industry as a source of active compound and medicine as a great part of drugs. The essential oil of rosemary has been widely studied; J.C. Chalchat *et al*. [9] reported comparison Spain, Morocco and France Rosemary oils composition. For example the level of α-pinene (30-35%) was always higher than 1, 8-cineole (14-20%), which was in turn higher than camphor (7-12%). Oils of the other origins from Turkey [10], Tunisia [11], Algeria [12], Cuba [13], Argentina [1], Italy [14], Yugoslavia [15], USA [16], Portugal [17] and Greek [18] have also been studied but yet to now the compositions oils of rosemary species that grow in Kerman province in Iran haven't studied. In the present work we have studied the chemical compositions of two different oils rosemary that grow in different weather in Kerman province (Kerman and Lalehzar) and then the results were compared with various origins in other countries.

Experimental

Plant Material: Fresh aerial parts of wild rosemary were collected during flowering stage from southern east of Iran (Kerman altitude 1700 m and Lalehzar altitude 2800 m).

Isolation Procedure: Fresh aerial parts of plants (500 g) were submitted in a Clevenger type apparatus. The oil was isolated by water and steam distillation. The yield of the oils was 2.6% w/w for Lalehzar and 2.1% w/w for Kerman. The sample oils were dried over anhydrous sodium sulfate and stored in vial at low temperature under nitrogen before analysis.

GC: GC-FID analyses of the oil were conducted using a Thermoquest-Finnigan instrument equipped with a DB-1 fused silica column (60 m × 0.25 mm i.d., film thickness 0.25 μm). Nitrogen was used as the carrier gas at the constant flow of 1.1 ml/min. The oven temperature was raised from 60°C to 250°C at a rate of 5°C/min. The injector and detector (FID) temperatures were kept at 250°C and 280°C, respectively.

GC/MS: GC/MS analysis was carried out on a Thermoquest-Finnigan Trace GC/MS instrument equipped

Corresponding Author: D. Afzali, International Center for Science, High Technology and Environmental Sciences, Kerman, Iran

with a DB-1 fused silica column (60 m × 0.25 mm i. d., film thickness 0.25 μm). The oven temperature was raised from 60°C to 250°C at a rate of 5°C/min; transfer line temperature was 250°C. Helium was used as the carrier gas at a flow rate of 1.1 ml/min with a split ratio equal to 1/50. The quadrupole mass spectrometer was scanned over the 35-465 amu with an ionizing voltage of 70 eV and an ionization current of 150 μA.

Identification of Components: The constituents of the volatile oils were identified by calculation of their retention indices under temperature-programmed conditions for *n-alkanes* (C_6-C_{24}) and the oil on a DB-1 column under the same conditions. Identification of individual compounds was made by comparison of their mass spectra with those of the internal reference mass spectra library or with authentic compounds and confirmed by comparison of their retention indices with authentic compounds or with those of reported in the literature. Quantitative data was obtained from FID area percentages without the use of correction factors.

RESULT AND DISCUSSION

The essential oils isolated by water distillation were obtained in yield 2.6% w/w base on dry weight of sample for Lalehzar and 2.1% w/w for Kerman. Forty nine components were identified, representing 100% of the oil for Lalehzar while thirty one components for Kerman Rosemary oil, representing more than 99.9%. The chemical compositions of the oils of two origins are given in Table 1. The main components of the Rosemary oils were α-pinene (43.9% and 46.1%), 1, 8-cineole (11.1% and 11.1%), camphene (8.6% and 9.6%), camphor (2.4% and 5.3%), β-myrcene (3.9% and 3.9%) and broneol (3.4% and 3.4%) for Lalehzar and Kerman respectively. The sabinen (4.6%) is one of the main components in Kerman Rosemary oil while isn't in Lalehzar rosemary oil. The compounds of 3-Octanone (1.4%), β-Phellanderene (1.3%) and Limonene (1.2%) are exited in Lalehzar oil while don't exit in Kerman rosemary oil. The Verbenol is in Lalehzar oil (2.2%) while is in Kerman oil only 0.1%. The comparisons of the oils component were given in Table 1.

Table 1: Chemical composition of essential oils of Rosemary

No.	Compound	RI	Method of identification	Percentage (Lalehzar)	Percentage (Kerman)
1	Tricyclene	926	RI, MS	0.4	0.5
2	α-Thujene	931	RI, MS, Co-I	0.2	-
3	α-Pinene	941	RI, MS, Co-I	43.9	46.1
4	Camphene	953	RI, MS, Co-I	8.6	9.6
5	Verbenone	961	RI, MS	2.6	2.3
6	Sabinene	969	RI, MS	-	4.6
7	β-Pinene	979	RI, MS, Co-I	1.9	1.9
8	3-Octanone	984	RI, MS	1.4	-
9	β-Myrcene	988	RI, MS	3.9	3.9
10	3-Octanol	995	RI, MS	t	-
11	α-phellandrene	1007	RI, MS	0.1	0.1
12	α-Terpinene	1016	RI, MS	0.3	0.3
13	p-cymene	1021	RI, MS	0.4	0.9
14	β-Phellanderene	1029	RI, MS, Co-I	1.3	-
15	Limonene	1030	RI, MS, Co-I	1.2	-
16	1, 8-Cineole	1033	RI, MS, Co-I	11.1	11.1
17	trance-Ocimene	1040	RI, MS,	0.3	-
18	ã-Terpinene	1057	RI, MS	0.4	0.4
19	cis-Sabinene hydrate	1068	RI, MS	0.2	-
20	α-Terpinolene	1080	RI, MS	0.6	0.6
21	m-Cymenene	1084	RI, MS	0.3	-
22	p-Cymenene	1089	RI, MS	0.2	-
23	Linalool	1094	RI, MS, Co-I	1.7	2.1
24	D-Fenchyl alcohl	1110	RI, MS	0.2	-
25	Chrysthenone	1120	RI, MS	0.8	0.8
26	Camphor	1136	RI, MS	2.4	5.3
27	Verbenol	1138	RI, MS	2.2	0.1
28	Iso-Pulegol	1143	RI, MS	0.3	-

