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Research article/Araştırma makalesi

Comparison of essential oil compositions of fresh and dried plant of endemic *Salvia cadmica* Boiss. var. *bozkiriensis* Celep, Kahraman & Doğan, in Turkey

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Abstract

In this study, essential oil compositions of *Salvia cadmica* Boiss. var. *bozkiriensis* Celep, Kahraman & Doğan, (dried and fresh aerial parts) collecting from type locality was investigated. Essential oil was obtained by hydrodistillation for 3 h using Clevenger type apparatus and the compositions was determined in GC-MS. In this research, it was observed that the EO compositions varied with respect to be fresh or dry of the plant parts. The LSD test results revealed that the highest EO content was 2-nonanone (29.59 %) in fresh aerial parts, while the highest content was pulegone (20.14 %) in dried part of the plant. Furthermore, some EO components were not found in the fresh aerial parts, while it was determined in dried parts of the plant (p-methylanisole, isomenthone, p-cymene, homofuranol, azunol, isomenthone, carvacrol, menthylacetate, roseoxide-2-one, pulegone, lauric aldehyde, isogermacrene-epoxide, isoborneol, geranyl butyrate, valealdehyde and safranol). On the contrary, some components were observed in the fresh aerial parts, while it was not found in dried parts of the plant (lindoxide, 2-oxapropanoic acid, α-terpineol, α-terpinene, carvone, geranyl butyrate, valealdehyde and safranol). The objective of the study was that the determination of the differences between the EO compounds and compositions varied according to be the plant fresh or dry.

Key words: essential oil, endemic, fresh parts, dried parts, *Salvia cadmica* var. *bozkiriensis*

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Taze ve kurutulmuş Türkiye endemiği *Salvia cadmica* Boiss var. *Bozkiriensis* Celep, Kahraman & Doğan bitkisinin uçucu yağ bileşenlerinin karşılaştırılması

Özet

Bu çalışmada, Doğal lokasyondan toplanan *Salvia cadmica* Boiss. var. *bozkiriensis* Celep, Kahraman & Doğan bitkisinin (yaş ve kuru herbalarında) uçucu yağ bileşenleri araştırılmıştır. Bitkinin uçucu yağı, Clevenger aparatı kullanılarak 3 saat boyunca hidrotistilasyon yöntemiyle elde edilmiştir ve uçucu yağ bileşenleri de GC-MS ile belirlenmiştir. Bu araştırmada yaş ve kuru herbadan elde edilen uçucu yağ bileşenlerinin farklılık gösterdiği gözlemlenmiştir. LSD test sonuçlarına göre, bitkinin taze herbasında en yüksek uçucu yağ bileşeninin 2-nonanon (% 29.59), kurutulmuş herbasında en yüksek uçucu yağ bileşeninin pulegone (% 20.14) olduğu ortaya konulmuştur. Ayrıca bazı uçucu yağ bileşenleri taze herbada tespit edilmemişken, kuru herbadan elde edilen uçucu yağda belirlenmiştir (p-methylanisole, isomenthone, p-cymene, homofuranol, azunol, isomenthone, carvacrol, menthylacetate, roseoxide-2-one, pulegone, lauric aldehyde, isogermacrene-epoxide, isoborneol, geranyl butyrate, valealdehyde and safranol). Bunun aksine bazı uçucu yağ bileşenleri de taze herbada belirlenmişken, kuru herbada belirlenmemiştir (lindoxide, 2-oxapropanoic acid, α-terpineol, α-terpinene, carvone, geranyl butyrate, valealdehyde and safranol). Çalışmamızın amacı, bitkinin taze ve kuru herbasından elde edilen uçucu yağ bileşenleri arasında farklılığı ortaya koymaktır.

