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Composition of the Volatile Oils of Two *Achillea* L. (*A. filipendulina* Lam. and *A. vermicularis* Trin.) Species from East Anatolian Region (Turkey)

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Abstract

In this study the essential oil composition of aerial parts of *Achillea filipendulina* and *A. vermicularis* aerial parts was analyzed. The samples of the essential oils from these two species were obtained by hydro-distillation and analyzed by GC and GC/MS. The oils of *A. filipendulina* and *A. vermicularis* yields were found as 0.2% (v/w) and 0.6% (v/w) and twenty-five and twenty-two components were identified representing 95.94% and 92.26% of the oils, respectively. The main compounds of *A. filipendulina* were 1,3-pentadiene (25.65%), 1,8-cineole (19.11%), endobornyl acetate (12.21%), borneol (10.39%), camphene (5.84%), and santolinatriene (4.80%) whereas 1,8-cineole (35.32%), endobornyl acetate (13.75%), piperitone (12.19%), and siloxypentane (8.42%) were found as major constituents of *A. vermicularis*.

Key words: *Achillea filipendulina*, *Achillea vermicularis*, essential oil, GC/MS, 1,3-pentadiene, 1,8-cineole

Doğu Anadolu Bölgesi'nden (Türkiye) Yetişen iki *Achillea* L. (*A. filipendulina* Lam. and *A. vermicularis* Trin.) Türünün Uçuçu Yağ Kompozisyonları

Özet

Bu çalışmada *Achillea filipendulina* ve *A. vermicularis*'in toprak üstü kısımlarının uçucu yağ kompozisyonları analiz edilmiştir. Bu iki türün su distilasyonu ile elde edilen uçucu yağların içeriği GC ve GC/MS cihazıyla tespit edilmiştir. *Achillea filipendulina* and *A. vermicularis* türlerinden yaklaşık olarak %0.2 (ml/gr) ve %0.6 (ml/gr) verimle elde edilen yağların %95.94 ve %92.26'lık kısmını oluşturan yirmi beş ve yirmi iki bileşen tanımlanmıştır. *A. filipendulina*'nın ana bileşenleri, 1,3-pentadien (%25.65), 1,8-sineol (%19.11), endobornil asetat (%12.21), borneol (%10.39), kamfen (%5.84) ve santolinatrien (%4.80) iken, *A. vermicularis*'in ana bileşenleri, 1,8-sineol (%35.32), endobornil asetat (%13.75), piperiton (%12.19) ve siloksipentan (%8.42) olarak bulunmuştur.

Anahtar Kelimeler: Lakkaz, gen klonlama, *Scytalidium thermophilum*, propeptit

Introduction

Achillea L. is the largest and the most important genus of the family Asteraceae, which is the largest family of vascular plants and distributed throughout the world (Turkmenoglu et al., 2015). Members of the genus *Achillea* are usually perennial herbaceous plants spread in the northern hemisphere (Davis, 1975). The some taxa of *Achillea* genus are known in Turkey as "civan percemi".

This genus is represented in Turkish flora by 43 species, 13 subspecies and 2 varieties altogether 58 taxa, 30 of which are endemic in Turkey (Guner et al., 2012). Two main centers of the diversity occur in S.E. Europe and S.W. Asia according to distribution of genus *Achillea* (Guo et al., 2004; Radulovic et al., 2007). Hairy aromatic leaves and flat clusters formed by small capitula at the terminal of the stems are characteristic for the genus (Huber-Morath, 1975; Duman, 2000; Arabaci and Budak, 2009; Turkmenoglu et al., 2015).

Some *Achillea* species have ethnopharmacologic importance as known to be used in folk remedies for various purposes (Baytop, 1995). *Achillea* species have been used medicinal,

agricultural, cosmetic and fragrance properties (Kocak et al., 2010). Nonetheless, some of the *Achillea* taxa are used in abdominal pain, symptomatic relief of colds, diarrhea, wound healing, stomachache, ulcer, as diuretic, emmenagog, carminative, appetizer and insectisidal agent by the Turkish people (Honda et al., 1996; Baytop, 1999; Sezik et al., 2001; Ezer and Arisan, 2006).

In this study, we report the chemical composition of the oil obtained by hydro-distillation from the aerial parts of *A. filipendulina* and *A. vermicularis* and analyzed by gas chromatography to mass spectrometry (GC/MS).

Materials and Methods

Plant Source

A. filipendulina specimens were collected from natural habitats in Bingol in 2013, and *A. vermicularis* specimens were collected in Bingol, in 2013. Voucher specimens have been kept at the Bingol University Herbarium (BIN).

Isolation of the Essential Oils

Air-dried aerial parts of the plant materials (100 g) were subjected to hydro-distillation using a Clevenger-type apparatus for 3 h to yields.

