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RESEARCH ARTICLE

Chemical composition of *Achillea schischkinii* Sosn., an endemic species from Turkey

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Abstract

In this study, we investigated the chemical composition of an endemic species of *Achillea schischkinii* Sosn. (Asteraceae) collected from eastern part of Turkey (Van). Air-dried aerial parts were subjected to water-distillation using a Clevenger-type system. The essential oil was analyzed by GC-MS. Thirty-nine compounds were characterized, representing 99.2% of the total oil, were identified. The main constituents were camphor (33.4%), 1,8-cineole (9.0%) and spathulenol (8.6%). Oxygenated monoterpenes dominated the oil.

Keywords: *Achillea schischkinii*, essential oil, camphor, 1,8-cineole, GC-MS

Introduction

The genus *Achillea* L. (Asteraceae) includes 59 taxa divided into 6 sections (*Ptarmica* Bieb., *Arthrolepis* Boiss., *Babounya* Boiss., *Santalinoidea* DC., *Millefolium* (DC.) W. Koch, *Filipendulinae* (DC.) Boiss. Among them, 31 taxa are endemic to Turkey (%53) (Arabaci 2012; Aytac et al., 2016). *Achillea schischkinii* Sosn. (Syn: *Achillea muschensis* Bornm.) is one of the endemic species and belongs to *Santalinoidea* (*A. wilhelmsii* C. Koch, *A. falcata* L., *A. cacullata* (Hausskn.) Bornm., *A. vermicularis* Trin., *A. monocephala* Boiss. & Balans, *A. boissieri* (Hauskn.) Boiss., *A. schiskinii* Sosn. *A. lycaonica* Boiss. & Heldr., *A. magnifica* Hub.-Mor., *A.tenuifolia* Lam., *A. phrygia* Boiss. & Balans, *A. gypsicola* Hub.-Mor., *A. aleppica* DC., *A. pseudoaleppica* Hub.-Mor., *A. teretifolia* Willd. *A. cretica* L., *A. armenorum* Boiss. & Hauskn. *A. sintenisii* Hub.-Mor., *A. goniocephala* Boiss. & Balans and *A. spinulifolia* Fenzl ex Boiss.) group. The plant is an Irano-Turanian element and is distributed in the eastern part of Anatolia (Huber-Morath, 1975).

Achillea schischkinii is close to *A. vermicularis* Trin. but differs from it by elliptic-oblong (not hemispherical) involucre and longer (2-3.5 not 1-2.5 mm) ligules (Huber-Morath, 1975). In the Flora of Turkey, this species is described as height 15-35 cm. Leaves greenish, densely woolly, ± glabrescent, linear, median cauline (1-) 1.5-3 (-5) x 0.2-0.3 cm, pinnatisect, segments densely imbricate or somewhat distant, 0.5-1 mm, undiveded or 3 lobed, lobs orbicular to lanceolate, denticulate. Capitula (7)10-30 (-40) , corymbos 2-8 cm broad, peduncle 3-10 cm. Involucre elliptic to oblong, 4.5-6 x 3-4 mm, shortly rotundate base. Phyllaries ovate-elliptic to oblong, obtuse, carinate, with narrow scarious, often brownish margins, adpressed-tomentose, glabrescent. Ligules 3-5, pale to golden yellow, 2-3.5 mm; disc flowers c. 15-25. Flowering time: 5-7, steppe, rocky slopes, fallow field, 700-2200 m (Huber-Morath, 1975).

Achillea schischkinii is locally known as “Deli Civanpercemi” in Turkey (www.bizimbitkiler.org.tr). In traditional medicine of Turkey, *Achillea* species are used for the treatment of wounds, diarrhea, flatulence

and used as a diuretic, emmenagogue, and for abdominal pain [Karaalp et al., 2009; Turkmenoglu et al. 2015]. *Achillea schischkinii* essential oil has previously been evaluated for its antimicrobial, antiinflammatory and antinociceptive activities (Iscan et al., 2006). The oil had shown weak activity against *Escherichia coli*, Methicillin-resistant *Staphylococcus aureus*, *Enterobacter aerogenes*, *Salmonella typhimurium*, *Bacillus cereus*, *Staphylococcus aureus* and *Candida albicans* except for *Staphylococcus epidermidis* (MIC value of 62.5 μg/mL), while no noticeable *in vivo* antiinflammatory and antinociceptive activity was observed (Iscan et al., 2006).

Continuing our research on the chemical investigation of medicinal and aromatic plants, in this current study we investigated the essential oil composition of *A. schischkinii* from Turkey.

Materials and Methods

Plant material

The aerial parts of *A. schischkinii* were collected while flowering from Van: Van-Ercis road, 13 km, road sites, 1750-1800 m (384380N 432056E) in July. A voucher specimen has been deposited at the Herbarium of the Gazi University, Faculty of Science, Ankara, Turkey (Voucher specimen no: ZA8239).