Anahtar kelimeler: temel yağ, endemic, taze parçalar, kurutulmuş parçalar, *Salvia cadmica* var. *bozkiriensis*

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1. Introduction

Salvia L. (tribe Mentheae: subtribe Salviinae), the largest genus of the family Lamiaceae, representing a diverse cosmopolitan assemblage of nearly 1000 species. The genus is found predominantly in 3 regions of the world; there are at least 500 species in Central and South America, 200 species in western Asia, and 100 species in eastern Asia (İpek et al., 2012; Ranjbar and Paketchi 2014; Walker et al., 2004).

The genus *Salvia*, with about 700 species and represented in Turkish flora by 88 species and 45 endemics, is one of the most widespread members of the family Lamiaceae. An unusually large number of useful secondary metabolites belonging to various chemical groups, such as essential oils, terpenoid compounds, and phenolic derivatives, have been isolated from the genus, which features prominently in the pharmacopoeias of many countries throughout the world (Bondhorpe et al., 1989; Luis et al., 1992; Ulubelen and Topcu 1992).

Salvia cadmica Boiss. var. *bozkiriensis* is an aromatic herb belonging to Lamiaceae. The wild growing species is endemic to on calcareous rocks of Turkey, widely distributed from 1000 to 2000 m (Celep et al., 2011).

The genus *Salvia* is known throught the world as important because of the useful essential oils produced by the foliage. Many species and varieties grown wild or are cultivated in many parts of the world. The herbs and their derivatives such as essential oils are used commonly in the food, drug and perfumery industries. These oils are used as flavorings, fragrances in the food industry, and for medicinal purposes in several regions. Infusion of dried leaves of some *Salvia* genus are used for their spasmolytic, hypoglycaemic, diuretic, choleretic and emmenagogue properties in flok medicine (Kelen and Tepe 2008). Perhaps the best known and widely used sage oils come from Dalmatian sage (*S. officinalis*) and from clary sage *(S. sclarea*) (Ford et al., 2011; Kamatou et al., 2008). Also, Başer et al. (2009) were studied Comparative Morphological and Phytochemical Characterization of *Salvia cadmica* and *S. smyrnaea*).

S. cadmica var. *bozkiriensis* belong to the family Labiatae is perennial herbaceous plants collected from type locality (Bozkır-Konya) Turkey.

The aim of this study was to establish the chemical composition of dried and fresh aerial parts the *S. cadmica* var. *bozkiriensis* growing wild in Turkey. In the present paper, we report for the first time on the chemical composition of the essential oils obtained from aerial parts of dried and fresh *S. cadmica* var. *bozkiriensis*.

2. Materials and methods

2.1. Plant materials

Fresh aerial parts of *S. cadmica* var. *bozkiriensis* was collected during the flowering period from Bozkır Konya in 2011 and the aerial parts were dried in the shade at room temperature. Plant was identified by Dr. Bağcı, and a voucher specimen (Doğu 3421 & Bağcı) is kept at the herbarium of the Biology Department, University of Selçuk, Turkey.

2.2. GC-MS profile of the plant parts

Aerial parts (dried and fresh branch, leaf and herb) of the *S. cadmica* Boiss. var. *bozkiriensis* were subjected to hydrodistillation for 3 h using Clevenger type apparatus to produce essential oil. The essential oils were stored at -200C until analyzed.

GC analysis was performed on a Agilent 6890N Network GC system combined with Agilent 5975C VL MSD Network Mass Selective Detector. The GC conditions were; column, DB Waxter- HP Innowax Capillary (60.0 m × 0.25 mm, 0.25 μm); oven temperature programme: The column held initially at 60 ºC for 10 min after injection, then increased to 220 ºC with 4ºC/min heating ramp for 10 min and increased to 240oC with 10 ºC/min heating ramp without hold; injector temperature 250oC; carrier gas; Helium; inlet pressure, 9.60 psi; linear gas velocity, 7 cm/sec; initial flow 0.3 ml/min; split ratio, 65.0:1; injected volume 1.0μl. MS conditions were regulated as follows; ionization energy: 70 eV, ion source temperature: 280 °C; interface temperature: 250 °C; mass range: 35–450 amu.

