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RESEARCH ARTICLE

Chemical Characterisation of the Essential Oil of *Hypericum aviculariifolium* Jaub. & Spach subsp. *depilatum* (Freyn & Bornm.) Robson var. *bourgaei* (Boiss.) Robson from Turkey

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Abstract

The genus *Hypericum* L. is represented by 96 species, 47 taxa being endemic for Turkey. The study material of this present work *Hypericum avicularіifolium* Jaub. & Spach subsp. *depilatum* (Freyn & Bornm.) Robson var. *bourgaei* (Boiss.) Robson (Clusiaceae) is also endemic. The essential oil was obtained by hydrodistillation of the aerial parts collected from Antalya, Turkey.

Essential oil was analysed both by GC and GC/MS, simultaneously. Hexadecanoic acid (28.0 %), lauric acid (11.3%), myristic acid (9.7%) and caryophyllene oxide (8.7 %) were found as the main constituents. To the best of our knowledge, this is the first study on the essential oil chemistry of this plant.

Keywords: Essential oil, *Hypericum*, Clusiaceae

Introduction

The genus *Hypericum* L. is the type genus of Hypericaceae, now usually included as subfamily (Hypericoideae) in Clusiaceae (Guttiferae) and comprises more than 450 species divided in 36 sections with worldwide distribution in warm temperate, subtropical and mountainous tropical regions (Robson, 2001). The genus *Hypericum* L. is represented by 96 species in Turkey, 47 taxa being endemic. *H. avicularіifolium* Jaub. & Spach subsp. *depilatum* (Freyn & Bornm.) Robson var. *bourgaei* (Boiss.) Robson (Clusiaceae) is an endemic species in Turkey (Güner, 2013; Davis 1967). Different parts of *Hypericum* species are used as appetizer, sedative, antispasmodic, antidiarrheic, anthelmintic and diuretic in Anatolian folk medicine. *H. perforatum* is used as a dye, in flavouring, in food, as a medicine in wound healing, ulcers, the common cold, diabetes mellitus and as an astringent (Demirezer et al., 2007; Kaçar, 2005; Baytop, 1999; Tuzlacı 2006).

Phytochemical investigations on *H. perforatum* have shown that it contains flavonols (catechins), naphthodianthrons (hypericin, pseudohypericin), xanthones, coumarins, glycosides, anthraquinones, phloroglucinols (hyperforin, adhyperforin), flavonoids (rutin, hyperoside, quercitrin), flavonol glycosides, lactones, pyrones, lipids, triterpenes, tannins, and essential oils. Hypericine and its derivatives have been reported to be responsible for antidepressant activity (Nahrstedt, and Butterweck 1997; Lavie, 1995).

The pharmacological activities of *Hypericum* extracts namely, antidepressive and antiviral activities are mainly attributed to their flavonoid, hypericin and phloroglucinol contents (Avato, 2005). *H. avicularіifolium* Jaub. & Spach subsp. *depilatum* (Freyn & Bornm.) Robson var. *depilatum* is another member of *Hypericum* genus from Turkish flora which grows wild in some dry stony or rocky and calcareous zones of Turkey (Davis, 1988). *H. avicularіifolium* subsp. *depilatum* var. *depilatum* was reported to have great pharmaceutical

potential, with its well-documented contents of hypericin, hyperforin and flavonoids (Cirak, Radusiene, Janulis, & Ivanauskas, 2007).

Materials and Methods

Plant Sample

H. aviculariifolium subsp. *depilatum* var. *bourgaei* was collected from Aydın, Didim in Turkey on June 16, 2008. Voucher specimens are kept at the Herbarium of Anadolu University, Faculty of Pharmacy Turkey (ESSE 14682).

Isolation of the Essential Oils

Aerial parts of the plant were water distilled for 3h using a Clevenger-type apparatus to yield 1.3% oil on moisture-free basis.

GC and GC/MS Conditions

The oils were analysed by capillary GC and GC/MS using an Agilent GC-MSD system.

