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Essential Oil Content and Composition of *Salvia tomentosa* Mill. from Gölcük, Isparta

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Abstract: This study was conducted to determine the essential oil content and composition of *Salvia tomentosa* Mill. which is widespread in flora of Turkey, collected from populations of Isparta province. Flowered branches of *S. tomentosa* collected from the Gölcük Natural Park at an altitude of 1430 m during the flowering stage in July, 2009 were used as plant material in this study. Essential oil contents of air-dried samples were obtained by hydrodistillation method using Clevenger-type apparatus. Composition of essential oil was analyzed GC-MS. The average of essential oil content was determined as 2.36±0.29%. Main constituents of essential oil were identified as borneol (29.32%) and α-pinene (24.65%).

Isparta Gölcük'ten Toplanan *Salvia tomentosa* Mill. Uçucu Yağının İçerik ve Kompozisyonu

Anahtar Kelimeler
Adaçayı
Uçucu yağ bileşenleri
Borneol
α-pinene.

Özet: Bu çalışma, Türkiye florasında yaygın olarak bulunan *Salvia tomentosa* Mill.'nın Isparta yöresinden toplanan populasyonlarında uçucu yağ oran ve bileşenlerini belirlemek amacıyla yürütülmüştür. Çalışmada bitki materyali olarak kullanılan *S. tomentosa*' nın çiçekli dalları, Gölcük Tabiat Parkından 2009 yılı Temmuz ayında toplanmıştır. Uçucu yağ oranları hava kurusu örneklerde su distilasyonu yöntemiyle Clevenger aparatı kullanılarak belirlenmiştir. Uçucu yağ kompozisyonu ise GS-MS ile belirlenmiştir. Ortalama uçucu yağ oranı % 2.36±0.29 olarak saptanmıştır. Uçucu yağın ana bileşenleri, % 29.32 oranında borneol ve % 24.65 oranında α-pinene olarak belirlenmiştir.

1. Introduction

The genus of *Salvia* L. is the largest genus in the family of Lamiaceae both in Turkey and in the rest of the world (Celep et al., 2010). The genus represents approximately 1000 species showing remarkable diversity in growth forms, secondary compounds, floral morphology, and pollination biology and has distributed extensively in 3 regions of the world: Central and South America (500 spp.), western Asia (200 spp.) and eastern Asia (100 spp.) (Walker and Sytsma, 2007).

Flora of Turkey contains more than 1000 infrageneric taxa, of which 34.5% are endemic (Başer, 2002). The family of Lamiaceae is represented by 45 genera, 546 species and 730 taxa in Turkey and the rate of endemism is 44.2% (Akgül and Özcan, 1999). *Salvia* is represented in Turkey by 94 taxa belonging to 89 species with 50 % endemism (Başer, 2002). *Salvia* taxa of Turkey were classified according to main constituents of essential oil by Başer (2002). According to this classification, *Salvia tomentosa* belongs to Pinene group. Essential oil content of *S. tomentosa* varies between 0.6–1.3%, α-pinene and β-pinene contents vary between 6–29% and 5–33%, respectively (Ozek et al., 2007; Başer, 2002).

Salvia species are commonly used traditionally in Anatolia for colds, stomach aches, and sore throats. A solution of the plant is also used by pouring on to the open cuts and called "Tenturdiyot otu (Iodine tincture herb)", "Moşabla" or "Boş yaprak" (Aşkun et al., 2010). The same species have been used in folk medicine since ancient times to cure tuberculosis, cancer, diabetes, coronary heart diseases, angina pectoris, and myocardial infarction. Skin diseases such as psoriasis and eczama could be treated by same species and they also exhibit oestrogenic activities (Topçu et al., 2007). Besides, mentioned species are used as traditional medicines all around the world, possessing antibacterial, antioxidant, antidiabetic, and antitumor properties (Ulubelen, 2003). Because of extensive usage of the species, it

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was aimed to determine the essential oil content and constituents of *S. tomentosa* grown naturally in Gölcük, Isparta.

