

THE ESSENTIAL OIL OF *Achillea boissieri*

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The genus *Achillea* L. (Asteraceae: Anthemideae) includes about 110–140 species that are mainly distributed in SE Europe and SW Asia with extensions through Eurasia to North America [1]. Some *Achillea* spp. are used as antiinflammatory, antibacterial, cytotoxic, and hemostatic agents [2–6]. *Achillea millefolium* L. is a well-known species among the members of *Achillea* [7] and is used in folk remedies as an appetizer, wound healer, diuretic, carminative, or menstrual regulator [8]. Flowers of *A. ageratum* L. are used in gastrointestinal disorders, and aerial parts of the same plant were reported to have cytotoxic activity. The rhizomes of *A. ptarmica* L. were reportedly used for the treatment of urinary tract infections, rheumatism, toothache, and as a carminative [3–6].

Achillea boissieri is one of the endemic species of the genus *Achillea*. The objective of this study was to determine the essential oil composition of this species.

Water-distilled essential oil from aerial parts of *Achillea boissieri* in Turkey have been analyzed by means of GC and GC-MS. The resulting main components of the oil are shown in Table 1. The essential oil yield of *A. boissieri* was 0.2857%. Forty-eight compounds were identified, representing 93.0% of the oil. The major components were found to be 1,8-cineole (27.4%), camphor (25.3%), caryophyllene oxide (4.60%), α -terpinol (3.7%), and terpinen-4-ol (3.76%).

Plant Material. The plant material of study was collected from Elbistan, between Kabaktepe-Sariguzel, 1600 m altitude from Kahramanmaraş Province (Turkey) in August 2007. The voucher specimens have been deposited in the Herbarium of Inonu University (INU) in Malatya, Turkey (INU-Collector No: TA 2594).

Extraction of the Essential Oil. Air-dried aerial parts of the plants were hydrodistilled for 3 h using a Clevenger-type apparatus. Briefly, the plant was immersed in water and heated to boiling, after which the essential oil was evaporated together with water vapor and finally collected in a condenser. The distillate was isolated and dried over anhydrous sodium sulfate. The oil was stored at 4°C until analysis by GC and GC-MS. The percentage yield (%) of the oil calculated on a moisture-free basis was % 0.2857 for *Achillea boissieri* Hausskn. ex Boiss. (v/w).

GC and GC/MS. The essential oils were analyzed by GC and GC/MS. GC analysis was carried out using an Agilent Technologies 6890N Network system. An HP-Innowax column (60 m $\times$ 0.25 mm i.d., 0.25 μ m film thickness) was used, with helium as carrier gas. The oven temperature was kept at 60°C for 10 min and increased to 220°C at a rate of 4°C/min and then kept constant at 220°C for 10 min, then increased to 240°C at a rate of 1°C and then kept constant at 240°C for 10 min. Split flow was adjusted at 84.9 mL/min. The split ratio was adjusted to 50:1. The injector and flame ionization detection (FID) detector temperatures were 250°C.

GC/MS analysis was conducted using an Agilent Technologies 5973 inert mass selective detector (Agilent G3180B two-ways splitters with make-up gas) system. The same column and operational conditions as in GC were applied. The carrier gas was helium. MS were taken at 70 eV. The mass range was between m/z 10 and 425. A library search was carried out using the Wiley 7n GC/MS Library, the Adams Library, and the Nist 05 Library. Relative percentage amounts of the separated compounds were calculated from FID chromatograms.

n-Alkanes were used as reference points in the calculation of relative retention indices (RRI).

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TABLE 1. Composition of the Essential Oil *Achillea boissieri*

Compound	RRI	%	Compound	RRI	%
Tricyclene	1007	0.1	β -Caryophyllene	1656	0.2
α -Pinene	1019	2.2	Terpinen-4-ol	1658	3.7
α -Thujene	1022	0.2	<i>cis-p</i> -Menth-2-en-1-ol	1677	0.3
Camphene	1067	2.5	Salicylaldehyde	1729	Tr.
β -Pinene	1117	1.0	α -Terpineol	1735	3.7
Sabinene	1135	0.4	Borneol	1740	2.3
α -Terpinene	1211	0.3	Germacrene D	1749	0.1
Limonene	1236	0.8	Bicyclogermacrene	1768	0.1
1,8-Cineole	1248	27.4	Geranyl acetate	1179	0.2
γ -Terpinene	1295	1.0	δ -Cadinene	1785	Tr.
3-Methyl-3-buten-1-ol	1298	0.1	6-Octen-1-ol, 7-methyl-3-methylene	1802	1.9
<i>p</i> -Cymene	1327	1.6	Myrtenol	1810	Tr.
2-Methylbutyl-2-methyl butyrate	1332	0.2	<i>trans</i> -Carveol	1840	Tr.
Terpinolene	1340	0.2	Geraniol	1845	0.4
Amyl isovalerate	1353	0.4	Caryophyllene oxide	1954	4.6
Methyl-5-hepten-2-one	1403	Tr.	Methyl eugenol	1967	Tr.
<i>cis</i> -Linalool oxide	1510	0.5	(<i>E</i>)-Nerolidol	1979	2.5
<i>trans</i> -Sabinene hydrate	1530	1.6	Spathulenol	2042	0.3
Camphor	1587	25.3	Eugenol	2071	0.1
Benzaldehyde	1584	Tr.	Thymol	2079	Tr.
β -Linalool	1605	2.5	Carvacrol	2098	Tr.
<i>cis</i> -Sabinene hydrate	1608	1.4	2 <i>E</i> ,6 <i>E</i> -Farnesol	2178	1.0
<i>trans-p</i> -Menth-2-en-1-ol	1622	0.5	Caryophyllenol-II	2200	1.0
Pinocarvone	1633	0.3	Total		93.0
6-Methyl-3,5-heptadien-2-one	1651	0.1			

RRI: relative retention indices; Tr.: trace (< 0.1%).

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