Nat. Volatiles & Essent. Oils, 2018: 5(1): 7-10

NVEO Natural Volatiles & Essential Oils

RESEARCH ARTICLE

A monotypic species from Turkey: Characterization of the essential oil of *Berula erecta* (Apiaceae)

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Abstract

The genus *Berula* W. Koch belongs to the Apiaceae family and it is only represented by *B. erecta* (Huds.) Coville in Turkey. *B. erecta* was collected in June, 2014 from Konya province. The chemical composition of essential oil obtained by hydrodistillation from the dried aerial parts of *B. erecta* was analysed by GC-FID and GC-MS. Thirty-five compounds, constituting about 79.4% of the total oil, were identified. The major components were found as hexahydrofarnesyl acetone (14.1%) and α-bisabolol oxide A (12.8%).

Keywords: *Berula erecta,* essential oil, GC-FID, GC-MS, Turkey

Introduction

The Apiaceae is one of the best known families of flowering plants because of its characteristic inflorescences and fruits, and the diverse chemistry reflected odour, flavour and even toxicity of many of its members. It contains about 300 genera and 2500-3000 species throughout the world (Heywood, 1979). The genus *Berula* W. Koch belongs to the Apiaceae family (subfam. Apioideae, tribus Oenantheae). It is only represented by *B. erecta* (Huds.) Coville (syn. *Sium erectum* Huds, *Sium angustifolium* L. *Berula angustifolia* (L.) Mert. & W.D.J. Koch) in Turkey (Peşmen, 1972).

B. erecta, water-parsnip, is an aquatic plant, probably a monotypic species distributed in damp places in Europe, Asia, East and South Africa, North America, and many parts of Iran and Turkey (Javidnia et al., 2011). The local name of plant is “gendeme” (Güner et al., 2012). The plant is toxic, and capable of causing death to grazing animals. The leaves and flowers have been used for food. The plant is used externally in the treatment of rheumatism. An infusion of the whole plant can be used as a wash for swellings, rashes and athletes foot infections (http, 2018). *B. erecta* is a perennial glabrous, 40-100 cm in height, leaves 3-4-pinnate, rays 8-20 erecto-patent, 1-4 cm, bracts lanceolate, mericarps c. 2x1.5 mm. It grows on marshy places by streams, and at sea level-1750 m altitudes in Anatolia (Peşmen, 1972).

There are two previous papers on the chemical composition of *B. erecta* from Serbia (Lazarevic et al., 2010) and Iran (Javidnia et al., 2011). Here we report on the composition of the aerial parts essential oil of *B. erecta* which has not been reported previously from Turkey.

Materials and Methods

Plant material

B. erecta was collected during the flowering period (June, 2014) from Konya province. B4 Konya: Sille, 1170 m, hills, 26.06.2014. The voucher specimens (M Dinç 3588 & S Doğu) are deposited at the Herbarium of the Department of Biology, Necmettin Erbakan University, Konya, Turkey (NEÜ Herb.).

Isolation of essential oil

The essential oil from air-dried plant materials was isolated by hydrodistillation for 3 h, using a Clevenger-type apparatus to produce a trace amount of essential oil which was trapped in n-hexane. The yield of oil was 0.01%. The obtained oil was dried over anhydrous sodium sulphate and stored at +4°C in the dark until analyzed and tested.

GC-MS analysis

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.

GC analysis

The GC analysis was carried out using an Agilent 6890N GC system. 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 FID chromatograms. The analysis results are given in Table I.

Identification of the components

Identification of the essential oil components were 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 (Wiley GC/MS Library, MassFinder Software 4.0) (McLafferty & Stauffer, 1989; Hochmuth, 2008) and in-house "Başer Library of Essential Oil Constituents" built up by genuine compounds and components of known oils.

Results and Discussion

The identified volatile constituents of *B. erecta* are reported in Table I. Analysis of the essential oil of *B. erecta* led to the identification of 35 compounds, which represented 79.4% of the total oil. Components of the oils can be grouped into six main chemical classes, sesquiterpene hydrocarbons, oxygenated sesquiterpenes, fatty acids, diterpenes, alkanes and others. The oil was characterized by a high content of others (27.7%), oxygenated sesquiterpenes (23.9%) and alkanes (18.5%). The main components of the oil were found as hexahydrofarnesyl acetone (14.1%) and α-bisabolol oxide A (12.8%).