GC and GC/MS Analysis

The essential oils were analyzed using GC-FID-MS (Agilent Technologies 5975C insert MSD with Triple-Axis Detector system, Agilent Technologies 7890A GC system) in central research laboratory. HP88 column (60m x 0.25 mm i.d., film thickness 0.25 m) was used with helium as the carrier gas. Injector temperature was 250°C and split flow was 1.3 ml/min. The GC oven temperature was kept at 50°C for 2 min. and programmed to 150°C at a rate 5°C /min and then kept constant at 150°C for 15 min and raised to 240°C at a rate of 5°C/min. Alkanes were used as reference points in the calculation of relative retention indices (RRI). MS were taken 70 eV and a mass range of 35-425. Component identification was carried out using spectrometric electronic libraries (Wiley and Nist).The identification constituents of the essential oils are listed in Table 1.

Results and Discussion

The essential oil yields of *A. filipendulina* an *A. vermicularis* were 0.2 and 0.6% (v/w), respectively. The results of analysis of *A. filipendulina* and *A. vermicularis* essential oils are present in Table 1. In the case of *A. filipendulina*, 25 compounds were identified representing 95.94% of the oils. 1,3-pentadiene (25.65%) was determined as the major component. The presence of 1,8-cineole (19.11%), Endo-bornyl acetate (12.21%), Borneol (10.39%), Camphene (5.84%), and Santolinatriene (4.80%) were also important for the oil profile. A comparison of the data presented in this paper with those in the literatures for other species of *Achillea* show that there are qualitative and quantitative differences in the levels of some of the components. The oil obtained from the aerial parts of *A. teretifolia* willd. is reported to contain a high percentage of 3-cyclohexen-1-one, linalool, 1,8-cineol, chrysanthenone, trans-chrysanthenol, and -cadinene (Kocak et al., 2010).

Other species of the genus *Achillea*, include; *A. santolina* (Bader et al., 2003; El-Shazly et al., 2004), *A. millefolium* (Judzentiene and Mockute, 2010; Kotan et al., 2010; Turkmenoglu et al., 2015), *A. falcate* (Senatore et al., 2005), *A. lingulata* (Kundakovic et al., 2007), *A. aleppica* (Iscan et al., 2006), *A. schischkinii* (Iscan et al., 2006), *A. biebersteinii*, *A. hamzaoglui*, and *A. kotschyi* subsp. *kotschyi* (Turkmenoglu et al., 2015) are rich in 1,8-cineole.

In the case of *A. vermicularis*, 22 components were identified representing 92.26% of the oil (Table 1). 1,8-cineole was the predominant compound (35.32%) followed by Endo-bornyl acetate (13.75%), Piperitone (12.19%), and Siloxypentane (8.42%).

In conclusion, this study demonstrates the occurrence of 1,3-pentadien/1,8-cineole chemotype of *A. filipendulina* and 1,8-cineole/endo-bornyl acetate chemotype of *A. vermicularis* in eastern Anatolia region of Turkey. The above data display numerous oil chemotypes, which strongly correlate with a different geographical origin, the plant material, the vegetative period, and method used for isolating the volatiles. Some studies carried out on the variability of essential oils in different vegetation and phenolical stages on some species (Schwob et al., 2004).

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Table 1. Constituents of the essential oils of *A. filipendulina* and *A.vermicularis*

No	Compounds	RRI	Percentage	
			A. filipendulina	*A.vermicularis*
1	α-pinene	948	1.33	1.01
2	Santolinatriene	972	4.80	-
3	Camphen	1028	5.84	2.98
4	Sabinene	1208	-	0.51
5	β-pinene	1176	0.77	-
6	α-terpinene	1217	1.65	-
7	-terpinene	1276	0.46	0.71
8	1,8-cineole	1323	19.11	35.32
9	β-cymen	1357	4.22	1.36
10	1,3,5- trimethylbenzene	1375	-	0.46
11	Trans-epoxyocymene	1396	0.58	-
12	Siloxypentane	1479	-	8.42
13	1,3-pentadiene	1521	25.65	-
14	Artemisia alcohol	1593	0.62	2.77
15	4-thujanol	1602	1.44	0.86
16	Filifolon	1617	-	1.7
17	Butanoicacid	1665	0.38	-
18	Chrysanthenylacetate	1701	-	1.08
19	Cis-sabinene hydrate	1716	1.34	-
20	Endo-bornyl acetate	1765	12.21	13.75
21	Camphor	1812	-	1.85
22	Borneol	1992	10.39	2.99
23	Caren	2037	0.43	-
24	*E*-ocimenol	2041	-	0.42
25	Cis-carveol	2111	0.27	-
26	Piperitone	2170	-	12.19
27	Trans-cyclohexen	2180	1.22	-
28	Verbenone	2206	0.24	0.16
29	Naphthalene	2211	-	0.17
30	2-Cyclohexen-1-one	2326	-	0.33
31	α-cubebene	2399	0.17	-
32	5-octen-4-on	2455	2.31	-
33	Spathulenol	2460	0.26	0.3
34	Chrysanthenon	2486	-	2.92
35	Cyclooctanone	2564	0.08	-
36	Dehydroaromadendrene	2744	0.18	-
	Total		95,94	92,26

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