Determination of the components was performed by comparison of their mass spectra with Wiley 7.1 and Nist GC–MS Libraries and retention indices, relative to n-alkanes, with corresponding data from relevant literature. The percentages of the components were calculated from the GC peak areas using the normalization method.

3. Results

3.1. Essential oil composition of *Salvia cadmica* Boiss. var. *bozkiriensis* Celep, Kahraman & Doğan

Results was indicated that there were significant ($p<0.01$) differences between the the aerial parts of dried and fresh *S. cadmica* var. *bozkiriensis* with respect to their essential oil compositions. The oil yields of the the plants was determined to be in amount trace. The LSD test results revealed that the highest EO content was 2-nonanone (29.59 %), followed by 6-methyl-3,5-heptadien-2-one (12.64 %), 2-nonanol (7.90), β-ocimene (7.81 %) and delta-decalactone

(4.92 %) in fresh aerial part of the plant. EO composition may vary considerably between aromatic plant species and varieties, and within the same variety from different geographic areas (Zygadlo and Julianı 2003). On the other hand, in this research, it was found that the EO compositions varied with respect to be fresh or dry of the plant parts. According to this data, on the contrary, it was observed that the highest EO content was pulegone (20.14 %), followed by roseoxide-2-one (9.37%), delta-decalactone (6.32 %), carvacrol (3.97 %) and isogermacrene-epoxide (3.49 %) in the dried aerial part of the plant. The major EO compositions was also shown in Figures 1, 2 and 3.

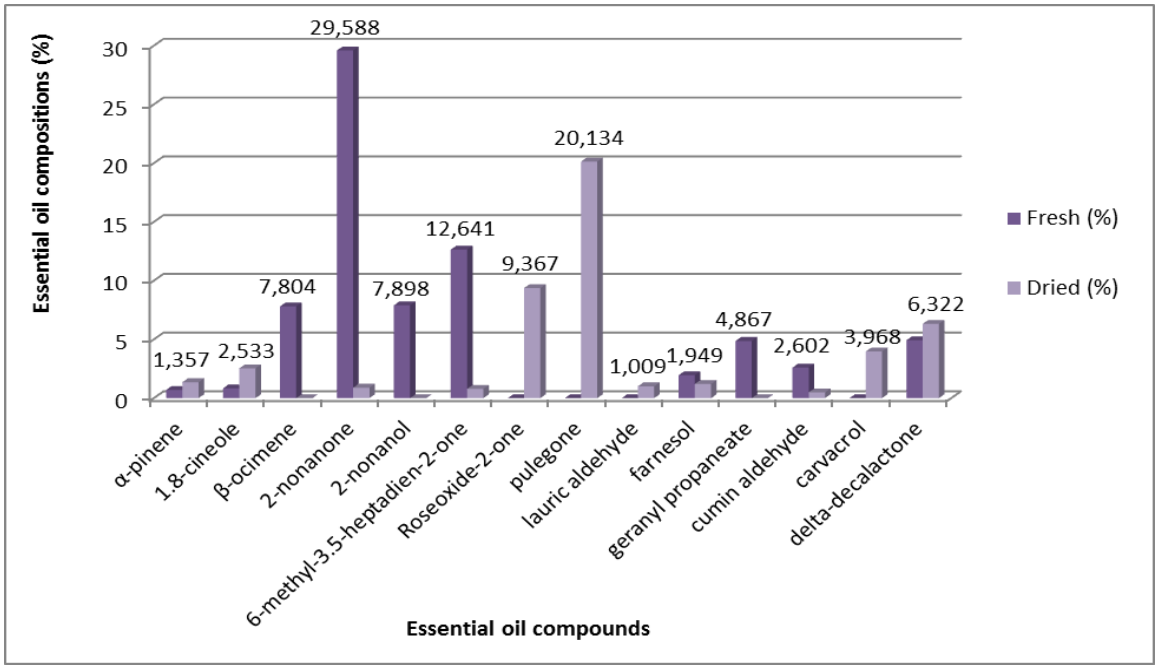

Figure 1. Essential oil compouds and compositions of the aerial dried and fresh parts of *Salvia cadmica* Boiss. var. *bozkiriensis*

