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Determination of Volatile Components of *Helichrysum arenarium* subsp. *aucheri* Naturally Distributed in Two Different Regions

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Abstract

The aim of this study was to determine the volatile components of *Helichrysum arenarium* (L.) Moench subsp. *aucheri* that belongs to the *Helichrysum* genus, belonging to the Asteraceae family, one of the important families for Turkey and generally known as 'ölmez çiçek, altın otu or mantuvar' in Turkey. To determine volatile components, leaves and flowers of *Helichrysum arenarium* subsp. *aucheri* specimens were collected from Isparta Aksu and Adana Feke villages in Turkey, and dried at room temperature. Then, volatile components were determined with HS-SPME/GC-MS analysis. As a result of the findings obtained, a total of 86 volatile components were found for *Helichrysum* species. A total of 64 volatile components were determined for *Helichrysum arenarium* subsp. *aucheri* specimens collected from Isparta Aksu region, whereas the main components were found as trans-Caryophyllene (24.33%), α -humulene (16.14%), α -pinene (14.79%); and dl-limonene (11.98%), respectively; and a total of 87 volatile components for specimens collected from Adana Feke region, whereas the main components were found as trans-caryophyllene (24.57%), α -pinene (22.5%), β -pinene (8.98%), limonene (8.21%), respectively.

Keywords: *Helichrysum arenarium* subsp. *aucheri*, volatile components, HS-SPME/GC-MS, α -pinene, trans-caryophyllene, Türkiye

İki Farklı Yörede Doğal Yayılış Gösteren Yayla Çiçeği (*Helichrysum arenarium* subsp. *aucheri*)'nin Uçucu Bileşenlerinin Belirlenmesi

Öz

Bu çalışmada ülkemiz için önemli familyalarından olan Asteraceae familyasına ait Türkiye'de yaygın olarak 'ölmez çiçek, altın otu veya mantuvar' olarak bilinen *Helichrysum* cinsine ait *Helichrysum arenarium* (L.) Moench subsp. *aucheri* 'nin uçucu bileşenlerinin belirlenmesi amaçlanmıştır. Isparta Aksu ve Adana Feke Köyü mevkiilerinden doğal olarak yayılış gösteren *Helichrysum arenarium* subsp. *aucheri* örnekleri uçucu bileşenleri belirlemek amacıyla yaprak ve çiçekleri toplanmış ve oda sıcaklığında kurutulmuştur. Daha sonra HS-SPME/GC-MS analizi ile uçucu bileşenleri belirlenmiştir. Elde edilen bulgular sonucunda altın otu türüne ait toplam 86 adet uçucu bileşen belirlenmiştir. Isparta Aksu mevkiinden toplanan *Helichrysum arenarium* subsp. *aucheri* 'da 64 uçucu bileşen, bu bileşenler içerisinde temel bileşenler; trans-caryophyllene %24.33, α -humulene % 16.14, α -pinene %14.79; dl-limonene (% 11.98); Adana Feke Köyü mevki örneklerinde 87 uçucu bileşen, bu bileşenler içerisinde temel bileşenler; trans-caryophyllene (%24.57), α -pinene(22.5), β -pinene (% 8.98), limonene (%8.21) bileşenleri tespit edilmiştir.

Anahtar Kelimeler: *Helichrysum arenarium* subsp. *aucheri*, uçucu bileşen, HS-SPME/GC-MS, α -Pinene, trans-Caryophyllene, Türkiye.

