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CHEMICAL COMPOSITION OF THE ESSENTIAL OILS OF *Anthemis coelopoda* var. *bourgaei* AND *A. aciphylla* var. *aciphylla*

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The genus *Anthemis* L. of Asteraceae (Compositae) is represented in the Flora of Turkey by 81 taxa belonging to 51 species, 29 of which are endemic to Turkey. *Anthemis aciphylla* var. *aciphylla* Boiss. is also one of the endemic species and grows wild in west and central Anatolia [1]. *Anthemis coelopoda* var. *bourgaei* Boiss. is distributed in western and southern regions of Turkey.

All of these *Anthemis* species are called "Papatya" in Turkey, and infusions of *A. coelopoda* var. *bourgaei* are used in Turkish traditional medicine especially as a digestive aid and as a gargle for toothache [2, 3]. Many *Anthemis* sp. are used as a herbal tea and for food flavoring, as well as in cosmetics and in the pharmaceutical industry [4–6]. Extracts, tinctures, salves, and tisanes are widely used as antispasmodic, anti-inflammatory, and antibacterial in Europe. The occurrence of sesquiterpene lactones, flavonoids, and essential oils in various *Anthemis* species has been reported in previous works [7–13].

To the best of our knowledge, there is no published report on the phytochemical composition of *A. coelopoda* var. *bourgaei* and *A. aciphylla* var. *aciphylla* essential oils. Therefore, we focused our study on the composition of the oils by GC and GC-MS analysis.

The results of analysis of *A. coelopoda* var. *bourgaei* and *A. aciphylla* var. *aciphylla* oils obtained by water distillation are shown in Table 1. GC/MS analysis of the oils was done. Fithy-eight components representing 87.8% of *A. aciphylla* var. *aciphylla* oil and 45 compounds representing 90.6% of *A. coelopoda* var. *bourgaei* oil were characterized.

The best of our knowledge, no report exists on the essential oil compotions of *A. coelopoda* var. *bourgaei* and *A. aciphylla* var. *aciphylla.* According to our results, the common main constituents of the essential oil from the overground parts of *A. aciphylla* var. *aciphylla* were characterized by a high percentage of irregular monoterpenes [santolinatriene (44.2%)], followed by [methyl chavicol (4.1%) and α-terpineol (3.2%)]. Monoterpene hydrocarbons [β-pinene (45.2%)] and irregular monoterpenes [santolinatriene (14.8%)] were found to be the main components in the essential oil from the overground parts of *A. coelopoda* var. *bourgaei*. β-Pinene was also found to be the major constituent in previously studied essential oils from *A. ruthenica*, *A. tinctoria*, *A. triumfetti,* and *A. austrica* [14–16].

The essential oils from the overground parts of *A. aciphylla* var. *aciphylla* and *A. coelopoda* var. *bourgaei* were characterized by a high percentage of santolinatriene (44.2% and 14.8%). The irregular monoterpene [santolinatriene (27.33% and 49.5%)] was also observed as the major constituents in previously studied essential oils of *A. melampodina* [17] and *A. pectinata* var. *pectinata* [18]. It was first isolated from *Santolina chamaecyparissus* L. [16]. Previous investigations on the essential oil from the overground parts of *A. aciphylla* Boiss. var. *discoidea* Boiss., collected from central Anatolia (Eskisehir), contained high concentrations of α-pinene (49.4%) and terpinen-4-ol (21.8%) [19]. These compounds were found in lesser concentrations in the essential oil of *A. aciphylla* var. *aciphylla*. Santolinatriene, the main component of the oil of *A. aciphylla* var. *aciphylla,* was not observed in the oil of *A. aciphylla* var. *discoidea*.

Plant Material. The overground parts of *A. coelopoda* var. *bourgae* and *A. aciphylla* var. *aciphylla* were collected from Izmir-Bozdag in May 2010 and identified by O. Secmen from Ege University. The voucher specimens (Nos. 1421, 1423) are deposited in the Herbarium of the Faculty of Pharmacy, Ege University, in Izmir. The essential oils of *A. aciphylla* var. *aciphylla* and *A. coelopoda* var. *bourgaei* were obtained by water distillation of the comminuted overground parts of the plant for 4 h.

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TABLE 1. Composition of the Essential Oil of *A. aciphylla* var. *aciphylla* and *A. coelopoda* var. *bourgaei*