2. Materials and Methods

Plant material

The flowered branches of *Salvia tomentosa* were collected from Gölcük Natural Park in Isparta, Turkey during the flowering stage in July 2009, at an altitude of 1430 m. Totally 17 genotypes representing from the populations were selected randomly and harvested from 15 cm above the soil surface. Plant materials were dried under shadow and room temperature. The plant specimens were identified by Herbarium Section of Suleyman Demirel University, Isparta.

Climate and soil characteristics

Gölcük Natural Park is located in "sub-humid" climate of the Western Mediterranean Region. According to averages of multi-year climate data, average of annual temperature is 12.01°C and rainfall is 558.7 mm. The average temperature decreases to 1.7°C in January, it increases to 23.2°C in July. Gölcük Natural Park shows the characteristics of Mediterranean climate as the temperatures do not decrease under 0.0°C in winter, where as it shows the different characteristics of the Mediterranean climate since it does not increase to 25.0°C in summer season. Because of these climatic features Gölcük Natural Park has the characteristics of a transition between the Mediterranean and Central Anatolian Region.
The Gölcük Natural Park instead of the lake area has salty alkali and salty alkali complex (barren) (10.23%), organic soils (1.87%), alluvial coastal marshes (0.64%), red Mediterranean soils (27.82%) and brown forest soils (59.44%). Plant material was collected from the stony and slope area of the Natural Park.

Essential oil isolation

The essential oils were extracted from air-dried flowered branches of *S. tomentosa* by hydrodistillation (1:10 w/v) for 3 hours using Clevenger type apparatus (British Pharmacopoeia, 1980). The essential oils were stored in dark glass bottles at 4°C until analysis.

Gas Chromatography-Mass Spectrometry

The essential oil composition was analyzed by gas chromatography-mass spectrometry (GS/MS) system in Experimental and Observational Research Center for Student of Süleyman Demirel University. The GC/MS analyses were performed using a Shimadzu GC/MS-QP 5050 A GC/MS system operating on electro spray ionization (EI) mode (equipped with a CP Wax 52 CB (50 m x 0.25 mm *i.d.*, film thickness 1.2 µm), using He (1 mL/min) as the carrier gas. Oven temperature was programmed from 60°C to 220°C at 2°C/min, then isothermal at 220°C for 20 minutes. The temperature of injector and detector was 240°C. Mass spectra were taken on 70 eV. After compounds in gas chromatography column were separated, each individual ion mass spectra was taken. Evaluation process was made using the library "Wiley, NIST and Tutor".

Statistical Analysis

Standard deviation was used as a statistical measure for range of essential oil content values.

3. Results

The essential oils of *Salvia tomentosa* were obtained by hydrodistillation and analyzed by GC–MS. Essential oil contents changed between 2.0% and 2.8 % and the average content was determined as 2.36±0.29%. A total of 19 constituents representing 99.35% of the essential oil were characterized. Borneol (29.32%) and α-pinene (24.65%) were found as main constituents of *S. tomentosa* essential oil. Another important components were identified as trans-caryophylene (6.74%), 1,8-cineole (6.16%), α-terpineole/fenchyl alcohol (4.65%), camphor (4.52%), limonene (3,69%), cadinene (2.54%) and β-pinene (2.39%). Essential oil composition of *S. tomentosa* was shown in Table 1.

Table 1. Essential oil composition of Salvia tomentosa

Essential Oil Constituents	Rt*	Area (%)
α -pinene	9.4	24.65
Camphene	11.4	1.45
β -pinene	13.3	2.39
Myrcene	15.8	0.99
Limonene	18.2	3.69
1,8-cineole	18.8	6.16
Cimene	20.0	1.16
Camphor	39.4	4.52
Linalool	40.0	1.16
Fenchyl acetate/Bornyl acetate	43.1	1.83
trans-Caryophyllene	44.5	6.74
Aromadendrene	45.2	1.37
α -terpineole/fenchyl alcahol	50.0	4.65
Borneol	50.5	29.32
Cadinene	54.1	2.54
Epiglobulol	64.7	1.79
Caryphyllene oxide	67.7	1.32
Veridiflorol	72.5	1.79
Spathulenol	74.4	1.83

*: Retention time.