1. Introduction

Thanks to its geographical location, climate and plant diversity, agricultural potential, and wide area, Turkey is one of the leading countries in the trade of medicinal and aromatic plants, because of its geographical location. This importance of Turkey stems from the fact that plants that produce many herbal products constituting the input of herbal medicine, plant chemicals, food and additive agents, and cosmetics and perfume industries present in the natural flora of Turkey. Therefore, these plants are being marketed with the collection from the wild (Bayram et al., 2010). Medicinal and aromatic plants have been used in health promotion and disease prevention. By observing the protection methods developed by the defense mechanisms of plants by secreting active substances such as various enzymes, essential fatty acids, and phenolic substances, it was identified with the trial-and-error method that these have been good for the treatment of a number of ailments in humans (Kayaalp, 2001). Growing production and marketing of natural health-promotion and personal care products has also created an increasing industrial demand for medicinal and aromatic plants as well (Igwill, 2019). Medicinal and aromatic plants contain bioactive secondary metabolites like steroids, flavonoids, saponins, alkaloids, terpenes, and phenolic compounds. These secondary metabolites possess antimicrobial, antifungal, antiallergic, antidiabetic, cardioprotective, antioxidant, anticancer, antithyroid, antihistaminic, antimalarial, anthelmintic, anti-inflammatory, antihypertensive, antispasmodic, and analgesic properties (Aftab, 2019). Medicinal and aromatic plants can be found in fresh, frozen, or dry forms. These plants are preferred in the pharmaceutical industry because of their therapeutic effects. Fixed oils (or fats, fatty acids that plants have (might be added) and essential oils extracted from plants are used in soft drinks and candies within food industry and in perfumes, skin care and hair care products and aromatherapy within cosmetic industry (Van Vuuren et al., 2010, Christaki, 2012). Since they are complex mixtures, effectiveness of essential oils varies depending on the amount and type of substances they contain (Bayaz, 2014).

The fact that almost 5.000 of the 7.000 chemical compounds, of which have been isolated and identified from plants thus far, were extracted from the members of this family is an indicator of how rich they are in chemical terms (Zeybek and Zeybek, 2002). The genus *Helichrysum* consists of an estimated 600 species all around the world, and is widely distributed in South Africa (250 species), Southern Europe, Southern-Western Asia, Southern India, Sri Lanka, Australia, and the Mediterranean basin (Anderberg, 1991). This genus is represented by 27 taxa, 15 of which are endemic in Turkish flora (Davis, et al., 1988; Güner et al., 2000; Sümbül, et al., 2003). *Helichrysum* species are grown in every region of Turkey and is supplied fresh in every season as it is not affected by the climate conditions. Hel species have been used as Daily herbal tea in Turkey, since they have bile and diuretic effects. (Şen and Kalaycı, 2016).

Heli species, growing in Corsica, France, is one of the most preferred species in perfumery and cosmetics industry around the World. (Bianchini et al., 2001). The economically used part of the *Helichrysum* species is its flowers. The main active substance of yellow flowers of *Helichrysum* species is the yellowish-colored essential oils in glandular hairs (Licina and

Kralj, 2016). Despite its floral scent, it can be used as a base note in perfume blends thanks to its strength and color (Lawless, 2002). *Helichrysum* species are reported to have a high degree of polymorphism (Peyron and Roubaud, 1971). Previous studies have reported that some of them show significant pharmacological properties and find wide use in perfumery (Bianchini et al., 2001). It was identified that *Helichrysum* volatile components show anti-inflammatory (Sala et al., 2002; Appendino et al., 2007), antimicrobial (Roussis et al., 1998; Nostro et al., 2001; Angioni et al., 2003), and antioxidant (Sala et al., 2002) activities. *Helichrysum* volatile components reportedly have anti-inflammatory, analgesic, cell regenerative, pain reducing, and sedative effects and it relieves stress. By reason of the fact that “anti-aging skincare” comes to mind when it comes to cell regeneration recently; *Helichrysum* volatile components are dermatologically applied against cracked skins, hemorrhoids, acne scars, surgical scars, and wounds, and can be in-depth effective even with a small content of dilutions (Harris and Harris, 2002; Haas, 2004; Schnaubelt, 2011). *Helichrysum* volatile components have been reported to be of great value as a cell regenerative and decongestant thanks to the fact that neryl acetate, one of the components in essential oil, has a very high antiradical activity and increases collagen type I production about 6 times (Millou et al., 2010). As they can aid the renewal of skin cells, they are used in skincare products and called “liquid stitches” (Price and Price, 2012). Additionally, studies suggest that *Helichrysum* volatile components prevent blood clot formation and accumulation (Marković, 2005; Battaglia, 2003; Gattefossé, 1993) and have mucolytic, anti-spasmodic, and expectorant effects, which are helpful for coughs, bronchitis, and sinusitis (Battaglia, 2003; Lawless, 2002; Poštić, 2013). Besides, it is reported that *Helichrysum* volatile components, together with chamomile (*Chamaemelum nobile*) and yarrow (*Achillea millefolium*), are used to reduce fever and has an anti-inflammatory effect (Mojay, 1996). It is reported that *Helichrysum* hydrosol, which is obtained by steam distillation, can help to relieve painful menstrual cramps, cleanse the liver from toxins, and combat gingivitis, as a mouthwash (Catty, 2001).

