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COMPOSITION OF THE ESSENTIAL OIL OF *Stachys bombycina* FROM TURKEY

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The genus *Stachys* L. contains about 285 species and is considered to be one of largest genera of the Lamiaceae [1], but information about its chemistry is limited. It is a subcosmopolitan genus, most diverse in the warm-temperate regions of the Mediterranean and Southwest Asia and with secondary centers in North and South America and southern Africa [2]. There are two main centers of diversity in terms of species number. One is in the South and East Anatolia, Caucasus, Northwestern Iran and Northern Iraq, and the other is on the Balkan Peninsula [3].

It also comprises several medicinal plants with recognized therapeutic applications, of which especially *S. recta* L., *S. sylvatica* L., and *S. palustris* L. are used as herbal anti-inflammatory, antirheumatic, and antibacterial drugs [4]. Plants of this genus have been used in folk medicine to treat genital tumors, sclerosis of the spleen, inflammatory tumors, and cancerous ulcers [5]. The essential oil of this species was tested for antibacterial activity [6].

S. bombycina Boiss. is one of the 84 Turkish endemic species of this genus [7]. It grows abundantly only in Antalya, Mugla, and Mersin provinces. According to our literature searches, the essential oil of *S. bombycina* has not been the subject of previous study, but the other *Stachys* spp. oils have been studied and showed vast variety in their chemical composition; e.g., the major components of the oil of *S. recta* L. and *S. balansae* L. from Turkey were reported to be oct-1-en-3-ol (33.8%), linalool (13.0%), and β-pinene (7.5%) for the first, and β-caryophyllene (24.3%), β-pinene (24.1%), and α-pinene (16.0%) for the second [8]. The oil of *S. athorecalyx* was also found to be rich in oct-1-en-3-ol (18.7%) and linalool (11.0%) [9].

In this study we describe the chemical composition of the essential oil of *S. bombycina* (Lamiaceae).

The water-distilled essential oil from the aerial parts of *S. bombycina* growing in Turkey were analyzed by means of GC and GC-MS. The resulting main components of the oil are shown in Table 1. The essential oil yield of *S. bombycina* was 1.13%. Sixty-five compounds were identified, representing 94.9% of the oil. The major components were found to be nonacosane (22.6%), *E*-9-octadecenoic acid (21.0%), hexadecanoic acid (14.4%), β-caryophyllene (5.6%), germacrene D (4.0%), caryophyllene oxide (3.9%), and phytol (2.6%).

Plant Material. The plant material of study was collected from Antalya province (Turkey) in June 2008. Voucher specimens have been deposited in the Herbarium of Balikesir University in Balikesir, Turkey (Collection No. Akcicek 5127).

Extraction of the Essential Oil. Air-dried aerial parts of the plants were hydrodistilled for 3 h using a Clevenger-type apparatus. Briefly, the plant was immersed in water and heated to boiling, after which the essential oil was evaporated together with the water vapor and finally collected in a condenser. The distillate was isolated and dried over anhydrous sodium sulfate. The oil was stored at 4°C until analysis by GC and GC/MS. The percentage yield (%) of the oil calculated on a moisture-free basis was 1.13% for *Stachys bombycina* Boiss. (Lamiaceae) (v/w).

Gas Chromatography (GC) and Gas Chromatography/Mass Spectrometry (GC/MS). The essential oils were analyzed by GC and GC/MS. GC analysis was carried out using an Agilent Technologies 6890N Network system. An HP-Innowax column (60 m × 0.25 mm i.d., 0.25 μm film thickness) was used with helium as carrier gas. The oven temperature was kept at 60°C for 10 min and increased up to 220°C at a rate of 4°C min and then kept constant at 220°C for 10 min, then increased up to 240°C at a rate of 1°C and then kept constant at 240°C for 10 min. Split flow was adjusted at 84.9 mL/min. The split ratio was adjusted to 50:1. The injector and flame ionization detection (FID) detector temperatures were 250°C.

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TABLE 1. Composition of the Essential Oil of *Stachys bombycina*

Compound	RRI	Composition, %	Compound	RRI	Composition, %
α-Pinene	1019	0.3	β-Sesquiphellandrene	1793	0.2
Hexenal	1088	0.9	*trans*-α-Bisabolene	1795	0.2
β-Pinene	1118	0.2	Isogeraniol	1818	0.2
Limonene	1236	0.1	(*E,E*)-2,4-Decadienal	1825	0.3
β-Phellandrene	1249	Tr.	*E*-β-Damascenone	1834	0.4
γ-Terpinene	1296	Tr.	*cis*-Calemenene	1844	0.1
p-Cymene	1327	0.1	Geraniol	1846	0.4
Octanal	1349	Tr.	Geraniol formate	1852	0.2
Nonanal	1463	0.3	Geraniol acetone	1855	0.3
E-2-Octenal	1500	Tr.	*E*-β-Ionone	1919	0.4
1-Octen-3-ol	1517	0.4	Caryophyllene oxide	1956	3.9
α-Copaene	1560	0.4	*E*-Nerolidol	1979	0.2
Decanal	1565	0.1	Hexahydrofarnesylacetone	2037	1.9
α-Bourbonene	1580	Tr.	Spathulenol	2042	0.2
β-Bourbonene	1586	0.5	Nonanoic acid	2062	0.7
β-Cububene	1600	Tr.	*tau*-Cadinol	2072	0.1
Linalool	1605	Tr.	Thymol	2073	0.1
Bergamol	1616	Tr.	*tau*-Muurolol	2081	0.4
Bornyl acetate	1640	Tr.	δ-Cadinol	2088	0.2
trans-α-Bergamotene	1644	Tr.	α-Cadinol	2110	0.3
β-Elemene	1649	0.2	Selina-6-en-4-ol	2124	Tr.
β-Caryophyllene	1659	5.6	Decanoic acid	2128	0.5
allo-Aromadendrene	1693	0.5	Isophytol	2134	Tr.
(*E*)-β-Farnesene	1708	0.2	Farnesyl acetone	2193	0.9
α-Humulene	1718	0.7	(*E*)-9-Octadecenoic acid	2282	21.0
γ-Muurolene	1732	0.4	Phytol	2399	2.6
α-Terpineol	1735	0.3	Benzylbenzoate	2427	0.2
D-Germacrene	1751	4.0	Tetradecanoic acid	2485	1.8
α-Muurolene	1759	0.2	9,12-Octadecadienoic acid	2497	2.2
α-Farnesene	1773	Tr.	Pentadecanoic acid	2615	1.1
E-2-Undecenal	1779	0.6	Nonacosane	2770	22.6
δ-Cadinene	1786	0.6	Hexadecanoic acid	2775	14.4
γ-Cadinene	1789	0.3	Total		**94.9**

RRI: relative retention indices; Tr.: trace (< 0.1%).

GC/MS analysis was conducted using an Agilent Technologies 5973 inert mass selective detector (Agilent G3180B two-way splitters with makeup gas) system. The same column and operational conditions as in GC were applied. The carrier gas was helium. MS were taken at 70 eV. The mass range was between *m/z* 10 and 425. A library search was carried out using the Wiley 7 n GC/MS Library, the Adams Library, and the Nist 05 Library. Relative percentage amounts of the separated compounds were calculated from FID chromatograms. *n*-Alkanes were used as reference points in the calculation of relative retention indices (RRI).

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