

Gas Chromatographic (GC-GC/MS) Analysis of Essential Oil of *Phlomis armeniaca* Willd. from Mediterranean Region in Turkey

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The chemical composition of the essential oil obtained by hydro-distillation from aerial parts of the endemic *Phlomis armeniaca* Willd. (Lamiaceae) collected from mediterranean region, C3 Beskonak (Antalya), Koprulu Canyon National Park in Turkey has been studied. Twelve components were identified composing 91.78 % of the essential oil of *P. armeniaca*. *P. armeniaca* essential oil contained germacrene-D (35.68 %), β -caryophyllene (18.08 %), caryophyllene oxide (13.35 %), (E)- β -farnesene (7.24 %) and hexahydrofarnesyl acetone (6.99 %) as main components. Germacrene-D was the dominant and distinctive compound of *Phlomis armeniaca* Willd.

Key Words: *Phlomis armeniaca* Willd., Turkey, Essential oil composition, Germacrene-D.

INTRODUCTION

Phlomis genus, belonging to the Lamiaceae family, is represented by 34 species and 52 taxa altogether, 34 of which endemic¹. Baytop² reported that some *phlomis* species are used as a tonic and stimulant in Anatolian folk medicine.

Phlomis armeniaca Willd. is a perennial and xeromorphic plant and prefers limestone rocks. This Lamiaceae plant has 60 cm height and yellow flowers. It is endemic to Anatolia, where it grows in Iran-Turan phytogeographic region¹.

The essential oil obtained from *P. armeniaca* Willd. collected from middle anatolian region in Turkey was studied³. However, the place of growth of the plant influences chemical composition of the essential oil⁴. Therefore, we analyzed the essential oil of *P. armeniaca* Willd. collected from mediterranean region in Turkey by gas chromatographic method using flame ionization and mass selective detections.

EXPERIMENTAL

The flowering aerial parts of *P. armeniaca* Willd. were collected from mediterranean region in Turkey, C3 Beskonak, Koprulu Canyon National Park, on limestone rocks, about 1850 m above the sea level at the end of July 2008. A voucher

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specimen is deposited at ISPO (Herbarium of the Forest Botany Department of Suleyman Demirel University) as Fakir 4021. The aerial parts were dried in a dark place at room temperature.

Isolation of the essential oil: The essential oil of the 200 g aerial parts of *P. armeniaca* Willd. was obtained by hydrodistillation using a Clevenger-type apparatus for 3 h in a yield of 1 % (w/w) based on dry weight.

GC and GC/MS analysis: The GC/MS analysis of the oil was performed using a Hewlett-Packard 6890 series gas chromatograph equipped with a HP-5MS capillary column (30 m × 0.25 mm i.d., 0.25 µm film thickness) directly coupled to a mass selective detector (MSD) 5973 of the same company operated in EI mode (70 eV). Helium was the carrier gas at a flow rate of 1 mL/min. The column temperature was kept at 60 °C for 5 min and then gradually increased to 220 °C at 5 °C/min. The conditions of GC equipped with a flame ionization detector (FID) were the same as for the GC/MS.

Identification of components: The components of the oil were identified by their retention times. The retention indices relative to *n*-alkanes that were injected after the oil sample at the same chromatographic conditions and by comparison of their mass spectra with the Wiley library or with data already available in the literature⁵⁻⁷. The relative percentages of the components were calculated from the total chromatogram by the computer.

RESULTS AND DISCUSSION

P. armeniaca Willd. from mediterranean and middle Anatolian³ regions in Turkey were comparable with respect to yield of essential oil. Present samples of *P. armeniaca* Willd. and *P. armeniaca* Willd. analyzed by reported method³ produced 1 % and 0.1 % essential oil based on dry weight of sample, respectively.

The constituents in the essential oil of *P. armeniaca* Willd. from mediterranean region in Turkey were listed in Table-1. Twelve components which were 91.78 % of the total oil of present sample were identified, whereas 93 compounds were characterized as 77.10 % of the total oil of *P. armeniaca* Willd. from middle anatolian region in Turkey³.