SPME (solid-based micro-extraction method) saves processing time and costs as it is a method that combines sample preparation, extraction and concentration stages in a single solvent-free stage. However, positive developments were observed in the sample preparation phase and results. The type and thickness of the material covering the fiber part in the syringe affects the effectiveness of the SPME method. The fact that SPME method can be performed in a short time such as 1-30 minutes reveals its advantage over other methods (Vas & Vekey, 2004; Araujo et al., 2007; Dönmez & Salman, 2017).

The aim of this study was to determine volatile components that were extracted from *Helichrysum arenarium* (L.) Moench subsp. *aucherii* (Boiss.) P.H. Davis & Kupicha, using solid-phase microextraction (SPME, Supelco, Germany) procedure.

2. Material and Method

2.1. Material

Helichrysum arenarium subsp. *aucherii* specimens, the research material, were collected from the research area in Aksu (1970m) 37°47'59" kuzey-31°03'59" doğu (Isparta province) and Feke (1160m) 37°48'46" kuzey-35°54'44" doğu (Adana province) counties in Turkey within the vegetation period.

Helichrysum arenarium subsp. *aucheri* species constitute samples of leaves and flowers. The plant was diagnosed by us using the discrimination key in "Flora of Turkey" (Davis, 1982).

The voucher specimens were placed in sample bags and the bags were labeled after coding, and collection data (collection time, place, and elevation) were marked on the label. The plant samples were kept at room temperature in a semi-dark and airy place, to use in the analysis of volatile components. After the specimens were dried, they were brought to the Laboratory of the Department of Forest Botany, Faculty of Forestry, Isparta University of Applied Sciences. The plant samples were identified in the Herbarium at S. Demirel University, Faculty of Arts and Science, Department of Biology. The identified voucher specimens were deposited in the Herbarium at Isparta University of Applied Sciences, Faculty of Forestry.

2.2. Determination of leaf and flower volatile components with HS-SPME/GC-MS analysis

In this study, leaf and flower samples were collected from the area where *Helichrysum* species grow, within the vegetation period. The collected leaf and flower samples were placed in bags and brought to the Laboratory of the Department of Forest Botany, Faculty of Forestry, Isparta University of Applied

Sciences within the same day, without any delay and exposure to sunlight. The voucher specimens were dried at room temperature (25°C) to constant weight.

Floral scent components of flowers and leaves were combined with Gas Chromatography/ Mass Spectrometric (GC-MS) and determined with Headspace Solid-Phase Microextraction (HS-SPME) procedure. Based on solid-phase microextraction (SPME, Supelco, Germany) procedure, 2 g of flower and leaf specimens were placed into a 10 mL vial and heated to 60°C for 30 minutes. After that, volatile components were absorbed from headspace using a 75 µm-thick Carboxen/Polydimethylsiloxane (CAR/PDMS) coated fused silica fiber and injected into capillary column (Restek Rx-5 Sil MS 30 m x 0.25 mm, 0.25 µm) of HS-SPME-compatible GC-MS (Shimadzu 2010 PLUS) instrument. The oven temperature was set to keep at 40°C for 2 minutes and to reach 250°C with a 4°C increase per minute. Injection and detection temperatures were set at 250°C. EI (70 eV) was used as an ionization mode and Helium (1.61 mL per minute) was used as carrier gas. Wiley, NIST Tutor, and FFNSC libraries were used to identify volatile components. LRI (Linear Retention Indices) values were calculated by using a series of the standards of C7-C30 saturated *n*-alkanes (Sigma-Aldrich Chemical Co., USA).

aucheri specimens collected from Isparta Aksu area, whereas the main components were found as trans-Caryophyllene (24.33%), α -Humulene (16.14%), α -Pinene (14.79%); and dl-Limonene (11.98%), respectively. Similarly, a total of 86 volatile components were determined for *Helichrysum arenarium* subsp. *aucheri* specimens collected from Adana Fekke village, whereas the main components were found as trans-Caryophyllene (24.57%), α -Pinene (22.5%), β -Pinene (8.98%), Limonene (8.18%), respectively.