GC/MS: The GC/MS analysis was carried out with an Agilent 5975 GC-MSD system. Innowax FSC column (60m x 0.25mm, 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 40:1. The injector temperature was at 250 °C. MS were taken at 70 eV. Mass range was from m/z 35 to 450.

GC

The GC analysis was carried out using an Agilent 6890N GC system. In order to obtain the same elution order with GC/MS, simultaneous injection was done by using the same column and appropriate operational conditions. FID temperature was 300 °C.

Identification of Compounds

The components of essential oils were identified by comparison of their mass spectra with those in the Baser Library of Essential Oil Constituents, Wiley GC/MS Library, Adams Library, MassFinder Library and confirmed by comparison of their retention indices. Alkanes were used as reference points in the calculation of relative retention indices (RRI). Relative percentage amounts of the separated compounds were calculated from FID chromatograms (ESO 2000, 1999; Jennings and Shibamoto, 1980; Joulain and Koenig, 1998; Koenig, Joulain and Hochmuth, 2004; McLafferty and Stauffer, 1989). The results of analysis are shown in Table 1.

Results and Discussion

Essential oil was analysed by GC and GC/MS, simultaneously. 27 compounds were identified, representing 92.6 % of the total oil components detected. Hexadecanoic acid (28.0 %), lauric acid (11.3%), myristic acid (9.7%) and caryophyllene oxide (8.7 %) were the main constituents. Fatty acids and their esters were the constituents predominated.

In other studies, α-pinene (52.1%), germacrene D (8.5%) and β-pinene (3.6%) have been reported as main constituents of *H. aviculariifolium* subsp. *depilatum* var. *depilatum* (Yuce & Bagci, 2012). In many studies with other species belonging to *Hypericum,* different results have been reported.

Major compounds of the volatiles of *H. cerastoides* (Spach) Robson were reported as α-pinene (58%), undecane (5%), and β-pinene (3%). The microdistillation of *H. montbretii* Spach resulted in the characterization α-pinene (26%), β-pinene (19%), and undecane (5%) as major compounds (Erken et al., 2001).

Major constituents of *H. perforatum* L. steam volatiles obtained by microdistillation were identified as α-pinene (50%) and carvacrol (22%). α-Pinene was reported as the main component in several *H. perforatum* essential oils (Erken et al., 2001; Cakir et al., 1997; Nogueira et al., 1999, Weyerstahl et al., 1995). While other *Hypericum* species investigated were predominated by monoterpene hydrocarbons, it was interesting to note the fatty acid dominating composition of the current species.

Table 1. The Composition of the Essential Oil of *H. aviculariifolium* subsp. *depilatum* var. *bourgaei*

RRI	Compounds	%
1032	α-Pinene	0.9
1048	2-Methyl-3-buten-2-ol	0.2
1065	2-Methyl decane	0.3
1100	Undecane	0.4
1690	Selina-4,11-diene	0.6
1704	γ-Muurolene	0.4
1740	Valencene	0.6
1973	Dodecanol	0.3
2008	Caryophyllene oxide	8.7
2037	Salvial-4(14)-en-1-one	0.7
2071	Humulene epoxide-II	0.4
2123	Salviadienol	1.0
2131	Hexahydrofarnesyl acetone	1.6
2144	Spathulenol	3.3
2243	Torilenol	1.0
2256	Cadalene	0.8
2296	Decanoic acid	1.1
2300	Tricosane	1.1
2324	Caryophylladienol II	0.9
2353	Caryophyllenol I	0.9
2369	Eudesma-4(15), 7-dien-1β-ol	2.0
2392	Caryophyllenol II	1.9
2503	Dodecanoic acid	11.3
2696	Tetradecanoic acid	9.7
2700	Heptacosane	2.3
2900	Nonacosane	12.2
2931	Hexadecanoic acid	28.0
	Total	**92.6**

RRI: Relative retention indices calculated against *n*-alkanes,
%: percentages were calculated from FID data

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