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Original Article

Chemical Variability of *Salvia eremophila* Boiss. (Case Study: Yazd Province, Iran)

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Abstract

Salvia eremophila Boiss. is an endemic plant from Iran. Plant metabolites are directly affected by some environmental factors. In following, secondary metabolites and chemical compounds might be varied that this variation can lead to changes the pharmacological efficacies. To investigate chemical variation of the species in different natural habitats, the essential oils were extracted by hydro-distillation method using Clevenger apparatus. Comparative outcomes revealed considerable variations in the obtained oils and constitutions. The essential oil yield varied between 0.69–0.81% during full flowering stages. The essential oil analyses identified 14 compounds (86.7–94.1% of the total oil) among which *α*-pinene (48.7–52.7%) was the highest component in all studied populations. The other main compositions were borneol (11.5–14.7%), isobornyl acetate (9.1-10.8%), and *trans*-Caryophyllene (6.9–8.2%). Based on the present research it could be found that chemical variation of *S. eremophila* in the studied areas is considerable. Ghavam Abad was the best one in quality and quantity of the chemical compounds.

Keywords: Flowering stage, *α*-pinene, Borneol, *Salvia eremophila* Boiss.

Introduction

One of the largest genera in Lamiaceae family is *Salvia* (tribe Mentheae: subtribe Salviinae) that demonstrate in the flora of Iran with 61 species, 18 of which such as *Salvia eremophila* Boiss. are endemic [1]. *Salvia* is famous for useful secondary metabolites such as phenolic compounds, terpenes, and their derivatives [2]. Moreover, essential oil of *Salvia* species is specially considered for its economically important [3-6].

Essential oil as one kinds of natural product is described by a rarely colored and strong smell. In general, the density of essential oil is lower than water [7-9]. Some phytochemical analysis revealed that essential oils consist of complex components, which the great majority of constituents belong to terpenes (oxygenated or not) [10,11]. These kinds of natural components not only can attract insects to promote the distribution of pollens and seeds but also have some pharmacologic efficacies such as antiviral, antibacterial, and antifungals. Furthermore, they can have an important role in allelopathic communication between plants [12-15].

Different accessions of medicinal plants in natural habitats could be affected by environmental factors. In following, secondary metabolites and chemical compounds might be varied that this variation can lead to changes the pharmacological efficacies [16]. For this purpose, different research groups investigated the level of variation in numerous aromatic and medicinal plant species [17-21].

A literature survey on *S. eremophila* showed different accessions had various main compounds. Investigation on the species in Darab, Fars showed *α*-pinene (21.5%), borneol (20.8%), and geranyl linalool (10.7%) were the main constitutions [22]. The results of two research groups in Kashan in different years showed some changes

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in the main compositions [23-24]. An analysis on *S. eremophila* in Meybod revealed *α*-pinene (41.70%), borneol (17.34%), and camphene (11.87%) as the main constitutions [25].

The present research aims to discover quantity and quality variation of *S. eremophila* Boiss. in different habitats at flowering time. In order to find the best habitat of each plant, this kind of study could be more useful.

Material and Methods

Plant Material

The samples were collected at full flowering stage in early summer at three natural habitats, Yazd, Iran. The plants were identified in the Herbarium of Yazd University that its specimen number was YUH-1435. Table 1 shows the geographical situation of each study area.

Extract of Essential Oil

The aerial parts of each community were cut and dried in a laboratory and dark situation. The dried powder (100 gr) of each community was hydro-distilled using a Clevenger apparatus for 3 hours to obtain the essential oil. The obtained oils were dried with sodium sulfate to prepare for GC-MS analyses.

Analysis of the Essential Oil

The GC-FID analysis was done using a Thermoquest-Finnigan apparatus, which contained a DB-5 fused silica column with a length of 60 m, an internal diameter of 0.25 mm, and film thickness of 0.25 μm. The carrier gas was nitrogen with a flow rate of 1.1 ml/min. The column of planning thermal was raised from 60 ºC to 250 ºC with a rate of 5 ºC/min. The GC-MS instrument was same as GC. The injector and detector temperatures were kept at 250 ºC and 300 ºC, respectively.