The essential oil of *P. armeniaca* Willd. from mediterranean region in Turkey presented nine sesquiterpene hydrocarbons (68.79 %), an oxygenated sesquiterpene (13.35 %), an aliphatic ketone (6.99 %) and a sesquiterpene alcohol (2.65 %).

The determined sesquiterpene hydrocarbon compounds were β-bourbonene (1.19 %), β-elemene (0.93 %), β-caryophyllene (18.08 %), α-humulene (1.80 %), (E)-β-farnesene (7.24 %), germacrene-D (35.68 %), bicyclogermacrene (1.88 %), β-bisabolone (0.76 %) and δ-cadinene (1.23 %); the oxygenated sesquiterpene compound was caryophyllene oxide (13.35 %); the aliphatic ketone compound was hexahydrofarnesyl acetone (6.99 %); the sesquiterpene alcohol compound was spathulenol (2.65 %).

TABLE-1
COMPOSITION OF THE ESSENTIAL OIL OF *Phlomis armeniaca* WILLD. FROM
MEDITERRANEAN REGION IN TURKEY

Constituent	RI ^a	% ^b
β-Bourbonene	1382	1.19
β-Elemene	1388	0.93
β-Caryophyllene	1418	18.08
α-Humulene	1443	1.80
(E)-β-Farnesene	1462	7.24
Germacrene-D	1480	35.68
Bicyclogermacrene	1495	1.88
β-Bisabolone	1510	0.76
δ-Cadinene	1524	1.23
Spathulenol	1577	2.65
Caryophyllene oxide	1584	13.35
Hexahydrofarnesyl acetone	1851	6.99
Sesquiterpene hydrocarbon	–	68.79
Oxygenated sesquiterpen	–	13.35
Aliphatic ketone	–	6.99
Sesquiterpene alcohol	–	2.65

a: Retention indices calculated against n-alkanes, b: Percentages calculated from FID data.

Although, some monoterpene and oxygenated monoterpene hydrocarbons, *e.g.* α-pinene, β-pinene, δ-2-carene, limonene, *p*-cymene and 1,8-cineole were identified in the essential oil of *P. armeniaca* Willd. from middle Anatolian region in Turkey³, but there were no monoterpene or oxygenated monoterpene hydrocarbons which were present in the essential oil of *P. armeniaca* Willd. from mediterranean region in Turkey.

The major constituents in essential oil of *P. armeniaca* Willd. from mediterranean region in Turkey were mainly sesquiterpene hydrocarbon compounds *i.e.*, germacrene-D (35.68 %), β-caryophyllene (18.08 %) and (E)-β-farnesene (7.24 %), while in the *P. armeniaca* Willd. from middle Anatolian in Turkey they were germacrene-D (23.40 %) and (Z)-β-farnesene (6.20 %)³. β-Caryophyllene was identified as second abundant component (18.08 %) in the oil of present sample was not detected in the oil of *P. armeniaca* Willd. from middle Anatolian region in Turkey³.

Caryophyllene oxide which was present as third abundant compound (13.35 %) in the oil of *P. armeniaca* Willd. from Mediterranean region in Turkey was identified as only 0.70 % of the oil of *P. armeniaca* Willd. from middle Anatolian region in Turkey³.

Hexahydrofarnesyl acetone, an aliphatic ketone was determined as a major component (6.99 %) in the oil of *P. armeniaca* Willd. from Mediterranean region in Turkey, while in the oil of *P. armeniaca* Willd. from middle Anatolian in Turkey it was detected as a minor component (2.30 %)³.

In conclusion, there are differences between chemical components of essential oils of *P. armeniaca* Willd. collected from mediterranean and middle Anatolian³ regions in Turkey which may be due to differences in geographical locations, climatic conditions and kind of soils.

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