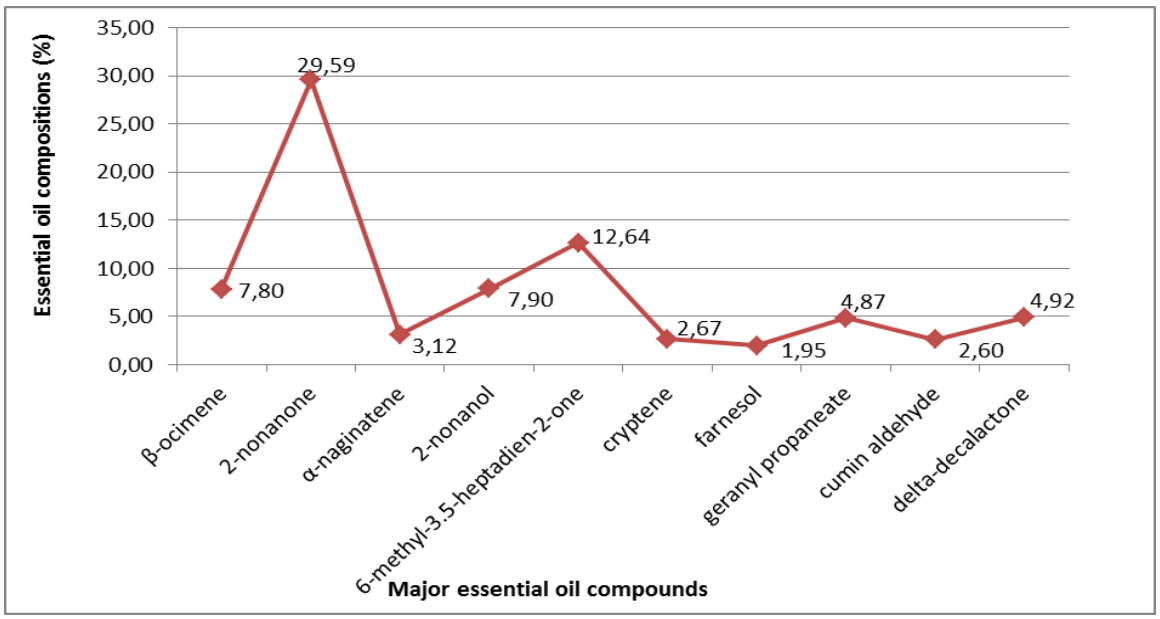

Figure 2. Major essential oil compounds and compositions of the aerial fresh part of *Salvia cadmica* Boiss. var. *Bozkiriensis*

It was also presented in Table 1 that, some EO components were not found in the fresh aerial parts, while it was determined in dried parts of the plant (for instance; p-methylanisole, isomenthone, p-cymene, homofuranol, azunol, isomenthone, carvacrol, menthylacetate, roseoxide-2-one, pulegone, lauric aldehyde, isogermacrene-epoxide, isoborneol, geranyl butyrate, valealdehyde and safranol).