Table 1: Continued

29	Trans-Pinocamphene	1152	RI, MS	0.2	0.1
30	Cis-Pinocamphene	1154	RI, MS	0.2	0.1
31	iso-Pinocamphene	1159	RI, MS	0.1	0.2
32	Borneoil	1162	RI, MS	3.4	3.4
33	Terpine-4-ol	1179	RI, MS	0.1	0.1
34	3-decanone	1182	RI, MS	t	-
35	α-Terpineol	1184	RI, MS	0.4	0.4
36	verbenone	1195	RI, MS	2.3	2.3
37	Pulegone	1237	RI, MS, Co-I	0.1	-
38	cis-Myrtanol	1244	RI, MS	0.4	0.4
39	Trans-Myrtanol	1251	RI, MS	0.3	0.4
40	Bornyl acetate	1281	RI, MS, Co-I	2.5	2.8
41	neo-Dihyro carveoil acetate	1315	RI, MS	0.2	-
42	iso-Dihyro carveoil acetate	1357	RI, MS	0.2	
43	Piperitenone	1361	RI, MS	0.1	-
44	Geranyl acetate	1382	RI, MS	0.1	
45	Methyl eugenol	1401	RI, MS	0.1	-
46	α-Caryophyllene	1408	RI, MS	0.5	0.1
47	β-Caryophyllene	1422	RI, MS, Co-I	1.6	0.1
48	α-Humulene	1443	RI, MS	0.1	-
49	trance-beta-Farnesene	1457	RI, MS	0.1	1.1
50	Caryophyllene-oxide	1581	RI, MS	0.1	0.1

RI= Retention index; MS= Mass spectrum; t= trace (<0.05%); Co-I= Co injection with an authentic sample

Table 2: Comparative the percentage of the main chemical composition of Rosemary oils

compound	1	2	3	4	5	6	7	8	9
α-Pinene	43.9	46.1	12.51	24.7	35.80	5.2	8.17	10.9	25.16
1, 8-Cineole	11.1	11.1	47.44	18.9	5.30	52.4	11.00	14.5	20.64
Camphene	8.6	9.6	3.62	11.2	8.30	3.0	5.18	5.1	5.52
β-Myrcene	3.9	3.9	1.57	4.9	2.10	1.7	-	17.9	0.55
Borneol	3.4	3.4	2.97	4.5	4.44	3.4	11.60	1.1	13.70
Verbenene	2.6	-	-	-	-	-	-	-	-
Bornyl acetate	2.5	2.8	0.23	1.0	14.30	1.1	-	0.9	-
Camphor	2.4	5.3	7.9	18.9	3.00	12.6	34.80	9.0	10.26
Verbenone	2.3	2.3	0.46	-	4.80	-	0.25	0.3	4.76
Verbenol	2.2	-	-	-	-	-	-	-	-
β-Pinene	1.9	1.9	7.2	3.4	4.30	5.7	2.49	4.8	1.05
Linalool	1.7	2.1	0.7	1.0	1.61	1.1	3.05	0.9	1.82
β-Caryophyllene	1.6	1.1	3.31	2.2	1.40	4.2	0.88	8.3	0.97
3-Octanone	1.4	-	-	-	-	-	t	-	-
β-Phellanderene	1.3	-	-	-	-	-	-	-	-
Limonene	1.2	-	1.9	3.1	3.40	-	2.80	2.9	1.33
Sabinene	-	4.6	0.12	0.4	0.21	-	5.06	-	0.63

1= Lalehzar oil; 2= Kerman oil; 3= Morocco oil (reference 9); 4= Spain oil (reference 9); 5= France oil (reference 9); 6= Algeria oil (reference 12); 7= Cuba oil (reference 13); 8= Argentina oil (reference 1); 9= Italy oil (reference 14);

Table 3: Physicochemical constant of essential oil

Origin	Refractive index at 20°C	Specific gravity at 20/20°C	Optical rotation at 20°C
Lalehzar	1.4734	0.903	+0.63°
Kerman	1.4612	0.912	+1.98°

We were compared these oils with other rosemary oils and the results were given in Table 2. The physicochemical characters of these oils studied and results were given in Table 3.

CONCLUSION

The analysis of different of essential oils of rosemary that grow in Kerman province (Kerman and Lalehzar) identified the components and the percent of components are slightly different. The soil, climate and altitude may be affected on the components and percent component therefore for different use of essential oils of rosemary different geographic for grown is necessary.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the financial support project by the Islamic Azad University of Bardsir, project No. 52263850715006.

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