Compound	RRI	1, %	2, %	Compound	RRI	1, %	2, %
α-Pinene	1032	2.4	2.6	Methyl chavicol	1687	4.1	–
α-Thujene	1035	0.7	–	α-Humulene	1687	–	0.3
Santolinatriene	1043	44.2	14.8	Selina-4,11-diene	1688	–	0.4
Ethyl 2-methylbutyrate	1063	–	0.2	(*=4,11-Eudesmadiene*)			
Ethyl isovalerate	1079	–	0.2	α-Terpineol	1706	0.8	0.5
Hexanal	1093	0.4	0.2	Germacrene D	1726	3.2	3.2
β-Pinene	1118	1.0	45.2	Neryl acetate	1733	–	0.3
Sabinene	1132	0.6	0.9	β-Bisabolene	1741	1.1	–
Propyl 2-methylbutyrate	1151	–	Tr.	β-Selinene	1742	–	0.4
Propyl isovalerate	1167	–	Tr.	Bicyclogermacrene	1755	0.9	–
Myrcene	1174	Tr.	–	Naphthalene	1763	–	0.2
1,8-Cineole	1213	0.8	1.4	Geranyl acetate	1765	–	0.4
β-Phellandrene	1218	0.4	0.4	δ-Cadinene	1773	0.7	Tr.
(*Z*)-β-Ocimene	1246	–	Tr.	Methyl salicylate	1798	1.0	Tr.
γ-Terpinene	1255	–	0.8	Myrtenol	1804	–	3.3
Butyl isovalerate	1259	–	0.2	(*E,E*)-2,4-Decadienal	1827	1.1	–
p-Cymene	1280	0.4	0.4	2,6-Dimethyl-3(*E*),5(*E*),7-octatrien-2-ol	1830	0.8	–
2-Methylbutyl 2-methylbutyrate	1286	–	Tr.	Benzyl 2-methylbutyrate	1880	–	Tr.
Terpinolene	1290	–	0.3	Geranyl isovalerate	1893	1.6	–
Octanal	1296	–	0.4	Benzyl isovalerate	1902	–	Tr.
2-Methylbutyl isovalerate	1299	–	Tr.	Caryophyllene oxide	2008	3.0	0.3
Hexanol	1360	–	0.1	Pentadecanal	2041	0.7	–
2-Methylpropyl hexanoate	1362	–	0.1	(*E*)-Nerolidol	2050	–	0.2
α-Pinene oxide	1384	–	0.2	Hexahydrofarnesyl acetone	2131	0.7	–
Nonanal	1400	–	0.3	Spathulenol	2144	0.6	–
Yomogi alcohol	1403	2.1	–	Octanoic acid	2084	0.5	–
Hexyl 2-methylbutyrate	1438	–	Tr.	Eugenol	2186	0.3	–
Hexyl 3-methylbutyrate	1457	–	Tr.	*T*-Cadinol	2187	–	0.9
(*=Hexyl isovalerate*)				Nonanoic acid	2192	0.8	–
3-Methylbutyl hexanoate	1468	–	Tr.	Thymol	2198	0.7	–
(*=Isoamyl hexanoate*)				*T*-Muurolol	2209	0.8	0.2
(*Z*)-3-Hexenyl 2-methylbutyrate	1482	–	0.1	4-Vinylguaiacol	2218	0.4	–
(Z)-3-Hexenyl 3-methylbutyrate	1494	–	0.1	Methyl hexadecanoate	2226	0.9	–
(*=(Z)-3-Hexenyl isovalerate*)				(*=Methyl palmitate*)			
α-Copaene	1497	1.0	–	α-Cadinol	2255	0.3	–
Linalool	1553	0.8	–	Decanoic acid	2298	0.7	–
Octanol	1562	–	0.2	Tricosane	2300	0.3	0.5
Pinocarvone	1586	–	0.3	Methyl octadecanoate	2431	Tr.	–
β-Elemene	1600	–	0.3	(*=Methyl stearate*)			
Terpinen-4-ol	1611	2.7	–	(*Z*)-9-Methyl octadecanoate	2456	Tr.	–
β-Caryophyllene	1612	2.4	1.7	(*=Methyl oleate*)			
Lavandulyl acetate	1617	–	0.2	Pentacosane	2500	0.1	Tr.
Myrtenal	1648	–	3.5	Dodecanoic acid	2503	0.9	–
(*Z*)-β-Farnesene	1668	–	1.3	Phytol	2622	0.7	0.3
trans-Pinocarveol	1670	–	0.6	Hexadecanoic acid	2931	1.0	Tr.
Lavandulol	1686	–	2.2	Total		87.8	90.6

RRI: relative retention indices calculated against *n*-alkanes. %: calculated from FID data; Tr.: Trace (< 0.1%).
1 – *Anthemis aciphylla*; 2 – *Anthemis coleopoda* var. *bourgae.*

GC-MS Analysis. The GC-MS analysis was carried out with an Agilent 5975 GC-MSD system. An Innowax FSC column (60 m × 0.25 mm, 0.25 μm film thickness) was used with helium as carrier gas (0.8 mL/min). GC oven temperature was kept at 60°C for 10 min and programmed to 220°C at a rate of 4°C/min, and kept constant at 220°C for 10 min and then programmed to 240°C at a rate of 1°C/min. The split ratio was adjusted at 40:1. The injector temperature was set at 250°C. Mass spectra were recorded at 70 eV. Mass range was from *m/z* 35 to 450.

GC Analysis. The GC analysis was carried out using an Agilent 6890N GC system. The FID detector temperature was 300°C. To obtain the same elution order with GC-MS, simultaneous auto-injection was done on a duplicate of the same column applying the same operational conditions. Relative percentage amounts of the separated compounds were calculated from the FID chromatograms. The analysis results are given in Table 1.

Identification of Components. 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 databases (Wiley GC/MS Library, Adams Library, MassFinder 3 Library) [20, 21] and the in-house database "Baser Library of Essential Oil Constituents" built up of genuine compounds and components of known oils, as well as MS literature data [22, 23], was used for the identification.

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