Table 1 Geographical location of study areas

Geography / Study area	Latitude	Longitude	Altitude
Damgahan	31° 31' 59" N	54° 19' 32" E	1947
Ghavam Abad	31° 48' 44" N	54° 04' 08" E	1730
Tang Chenar	31° 32' 21" N	54° 21' 12" E	1824

Table 2 Chemical compositions of *S. eremophila* Boiss. in different study areas

	Compounds	RI	Ghavam Abad	Damgahan	Tang Chenar
1	*α*-Pinene	934	48.7	52.7	50.5
2	Camphene	952	5.3	6.9	4.8
3	Myrcene	988	0.7	1	1.1
4	*α*-Terpinene	1018	0.6	1.6	0.0
5	*o*-Cymene	1027	0.4	0.4	0.0
6	Limonene	1030	1.7	1	0.5
7	*γ*-Terpinene	1058	0.1	0.4	0.0
8	Terpinolene	1086	0.2	0	0.0
9	Linalool	1100	0.8	tr	0.0
10	Borneol	1177	11.5	11.9	14.7
11	Terpinen-4-ol	1184	0.4	tr	0.0
12	*α*-Terpineol	1199	0.2	tr	0.0
13	Isobornyl acetate	1285	9.1	10	10.8
14	*trans*-Caryophyllene	1420	6.9	8.2	7.6
	Monoterpene Hydrocarbons		57.7	64.0	56.9
	Oxigenated Monoterpenes		13.0	11.9	14.7
	Oxigenated Sesquiterpene		9.1	10.0	10.8
	Sesquiterpene Hydrocarbons		6.9	8.2	7.6
	Total		86.7	94.1	90.0
	Essential oil %		0.81	0.69	0.78

Trace (tr) < 0.05 %

Table 3 A Summary of Published Data on the Main Compounds of *S.* Species

Species	Main compounds			References
S. mirzayanii Rech. F. & Esfand	*α*-terpinenyl acetate (22.6%)	1,8-cineole (21.2%)	linalool (8.9%)	[33]
S. hydrangea DC. ex Benth.	*β*-caryophyllene (25.1%)	1,8-cineole (15.2%)	caryophyllene oxide (11.5%)	[33]
S. santolinifolia Boiss.	*α*-pinene (72.4%)	*β*-pinene (6.6%)	Limonene (5.3%)	[33]
S. reuterana Boiss.	Germacrene-D (27.5%)	*β*-caryophyllene (15.5%)	Linalool (12.5%)	[34]
S. bracteata Bank et Sol.	*α*-pinene (72.4%)	*β*-pinene (7.9%)	Myrcene (7.6%)	[35]
S. multicaulis Vahl	Longifolen (17.2%)	Aristolen (17.2%)	Germacrene-D (14.2%)	[36]
S. limbata C. A. Mey.	Bicyclogermacrene (21.1%)	α-pinene (15.5%)	1,8-cineole (11.0%)	[37]
S. sclarea L.	linalyl acetate (34.0%)	Linalool (18.5%)	Germacrene-D (10.0%)	[38]

In order to comprise the present results with published data on the main compositions of *S.* species, table 3 has been created.

Identification of the Oil Components

Identification of oil constituents was made by comparing their retention indices and mass spectra with those of the internal reference mass spectra library (NIST, Adams 2001 and Wiley 7.0). It is noteworthy that the retention index (RI) of the compounds were calculated and compared with *n*-alkanes (C6 – C24) under the same chromatographic conditions.

Results and Discussion

Essential Oil Outcome

Hydro-distillation method was used to extract the oil of *S. eremophila* in the studied areas. The essential oils were yellow with an aromatic odor. The yield of each community was different and varied between 0.69 – 0.81 %. 14 compositions were identified in the oils that the components and their percentages are listed in the table 2 in order of their retention indices. As can be seen, all communities showed that monoterpene hydrocarbons were the predominate constituents. *α*-pinene, borneol, and isobornyl acetate were the main constitutions in all populations. In comparison with other research on *S. eremophila*, the present study shows some differences in the main components [22-25], which can be directly affected by geographic or climatic factors. It is speculated that the drying conditions, collection time, and mode of distillation had effective role for the obtained results. It is noteworthy that the studied species produce *α*-pinene impressively. In other words, the highest constitution in all populations is *α*-pinene, which is so valuable in pharmacologic efficacies such as anti-inflammatory [26], anti-nociceptive [27], antimicrobial [28-29], cytotoxic [29], gastro-protective, anti-ulcerogenic [30], and non-rapid eye movement sleep [31]. *α*-pinene not only is useful for its pharmacologic properties but also is important in food flavoring ingredient [29,32].

Conclusions

The current research has provided a primary knowledge of different *S. eremophila* population in Yazd province. Based on the present research it could be found that chemical variation of *S. eremophila* in the studied areas is considerable. Ghavam Abad was the best one in quality and quantity of the chemical compounds. Most of the identified components in the species were common in the oils of other *Salvia* species that have been previously investigated.

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Conflicts of Interest

The authors declare no conflicts of interest.

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