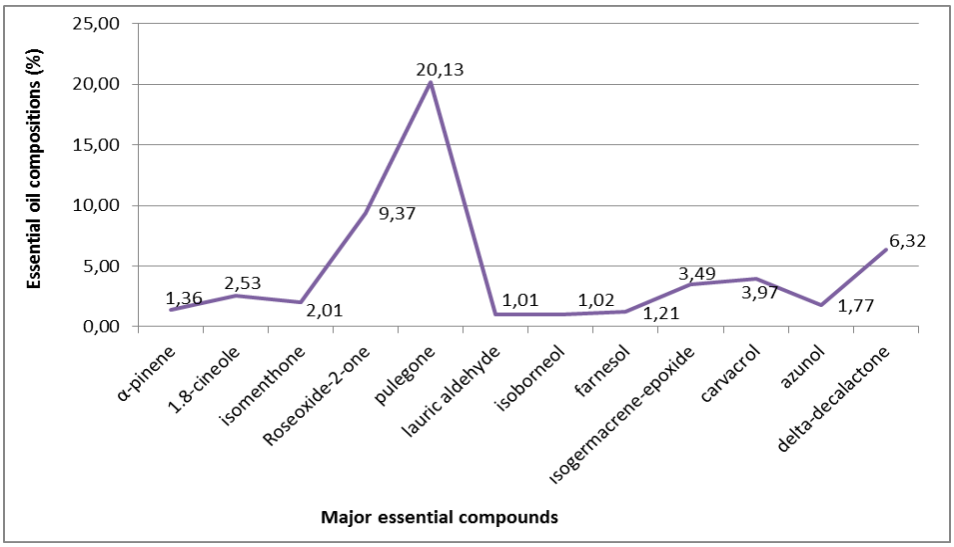

Figure 3. Major essential oil compounds and compositions of the aerial dried part of *S. cadmica* Boiss. var. *bozkiriensis*

Table 1. The essential oil compositions of the fresh and dried aerial parts of *Salvia cadmica* Boiss. var. *bozkiriensis*

RI	Compounds	Fresh (%)	Dried (%)
1021	α-pinene	0.69	1.36
1110	sabinene	0.44	0.48
1196	limonene	0.52	0.88
1200	cis-4-decenal	0.37	0.00
1202	1.8-cineole	0.84	2.53
1224	*p*-methylanisole	0.00	0.34
1226	β-ocimene	7.81	0.00
1236	*p*-cymene	0.00	0.77
1292	2-nonanone	29.59	0.90
1298	α-naginatene	3.13	0.00
1438	lindoxide	0.24	0.00
1493	isomenthone	0.00	2.01
1516	2-nonanol	7.90	0.00
1522	camphor	1.59	0.00
1539	linalool	1.75	0.00
1561	methyl acetate	0.00	0.28
1583	6-methyl-3,5-heptadien-2-one	12.64	0.78
1605	Roseoxide-2-one	0.00	9.37
1657	pulegone	0.00	20.13
1680	lauric aldehyde	0.00	1.01
1685	cryptene	2.67	0.00
1686	isoborneol	0.00	1.02
1688	farnesol	1.95	1.21
1700	α-terpineol	0.35	0.00
1703	α-terpinene	0.51	0.00
1749	carvone	0.50	0.00
1758	geranyl propaneate	4.87	0.00
1759	geranyl butyrate	0.00	0.86
1799	cumin aldehyde	2.60	0.50
1814	valeraldehyde	0.00	0.47
1942	safranol	0.00	0.96
2101	isogermacrene-epoxide	0.00	3.49
2128	2-oxapropanoic acid	0.03	0.00
2217	carvacrol	0.00	3.97
2245	azunol	0.00	1.77
2283	homofuronol	0.00	0.66
2351	delta-decalactone	4.92	6.32

Calculation formula of retention indice
Ip=100n+100 [tr(x)-tR(n)]/ [tR(n+1)-tR(n)]
Ip: Retention Indice, n: Carbon atom number of the hydrocarbon eluting before the sample, tr(x): Retention time of sample x (the components of the essential oil), tR(n): Retention time of the hydrocarbon eluting before the sample, tR(n+1): Retention time of the hydrocarbon eluting after the sample
a-c Means with no common superscripts within each row are significantly different ($P < 0.01$).

On the contrary, some components were observed in the fresh aerial parts, while it was not found in dried parts of the plant (for example; lindoxide, 2-oxapropanoic acid, α-terpineol, α-terpinene, carvone, geranyl butyrate, valealdehyde and safranol).

The aim of the study was that the differences between the EO compounds and compositions varied according to be the plant fresh or dry.

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