3. Results

In this study, volatile components of *Helichrysum arenarium* subsp. *aucheri* specimens were determined with SPME (Solid-Phase Microextraction) analysis. The volatile components determined were given in Table 1.

As a result of SPME analyses, a total of 64 volatile components were determined for *Helichrysum arenarium* subsp.

Table 1. Volatile components of *Helichrysum arenarium* subsp. *aucheri*

R.T.	Components	Flowering (Adana)	Flowering (Isparta)	Formula	Category
4.656	Hexanal	-	1.62	C ₆ H ₁₂ O	AA
6.144	2-Hexenal	-	1.23	C ₆ H ₁₀ O	AA
6.228	7-Methyl-1-Octene	-	0.98	C ₉ H ₁₈	OC
6.341	Ethyl-Benzene	-	0.12	C ₈ H ₁₀	AH
6.630	1,2-Dimethyl-Benzene	-	0.16	C ₈ H ₁₀ O ₂	AH
6.671	1,4-Dimethyl-Benzene	-	0.08	C ₈ H ₁₀ O ₂	AH
7.332	Styrene	-	0.37	C ₈ H ₈	OC
7.400	1-Nonanol	-	0.38	C ₉ H ₂₀ O	OC
7.754	Heptanal	-	0.09	C ₇ H ₁₄ O	AA
7.804	Bornylene	-	0.09	C ₁₀ H ₁₆	MH
8.410	Tricyclo heptane	-	0.02	C ₇ H ₁₀	AH
8.426	Tricyclene	0.05	-	C ₁₀ H ₁₆	MH
8.755	3-Heptanone	-	0.03	C ₇ H ₁₄ O	MH
8.911	α -Pinene	22.15	14.79	C ₁₀ H ₁₆	MH
9.361	α -Fenchene	-	0.54	C ₁₀ H ₁₆	MH
9.369	2,2-Dimethyl-3-Methylene	0.23	-	C ₁₁ H ₂₂	MH
9.421	Camphene	0.95	0.75	C ₁₁ H ₂₂	MH
9.739	4-Undecene	0.25	0.34	C ₁₁ H ₂₂	AH
9.859	Benzaldehyde	0.21	0.29	C ₇ H ₆ O	AAI
9.950	Cyclopropane	0.22	0.16	C ₃ H ₆	SH
10.094	2-Hexenoic Acid	0.04	-	C ₇ H ₁₂ O ₂	FA
10.235	Cymene	0.03	-	C ₁₀ H ₁₄	MH
10.502	2-, β -Pinene	8.98	6.38	C ₁₀ H ₁₆	MH
10.680	1-Octen-3-Ol	0.08	0.04	C ₈ H ₁₆ O	AAI
10.839	6-Methyl-5-Hepten-2-One	0.07	0.40	C ₈ H ₁₄ O	AAI
11.004	β -Myrcene	0.87	4.83	C ₁₀ H ₁₆	SH

