Nat. Volatiles & Essent. Oils, 2016; 3(2): 15-19

NVEO
Natural Volatiles & Essential Oils

RESEARCH ARTICLE

Composition of the essential oil of the *Hyssopus officinalis* L. subsp. *angustifolius* (Bieb.) Arcangeli

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Abstract

Hyssopus officinalis subsp. *angustifolius* (Bieb) Arcangeli growing in North East and South Anatolia is the only member of this genus growing in Turkey. Aerial parts of the plant material were hydrodistilled and the resulting oil was analyzed by GC and GC/MS simultaneously. Main components were identified as pinocarvone (27.1%), β-pinene (19.0%), and isopinocamphone (13.6%), respectively.

Key words: *Hyssopus officinalis*, Labiatae, Essential oil, pinocarvone, β-pinene, isopinocamphone

Introduction

Members of the genus *Hyssopus* L. (Lamiaceae) are aromatic semi-woody perennials (Mill, 1982). The most widespread species *H. officinalis* is naturalized in Western and Central Europe. It is known and recognised as "hyssop". In some regions, it is used as a spice to flavour soups (Small, 1997) or steeped in water to make a purgative infusion (Mill, 1982). Hyssop is considered a reasonable effective remedy for mild irritations of the respiratory tract that accompany the common cold (Baytop, 1994). *H. officinalis* subsp. *angustifolius* (Bieb) Arcangeli growing in North East and South Anatolia is the only member of this genus growing in Turkey. This species is locally known as 'çördük' (Mill, 1982) and 'zulfa otu'. Contrary to its use Europe, it is not a common medicinal plant in Turkey (Baytop, 1994).

According to the literature survey, the chemical composition of the essential oil of *H. officinalis* of various origins have been investigated. Letessier, et al., 2001; Kızıl et al., 2008; Kızıl et al. 2010; Moro et al., 2011; Fathiazad & Hamedeyazdan, 2011; Mohan et al., 2012; Figueredo et al., 2012; Dzami´c et al., 2013; Pandey et al., 2014; Hristova et al., 2015; Figueredo et al., 2015; Stappen et al., 2015, Schultz & Stahl-Biskup (1991), Gorunovic et al. (1995), Vallejo et al. (1995), Garg et al. (1999), Piccalgia et al. (1999), Salvatore et al. (1998) have determined the composition of various oils of hyssop collected from Turkey, Germany, Montenegro, Spain, India, Italy and France.

Materials and Methods

Plant Material

Aerial parts of *Hyssopus officinalis* subsp. *angustifolius* were collected in August 2003 from Kastamonu: Ihsangazi in Turkey. Voucher specimens are kept at the Herbarium of the Faculty of Pharmacy, Anadolu University in Eskisehir, Turkey (ESSE 14254).

Isolation of the Essential Oil

Air dried aerial parts were hydrodistilled for 3 h using a Clevenger-type apparatus to yield 2.2 % oil.

GC and GC/MS Analyses

The GC analysis was carried out using an Agilent 6890N GC system. Flame ionization detector (FID) 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 FID chromatograms.

The GC/MS analysis was carried out with an Agilent 5975 GC-MSD system. Innowax FSC column (60 m x 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. 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.

Identification of the Volatile Compounds

The components of the sample were identified by comparison of their mass spectra with those in the Baser Library of Essential Oil Constituents, Adams Library (Adams, 2007), MassFinder Library (Hochmuth, 2008), Wiley GC/MS Library (McLafferty & Stauffer, 1989) and confirmed by comparison of their retention indices. These identifications were accomplished by comparison of retention times with authentic samples or by comparison of their relative retention index (RRI) to a series of *n*-alkanes. Alkanes (C8-C22) were used as reference points in the calculation of relative retention indices (RRI) (Curvers, Rijks, Cramers, Knauss, & Larson, 1985). Relative percentage amounts of the separated compounds were calculated from FID chromatograms.

Results and Discussion

As shown in Table 1, overall 51 components were identified, constituting 98.6 % of the oil of *Hyssopus officinalis* ssp. *angustifolius*. The relatively high yielding characteristic oil contained pinocarvone (27.1%), β-pinene (19.0%), isopinocamphone (13.6%), and pinocamphone (13.6%) as main constituents. According to the literature, so far three types of *Hyssopus* oils have been encountered, namely; monoterpene ketone-type, 1,8-cineole type, and methyl eugenol-type (Gorunovic et al., 1995; Vallejo et al. 1995; Lawrence, 1993), respectively.

The oil examined in this present study is rich of monoterpene ketones and among these, the content of pinocarvone is remarkably high. This value is higher than the oils of *Hyssopus* previously studied, except for the oil from Gümüşhane, with 36.3% pinocarvone (Özer et al. 2005). According to the ISO 9847/1991 standard, commercial oil should contain 40-67.5 % monoterpene ketones and 13.5-23.0 % β-pinene (Mazzanti et al. 1998). The values obtained in this study (55 % monoterpene ketones and 19 % β-pinene) are compatible with the standard values.

Table 1. Chemical composition of the essential oil of *Hyssopus officinalis* ssp. *angustifolius*

RRI[a]	**Compounds**	**%**
1018	Methyl 2-methyl butyrate	<0.1
1032	α-Pinene	1.0
1035	α-Thujene	0.3
1076	Camphene	0.1
1078	5-Methyl 3-hexanone	<0.1
1118	β-Pinene	19.0
1132	Sabinene	2.1
1159	δ-3-Carene	<0.1
1174	Myrcene	4.2
1188	α-Terpinene	0.1
1195	Dehydro 1,8-cineole	<0.1
1203	Limonene	1.0
1213	1,8-Cineole	6.3
1232	(*Z*)-3-Hexenal	<0.1
1246	(*Z*)-β-Ocimene	1.2
1255	γ-Terpinene	0.2
1266	(*E*)-β-Ocimene	0.2
1266	5-Metil 3-heptanone	0.1
1280	*p*-Cymene	0.1
1290	Terpinolene	0.1
1394	Myrtenyl methyl ether	4.1
1452	1-Octen-3-ol	0.2
1474	*trans*-Sabinene hydrate	0.3
1500	Bicycloelemene	<0.1
1563	Pinocamphone	13.6
1553	Linalool	0.1
1562	Isopinocamphone	13.6
1586	Pinocarvone	27.1
1603	Nopinone	0.2
1612	β-Caryophyllene	0.5
1638	*cis*-*p*-Menth-2-en-1-ol	0.1
1648	Myrtenal	0.4
1670	*trans*-Pinocarveol	0.4
1682	δ-Terpineol	0.1
1687	α-Humulene	0.1
1706	α-Terpineol	0.1
1719	Borneol	0.2
1726	Germacrene D	0.3
1755	Bicyclogermacrene	0.1
1773	δ-Cadinene	<0.1
1804	Myrtenol	0.5
1830	2,6-Dimethyl-3[*E*],5[*E*],7-octatriene-2-ol	0.1

1838	[*E*]-β-Damascenone	<0.1
1845	*trans*-Carveol	<0.1
1864	*p*-Cymen-8-ol	<0.1
2008	Caryophyllene oxide	0.2
2029	Perillyl alcohol	0.1
2073	*p*-Mentha-1,4-dien-7-ol	0.1
2113	Cumin alcohol	<0.1
2114	Spathulenol	0.1
2186	Eugenol	<0.1

[a] Relative Retention Index

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