Bitlis Eren Univ J Sci & Technol
5 (2), 68-70, 2015

E - ISSN 2146-7706

Research Article

Composition of The Volatile Oils of Two *Achillea* L. (Asteraceae) Taxa from Turkey

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Abstract

The essential oils of water-distilled aerial parts of *Achillea arabica*(syn. *A. biebersteinii*) Kotschy and *Achillea coarctata* Poir., were analyzed by GC-MS. As a result of twenty-six and twenty-seven compounds were identified representing 96.7% and 92.53% of the oils, respectively. The major constituents of *A. arabica* were 1,8-cineole (42.33%), trans-chrysanthenon (12.71%), α-pinene (8.29%), β-cymen (5.42%), and camphene (5.10%), whereas 1,8-cineole (34.22%), camphor (9.24%), cis-sabinene hydrate (8.35%), caryophyllene oxide (7.59%), and borneol (7.20%) were the main compounds of *A. coarctata*.

Keywords: *Achillea arabica*, *Achillea coarctata*, essential oil, GC-MS, 1,8-cineole.

1. Introduction

The genus *Achillea* L. belongs to the Asteraceae (Compositae) family, which is the largest family of vascular plants and distributed throughout the world (Davis 1975; Turkmenoglu et al. 2015). *Achillea* 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). Members of the genus *Achillea* are usually perennial herbaceous plants spread in the northern hemisphere (Davis 1975). 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 & Budak 2009; Turkmenoglu et al. 2015).

Achillea species are used as medicinal plants against fever, common cold, and digestive complaints, and are topically used for slow-healing wounds and skin inflammations and *A. millefolium* has been used due to its anti-inflammatory, spasmolytic, haemostatic, and cholagogue effects (Si et al. 2006). Some *Achillea* species have ethnopharmacological importance as known to be used in folk remedies for various purposes (Baytop & Baser 1995). In particular, *A. millefolium* has been used as medicine by many cultures for hundreds years and is now listed in several pharmacopoeias (Newal et al. 1996; Blumenthal et al. 2000). 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 & Arisan 2006).

Most of the *Achillea* essential oils contain large amounts of 1,8-cineole (Figueiredo et al. 1992; Chalchat et al. 1999), camphor (Unlu et al. 2002), borneol (Simic et al. 2000; Stojanovic et al. 2001), camphene (Chalchat et al. 2000) piperitone (Kusmenoglu et al. 1995), α -thujone, artemisia ketone and santolina alcohol (Fleisher & Fleisher 1993).

2. Material and Method

2.1. Plant Source

A. arabica specimens were collected from natural habitats in Bingol, Sancak-Sudugunu village, 1650 m, Herbarium No: BIN-235 in 11.07.2013, and *A. coarctata* specimens were collected in Bingol, Solhan, 1200 m, Herbarium No: BIN-237, in 25.06.2013. Voucher specimens have been kept at the Bingol University Herbarium (BIN).

2.2. 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.

2.3. 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 μm) 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. n-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.

3. Results and Discussion

The essential oil yields of *A. arabica* and *A. coarctata* were 0.4 and 0.2% (v/w), respectively. The results of the analyses of *A. arabica* and *A. coarctata* essential oils are showed in Table 1. In case of *A. arabica*, 26 compounds were analyzed representing 96.7% of the oil. 1,8-cineole was determined to be present at the high percentage (42.33%). The presence of trans-chrysanthenon (12.71%), α-pinene (8.29%), β-cymen (5.42%), and camphene (5.10%) were also important for the oil profile.

The essential oil composition of *Achillea* species revealed that 1,8-cineole was the most abundant compound, ranging from trace levels to 47.7% as in

Received 16 November 2015
Available online December 2015

essential oils of Balkan *Achillea* (Radulovic et al. 2007). Some species of the genus *Achillea*, include; *A. santolina* (Bader et al. 2003; El-Shazly et al. 2004), *A. millefolium* (Judzentiene & Mockute 2010; Kotan et al. 2010; Turkmenoglu et al. 2015) *A. falcate* (Senatore et al. 2005) *A. lingulata* (Kundakovic et al. 2007) *A. aleppica*, *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. coarctata*, 27 components were identified representing 92.53% of the oil (Table 1). 1,8-cineole was the predominant compound (34.22%) followed by camphor (9.24%), cis-sabinene hydrate (8.35%), caryophyllene oxide (7.59%), and borneol (7.20%).

In conclusion, this study demonstrates the occurrence of 1,8-cineole / trans-chrysanthenone chemotype of *A.arabica* and 1,8-cineole / camphor chemotype of *A. coarctata* 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. So this result gives some clues about usability of these taxa as natural products especially in medicinal field.

Acknowledgements

This research was supported by Bingol University BUBAP Unit (BAP-101-20011).

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Table 1. Constituents of the essential oils of *Achillea arabica and Achillea coarctata*

No	Compounds	RRI*	Percentage	
			Achillea arabica	*Achillea coarctata*
1	α- pinene	948	**8,29**	0,79
2	Camphen	1030	**5,10**	0,60
3	β-pinene	1176	3,78	2,02
4	Sabinene	1208	3,90	-
5	α-terpinene	1217	0,70	-
6	Limonen	1224	0,84	-
7	γ-terpinene	1276	0,78	0,40
8	1,8-cineole	1323	**42,33**	**34,22**
9	β-cymen	1357	**5,42**	1,65
10	Artemisiaketon	1475	-	0,78
11	1.4-hexadiene	1509	1,05	-
12	Ylangene	1516	-	0,71
13	Nonanal	1559	-	0,11
14	Artemisiaalcohol	1593	-	0,22
15	4-thujanol	1602	0,58	0,12
16	Filifolone	1617	0,18	0,62
17	Linalool	1646	0,73	0,52
18	3-thujanon	1671	0,72	-
19	Chrysanthenylacetate	1701	-	0,60
20	Caryophyllene	1709	0,30	0,49
21	Cis-sabinene hydrate	1714	1,05	**8,35**
22	Endo-bornylacetate	1765	2,27	3,82
23	Camphor	1812	-	**9,24**
24	Trans-chrysanthenone	1816	**12,71**	-
25	β-bisabolene epoxide	1840	-	2,31
26	α-terpineol	1868	3,25	4,92
27	Borneol	1992	1,6	**7,20**
28	Artemisa triene	2048	0,25	-
29	Cis-carveol	2111	0,29	0,38
30	Piperitone	2170	0,17	1,74
31	2-cyclopentane-1-one	2388	0,07	-
32	Caryophyllene oxide	2423	-	**7,59**
33	Benzene methanol	2442	0,24	-
34	2-naphthalene methanol	2585	0,10	0,89
35	Adamantane	2638	-	1,42
36	Dodekan	2709	-	0,82
	Total		**96,7**	**92,53**

*RRI: Relative Retention İndices