11.080	Benzoic Acid 1-Methyl-Heptyl Ester	-	0.10	C ₁₅ H ₂₀ O ₂	AAI
11.090	1-Decene	0.13	-	C ₁₀ H ₂₀	MH
11.288	Methyl 12-Methyltetradecanoate	0.13	-	C ₁₆ H ₃₂ O ₂	OC
11.289	Methyl Isohexanoate	-	0.15	C ₇ H ₁₄ O ₂	AAI
11.350	Trans-2-Furan	0.02	0.05	C ₉ H ₁₂ O	OC
11.530	Octanal	0.02	0.13	C ₈ H ₁₆ O	AA
11.588	L-Phellandrene	0.23	0.21	C ₁₀ H ₁₆	MH
11.678	Linalyl Acetate	-	0.14	C ₁₂ H ₂₀ O ₂	OM
11.685	Δ-3-Carene	0.17	-	C ₁₀ H ₁₆	MH
11.851	1,4-Dichlorobenzene	0.23	0.18	C ₁₀ H ₁₂	AH
12.011	α-Terpinene	0.62	0.70	C ₁₀ H ₁₆	MH
12.297	1-Methyl-4 benzene	-	1.79	C ₁₀ H ₁₂	MH
12.302	Methyl -benzene	0.60	-	C ₁₀ H ₁₄	AH
12.503	dl-Limonene	-	11.98	C ₁₀ H ₁₆	MH
12.523	Limonene	8.21	-	C ₁₀ H ₁₆	MH
12.608	1,8-Cineole	0.18	1.27	C ₁₀ H ₁₈ O	MH
12.803	Cis-OCimene	0.79	0.04	C ₁₀ H ₁₆	MH
12.895	Oct-3(E)-En-2-One	0.01	-	C ₈ H ₁₄ O	AAI
13.008	Benzene acetaldehyde	0.06	0.08	C ₈ H ₈ O	AAI
13.206	1,3,6-Octatriene	1.14	0.10	C ₈ H ₁₂	AH
13.381	2-Isopropenyl-5-Methylhex-4-Enal	0.01	-	C ₁₀ H ₁₈ O	AAI
13.626	1,4-Cyclohexadiene	0.97	0.87	C ₁₀ H ₁₆	MH
14.087	3,5-Octadien-2-One	0.06	0.05	C ₈ H ₁₂ O	AAI
14.490	Ethenyl Benzene	0.02	-	C ₈ H ₁₀	AH
14.684	α-Terpinolene	1.06	0.60	C ₁₀ H ₁₆	MH
14.844	1-Methyl-4-Isopropenylbenzene	-	0.25	C ₁₀ H ₁₂	MH
14.846	1-Isopropenylbenzene	0.16	-	C ₁₂ H ₁₆	AH
14.981	Cyclopropane	0.13	-	C ₃ H ₆	AH
15.285	Linalool	0.04	-	C ₁₀ H ₁₈ O	OM
15.461	Nonanal	0.08	0.45	C ₉ H ₁₈ O	AAI
15.807	Neryl Nitrile	-	0.05	C ₁₀ H ₁₅ N	OC
15.809	Cyclohexane	0.04	-	C ₆ H ₁₂	AH
16.216	Octanoic Acid	0.08	-	C ₈ H ₁₆ O ₂	AAI
16.824	2,4,6-Octatriene	0.07	-	C ₁₀ H ₁₆	AH
17.026	Heptan-2-One	-	0.11	C ₇ H ₁₄ O	OC
17.300	2,6-Nonadienal	0.02	-	C ₉ H ₁₄ O	AAI
17.469	1-Undecene	0.06	-	C ₁₁ H ₂₂	AH
17.581	2-Nonenal	0.02	0.14	C ₉ H ₁₄ O	AAI
18.352	3-Cyclohexen-1-ol	0.03	-	C ₉ H ₁₄ O	AH
18.356	Trans-Sabinene Hydrate	-	0.09	C ₁₀ H ₁₈ O	OM
18.766	Benzoic Acid	0.04	-	C ₇ H ₆ O ₂	AAI
18.921	β-Fenchyl Alcohol	0.09	0.13	C ₁₀ H ₁₈ O	OM
19.010	1-methoxy-4 benzene	0.12	0.06	C ₆ H ₆	AH
19.350	Decanal	-	0.08	C ₁₀ H ₂₀ O	OM
20.010	Nonanoic Acid	0.05	-	C ₉ H ₁₈ O ₂	AAI
20.263	Z-3-Hexenyl 2-Methylbutanoate	0.07	-	C ₁₁ H ₂₀ O ₂	AAI
20.469	Butanoic Acid	0.15	-	C ₄ H ₈ O ₂	MH
20.550	2-Isopropyl-1-Methoxy-4-Methylbenzene	0.05	-	C ₁₁ H ₁₆ O	AH
20.693	Butanoate	0.02	-	C ₈ H ₁₆ O	AAI
20.981	Linalyl Acetate	0.06	-	C ₁₂ H ₂₀ O ₂	OM
22.214	Exobornyl Acetate	0.07	-	C ₁₂ H ₂₀ O	OM
22.769	Carvacrol	0.04	-	C ₁₀ H ₁₄ O	OM
23.589	3,7-Cycloundecadien-1-ol	0.01	-	C ₁₅ H ₂₆ O	OC
25.204	Cyclosativene	-	0.31	C ₁₅ H ₂₄	SH
25.231	Ylangene	3.22	-	C ₁₅ H ₂₄	SH
25.457	α-Copaene	3.61	2.86	C ₁₅ H ₂₄	SH
25.576	Satven	0.20	-	-	OC
26.345	Tetradecane	0.03	0.21	C ₁₆ H ₃₄	AH
26.426	Undec-4-Ene	0.12	-	C ₁₅ H ₂₄	SH
26.430	Caryophyllene	-	0.09	C ₁₅ H ₂₄	SH
26.527	α-Gurjunene	0.26	0.04	C ₁₅ H ₂₄	SH
26.650	Nonane	0.03	-	C ₉ H ₂₀	AH
26.788	Dehydro aromadendrane	0.04	-	C ₁₅ H ₂₄	SH
27.034	Trans-Caryophyllene	24.57	24.33	C ₁₅ H ₂₄	SH
27.265	Epi-Bicyclosquiphellandrene	0.03	-	C ₁₀ H ₁₆	OC
27.456	α-Guaiene	0.06	-	C ₁₅ H ₂₄	SH
27.552	Aromadendrene	0.15	-	C ₁₅ H ₂₄	SH