Table 1. The Composition of the Essential Oil of *Berula erecta*

RRI[a]	Compound	%[b]	IM[c]
1244	2-Pentyl furan	2.3	MS
1296	Octanal	tr	tR, MS
1400	Nonanal	tr	tR, MS
1500	Pentadecane	0.9	tR, MS
1548	(*E*)-2-Nonenal	0.8	MS
1600	Hexadecane	0.8	tR, MS
1695	(*E*)-β-Farnesene	3.6	MS
1700	Heptadecane	0.3	tR, MS
1715	2-Dodecanone	1.9	MS
1766	Decanol	3.7	tR, MS
1773	γ-Cadinene	0.8	MS
1815	Hexyl octanoate	1.2	MS
1827	(*E,E*)-2,4-Decadienal	0.4	MS
1868	(*E*)-Geranyl acetone	1.5	MS
1900	Nonadecane	0.1	tR, MS
1958	(*E*)-β-Ionone	0.2	MS
1992	Neophytadiene	0.6	MS
1973	Dodecanol	0.2	tR, MS
2000	Eicosane	1.3	tR, MS
2100	Heneicosane	3.7	tR, MS
2131	**Hexahydrofarnesyl acetone**	**14.1**	MS
2156	α-Bisabolol oxide B	2.0	MS
2200	Docosane	2.0	tR, MS
2200	α-Bisabolon oxide A	2.5	MS
2232	α-Bisabolol	5.4	tR, MS
2300	Tricosane	4.4	tR, MS
2384	Farnesyl acetone	1.2	MS
2430	Chamazulene	1.4	MS
2438	**α-Bisabolol oxide A**	**12.8**	MS
2500	Pentacosane	2.8	tR, MS
2622	Phytol	1.4	MS
2670	Tetradecanoic acid	1.1	tR, MS
2700	Heptacosane	0.7	tR, MS
2900	Nonacosane	1.5	tR, MS
2931	Hexadecanoic acid	1.8	tR, MS
	Sesquiterpene Hydrocarbons	4.4	
	Oxygenated Sesquiterpenes	23.9	
	Fatty acids	2.9	
	Diterpenes	2.0	
	Alkanes	18.5	
	Total	**79.4**	

[a]RRI: Relative retention indices calculated against *n*-alkanes; [b]%: calculated from FID data; [c]IM: Identification Method; tR, identification based on the retention times (tR) of genuine standard compounds on the HP Innowax column; MS, tentatively identified on the basis of computer matching of the mass spectra with those of the Wiley and MassFinder libraries and comparison with literature data. tr Trace (< 0.1 %)

According to literature survey, there are two study on the essential oil from aerial parts of *B. erecta* from Serbia (Lazarevic et al., 2010) and Iran (Javidnia et al., 2011). Lazarevic et al. (2010) studied essential oils of *B. erecta* subsp. *erecta* and they reported one hundred and twenty-five compounds and identified accounted for 96.2% of the total oil. The yield of oil was 0.004%. The oil was characterized by the presence of (Z)-falcarinol (21.5%), β-sesquiphellandrene (17.2%), β-caryophyllene (14.9%) and γ-terpinene (14.8%). Terpenoids (66.2%) constituted the main fraction of the oil, with monoterpene (19.3%) and sesquiterpene hydrocarbons (39.2%) as the most abundant compound class.

Javidnia et al. (2011) reported 44 compounds which represent 94.0% of the total oil from *B. angustifolia* (syn. *B. erecta*). The yield of oil was 0.04%. They found piperitenone oxide (14.6%), limonene (13.9%), α-zingiberene (12.8%), and (E)-β-farnesene (9.6%) as main compounds.

Various factors, both endogenous and exogenous, can affect the composition of the essential oil of *B. erecta*. We believe that the time of flowering, geographical, and climatic factors may be very important. Several papers have reported on the variation in the essential oil composition induced by environmental, physiological, and edaphic factors, which can induce changes in biosynthesis accumulation or metabolism of given compounds of the essential oil (Senatore et al., 1997).

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