Figure 1. *Achillea schischkinii*

Isolation of the essential oil

The air-dried plant materials (flowers, leaves, and stems) were hydrodistilled for 3 hours using a Clevenger-type apparatus. The oil was dried over anhydrous sodium sulphate and stored at 4 °C in the dark until analysed. The oil yield was calculated as 0.12%, v/w on dry weight basis.

Gas chromatography-mass spectrometry analysis conditions

The essential oil was analysed by GC/MS using a Hewlett-Packard GC/MSD system. An Innowax FSC column (60 m x 0.25 mm Ø with 0.25µm film thickness) was used with Helium as carrier gas. GC oven temperature was kept at 60˚C for 10 min and programmed to 220˚C at a rate of 4˚C/min and then kept constant at 220˚C for 10 min and to 240˚C at a rate of 1˚C/min. Split ratio was adjusted at 50:1 with 1mL/min flow rate. The injector temperature was 250˚C. MS were taken at 70 eV. Mass range was from *m/z* 35 to 425. Relative percentage amounts of the separated compounds were calculated from Total Ion Chromatograms by the computerized integrator.

Identification of the essential oil components was carried out by comparison of their relative retention times with those of authentic samples or by comparison of their relative retention index (RRI) to series of *n*-alkanes. Computer matching against commercial (Wiley GC/MS Library, MassFinder 3 Library) (McLafferty & Stauffer, 1989; Koenig, Joulain, & Hochmuth, 2004) and in-house "Baser Library of Essential Oil Constituents" built up by genuine compounds and components of known oils, as well as MS literature data (Joulain & Koenig, 1998; ESO 2000, 1999), was used for the identification.

Results and Discussion

The essential oil obtained by hydrodistillation from the air dried aerial parts of *A. schischkinii* was analyzed by GC-MS. A total of 39 compounds were characterized, representing 99.2% of the total oil (Table 1). Camphor (33.4%), 1,8-cineole (9.0%) and spathulenol (8.6%) were found as main constituents.

Table 1. The Composition of *Achillea schischkinii* Essential Oil

RRI[a]	Compound	%
1032	α-Pinene	5.3
1076	Camphene	2.6
1118	β-Pinene	2.7
1132	Sabinene	0.6
1203	Limonene	0.6
1213	**1,8-Cineole**	**9.0**
1255	γ-Terpinene	1.0
1280	*p*-Cymene	4.6
1386	1-Octenyl acetate	0.2
1431	7α-(H)-silphiperfol-5-ene	0.2
1487	*trans*-Sabinene hydrate	0.1
1487	Isoneroloxide	0.7
1532	**Camphor**	**33.4**
1541	Benzaldehyde	1.4
1571	*trans*-*p*-Menth-2-en-1-ol	3.0
1586	Pinocarvone	0.8
1611	Terpinen-4-ol	2.6
1638	*cis*-*p*-Menth-2-en-1-ol	2.1
1648	Myrtenal	0.3
1670	*trans*-Pinocarveol	1.4
1689	*trans*-Piperitol	1.5
1706	α-Terpineol	2.1

1726	Germacrene D	3.2
1748	Piperitone	0.3
1755	Bicyclogermacrene	0.4
1758	*cis*-Piperitol	2.0
1773	δ-Cadinene	0.2
1804	Myrtenol	0.5
1845	*trans*-Carveol	0.1
1864	*p*-Cymen-8-ol	0.2
1945	1.5-Epoxy-salvial(4)14-ene	1.8
2001	Isocaryophyllene oxide	0.1
2008	Caryophyllene oxide	3.2
2037	Salvial-4(14)-en-1-one	1.1
2077	Tridecanol	0.3
2131	Silphiperfol-6-en-5-one	0.4
2144	**Spathulenol**	**8.6**
2202	Germacrene D-4α-ol	0.5
2255	α-Cadinol	0.1
	Total	99.2

[a]RRI: Relative retention indices calculated against *n*-alkanes , % calculated from TIC data

The chemical composition of *A. schischkinii* essential oil from Turkey has previously been investigated (Donmez et al., 2005; Iscan et al., 2006; Turkmenoglu et al., 2015). Two samples collected from Sivas (central part of Turkey) were reported to show significantly different chemical profiles. Donmez et al., (2005) found that 1,8-cineole (31%), camphor (20%) and borneol (7.2%) were the major compounds, while Turkmenoglu et al., (2006) reported caryophyllene oxide (17.5%), spathulenol (9.1%), *p*-cymene (8.5%) and (*E*)-nerolidol (6.2%) as principle compounds. The third sample was collected from Erzincan (eastern part of Turkey) and 1,8-cineole (32.5%), camphor (7.8%) and β-eudesmol (5.7%) were identified as main constituents (Iscan et al., 2006). This variation could be due to geographic, environmental, climatic, soil conditions, altitude, and genotypic factors.

An excellent overview on the volatile compounds from *Achillea* species from Turkey has been recently published by Baser (2016) and 1,8-cineole and camphor were the main constituents in 19 *Achillea* species. In the present study, our sample, *A. schischkinii*, was rich in camphor. In conclusion, our results can be useful for the chemotaxonomic investigation of *Achillea* species.

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