27.658	Aristolen	1.35	-	-	OC
27.914	Humulen	0.26	-	C ₁₅ H ₂₄	SH
28.027	β-Farnesene	0.13	-	C ₁₅ H ₂₄	SH
28.140	α-Humulene	5.70	16.14	C ₁₅ H ₂₄	SH
28.269	Alloaromadendrene	1.34	0.05	C ₁₅ H ₂₄	SH
28.654	Cadina-1(6)	0.37	-	C ₁₅ H ₂₄	SH
28.740	α-Amorphene	0.88	0.13	C ₁₅ H ₂₄	SH
28.846	δ-Cadinene	2.19	0.34	C ₁₅ H ₂₄	SH
29.065	Isolene	0.13	-	C ₁₅ H ₂₄	SH
29.195	β-Selinene	-	0.76	C ₁₅ H ₂₄	SH
29.307	α-Copaene	0.38	-	C ₁₅ H ₂₄	SH
29.431	α-Selinene	-	0.23	C ₁₅ H ₂₄	SH
29.446	Epizonaren	0.53	-	C ₁₅ H ₂₄	SH
29.518	α-Murolene	0.75	0.21	C ₁₅ H ₂₄	SH
29.595	Pentadecane	-	0.15	C ₁₈ H ₃₈	AH
29.663	Δ-Cadinene	2.33	0.48		SH
30.288	Cadinene	0.32	-	C ₁₅ H ₂₄	SH
30.461	β-Guaiene	0.06	-	C ₁₅ H ₂₄	SH
30.840	α-Calacorene	0.65	-	C ₁₅ H ₂₀	AAI
31.476	Cadala-1(10),3,8-Triene	0.01	-	C ₁₀ H ₁₄	MH
32.081	Heptyl Octanoate	-	0.11	C ₁₅ H ₃₀ O ₂	OC
32.110	Cembrene	0.04	-	C ₂₀ H ₃₂	OC
32.698	Hexadecane	-	0.08	C ₁₆ H ₃₄	AH
		99.93	99.80		
	Component number	86	64		
	AA: Aromatik alkol	0.02	3.07		
	AAI: Aromatik aldehit	1.52	1.70		
	AH: Aromatik hidrokarbon	2.96	1.50		
	MH: Monoterpen hidrokarbon	44.91	40.29		
	OM: Oksijenli monoterpen	0.21	0.23		
	OC: Diğer bileşenler	1.78	2.05		
	SH: Seskiterpen hidrokarbon	48.49	50.96		
	FA: Yağ asitleri metil esteri	0.04	-		

*"- " sembolü 0.01'den az olan bileşenler için kullanılmıştır.

*"R.T." Retention Time

4. Discussion and Conclusion

Helichrysum arenarium subsp. *aucheri* according to the results obtained from flower plants leaves and flowers, α-Pinene (14.79%), (22.5%); trans-Caryophyllene 24.33%, 24.57% as it is the most active in samples from its two sample areas. The same analysis is in the sample samples from β-pinene Adana (8.98%), the main component is in the sample samples from Isparta (6.38%) in the environment at a lower rate. α-Humulene and dl-Limonene are the most effective applications in the samples collected from Isparta Aksu, respectively (16.14%) and (11.98%), while the α-Humulene was 5.70% lower in the samples from Adana and the dl-Limonene component was not detected.