4. Discussion

Average of *Salvia tomentosa* essential oil content was determined as 2.36±0.29%. The results showed differences among the researches. For instance; Şarer (1980) stated that essential oil content was 1.3%. Aşkun et al. (2010) reported that the content of essential oil was 1%. Bağcı and Koçak (2008), Tepe et al. (2005) and Haznedaroglu et al. (2001) revealed that the contents were 0.3, 0.51 and 0.8%, respectively. Ulukanlı et al. (2013) stated that content of essential oil was 0.31%. Başer (2002) determined that essential oil content varied between 0.6-1.3%. In the present study, essential oil contents were found two times higher than the others. It can be said that the differences from the other studies since the different part of the plant material was used. Haznedaroglu et al. (2001) and Ulukanlı et al. (2013) were used aerial parts of the plant. Şarer (1980) also used leave and tips of the flowering branches. Not only the different plant parts, but also the soil characteristics may be caused these differences. Besides of these, it can be explained with different ecological, orographic, edaphic or biotic factors. Ceylan, (1995) reported that genetic and individual variability such as diurnal, morphogenetic, ontogenetic and ecologic factors effects on secondary metabolites.

In present study, borneol and α-pinene were determined as the main constituents of the *S. tomentosa* essential oil with percentage of 29.32 and 24.65 (Table 1). A literature search revealed that essential oil of *S. tomentosa* belongs to pinene groups. The main constituents of the essential oil were noticed as α-pinene (6-29%) and β-pinene (5-33%) (Başer, 2002). In mentioned study, borneol content was found as 27% in only one sample of *S. tomentosa.* Accoding to Aşkun et al. (2010) α-pinene (25.1%), camphor (14.9%), and borneol (13.2%) were identified as the major components in the same species which were collected from Kazdağı, Balıkesir. Nevertheless, Bağcı and Koçak (2008) characterized that the major constituents were as α-pinene (33.7%), germacrene D (7.5%), β-pinene (6.8%), α-humulene (6.0%), veridiflorol (3.8%) and limonene (3.1%) in Elazığ,location. Also in the same study borneol content was found as 0.6%. Haznedaroglu et al. (2001) reported that *S. tomentosa* consisted of 1,8-cineole (17%), β-caryophyllene (11%), cyclofenchene (10%.) and δ-cadinene (6%) in Nif Mountain of İzmir and borneol content was found as 4.1%. In another report, β-pinene (39.7%), α-pinene (10.9%) and camphor (9.7%) were suggested the main components of the species in Osmaniye and borneol content was also determined as 4.3% by Tepe et al., (2005). In the same location, Ulukanlı et al. (2013) noticed that β-pinene (37.28%) and α-pinene (5.73%) were major constituents of *S. tomentosa* essential oil and borneol content was also found as 4.1%. Tsankova et al. (1994) determined that *S. tomentosa* essential oil was characterized by borneol (%19.4) and β-pinen (29.1%) in Bulgaria. Şarer (1980) indicated that borneol (26.6%), β-pinene (9.7%), camphor (8.6%) and 1,8 cineole (5.6%) were the main compounds of essential oil *S. tomentosa* growing in Abant, Bolu. In present study, bornel and α-pinene were determined as main constituents of flowered branches collected from Isparta. Literature research revealed that pinene groups were found as the main constituent of *S. tomentosa*, however; Şarer (1980) and Haznedaroglu et al. (2001) noticed that borneol (26.6%) and 1,8-cineole (17%) were the main constituents in the same species. Results of present study were found in agreement with Şarer (1980) in terms of major constituent (borneol) and its content. According to α-pinene content, the results were found parallel with Başer (2002) and Aşkun et al. (2010). The difference among the studies can be explained as the same with essential oil content which was described above.

In lots of study were stated that medical and aromatic plant species have different contents and compositions. In this study which was carried out to determine the essential oil content and composition of *Salvia tomentosa* Mill. in Isparta conditions. The essential oil content was obtained nearly more than two times higher than the other researches. In terms of constituents of the essential oil, borneol and α-pinene were differently determined as major constituents.

5. Conclusion

In conclusion, changes of essential oil content and composition might have arisen from several differences such as climatological, seasonal, geographical and geological conditions. Moreover, essential oil content and compositions may be affected by different harvesting periods, different harvesting parts and different harvest times of the plants even if they grow up under the same ecological conditions.

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