In general, the essential ingredients in *Helichrysum* spp. essential oil are neryl acetate (1), γ-curcumen (2), (+) - limonene, neryl propionate, α-pinene (3), ar-curcumen, italdione I (4), nerol, italicene, linalool, italdione II (5), eudesm-5-en-11-ol, italdione II isomer, 4,6-dimethyloctan-3,5-dione (italdione III), 4-methylhexan-3-one, isoitalicene and 1 Reported as 8-cineole (Tisserand & Young, 2014). It is reported that the essential oil components differ significantly due to the polymorphism in the studies conducted in the regions where it has a wide spread area. Geraniol (36%), geranyl acetate (15%) and nerolidol (12%) in Greek-origin essential oils (Chinou et al., 1996), neryl acetate (36-51%) and α-pinene in France-Corsica essential oils (17%) and γ-curcumen (15%) (Bianchini et al., 2001), neryl acetate (17%), α-pinene (5%) and γ-curcumen (16%) in goldgrass essential oils originating from Bosnia and

Herzegovina (Licina and Kralj, 2016), α-pinene, neryl acetate, α-cedrene, nerol, ar-curcumen, γ-curcumen and geranyl acetate (Mastelić et al., 2008), in goldgrass essential oils of Croatian origin neryl acetate (28.2%), γ-curcumen (18.8%), neryl propionate (9.1%) and ar-curcumen (8.3%) (Kladar et al., 2015), α-pinene (22%) in goldgrass essential oils of Serbia origin, γ-curcumen (10%), β-selinene (6%), neryl acetate (6%) and β-caryophyllene (5%), and ar-curcumen (15-29%) in group 1 in Adriatic goldgrass essential oils.) and γ-curcumen (10-22%), α-pinene (25-30%) and neryl acetate (4-14%) in group 2 (Blazević et al., 1995).

Torabbeigi et al. (2006) In Iran H. aucheri essential oil components α-pinene (39.6%), 1,8-cineol (19.7%), β-caryophyllene (7.3%); van Vuuren (2006); In South Africa, in Asia, H. Cymosum essential oil components include α-pinene (12.4%), 1,8-cineole (20.4%), β-Caryophyllene (10.8%); H. gymnocephalum 15 1,8-cineole (17%), borneol (16%), Italy-Caryophyllene (13%); Charles, D.J., Simon, J.E. (1991); In North Africa, H. italicum subsp. Nerylacetate (51.4%), α-pinene (17%), North African neryl acetate (17%), γ-curcumen (16%) in Italicum essential oil components; Tsoukatou et al., (1999) Spain H. stoechas ssp. Stoechas blown up α-pine (28.3%), epi-α-bisabolol (21.9%), Spain β-caryophyllene (5.5%) as the main target.

Solid-phase micro-extraction (SPME) method, which is used to obtain volatile components, was used in this study. The SPME method has become a highly preferred method that provides sensitivity with ease of use with fast and low cost sampling without solvent (Umaz et al., 2019). In this study, the volatile

components of gold grass from two different locations were determined and compared with the SPME / GC-MS method. In our research, *H. arenarium* ssp. The α -pinene component, which we identified as one of the most active components in our aucheri sample, was also found at high rates in studies conducted in literature, while other components determined in the literature were found at lower rates in our study. According to the studies carried out, some differences were determined in terms of the essential oil basic components and ratios of the tested plant species compared to other studies. When we look at the literature, the α -pinene component, which is one of the most active components we found in the experimental study, has antimicrobial (Moslemi et al.2012), anti-inflammatory, antibacterial, antioxidant, anticancer and antinociceptive activities (Aydın et al., 2013) and the anti-inflammatory component of the trans-Caryophyllene component (Fernandes et al., 2006), we can say that this plant can be used effectively in the pharmaceutical industry because it shows activity.

In addition, the variety and amount of bioactive substances present in medicinal and aromatic plants may also differ according to the part of the plant used, post-harvest processes, and the methods of obtaining and analyzing the essential oil used. Considering that essential oil components differ according to environmental factors, more studies should be carried out on different types of gold from different locations in our country, which are rich in gold grass species, in order to reveal the chemical profile of *Helichrysum* spp. species.

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