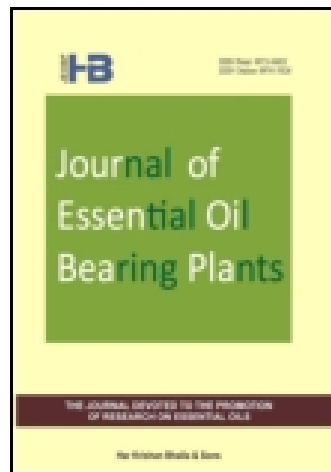


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Chemical Composition of the Essential oil of *Bougainvillea spectabilis* from Montenegro

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Abstract: The composition of the essential oil produced from the aerial parts of *Bougainvillea spectabilis* was analyzed by GC and GC-MS. Among the thirty nine compounds constituting 97.2 % of the essential oil, the main components were characterized as methyl salicylate (21.8 %), terpinolene (8.2 %) and α -(E)-ionone (9.8 %).

Key words: *Bougainvillea spectabilis*; essential oil composition; methyl salicylate; terpinolene; α -(E)-ionone.

Introduction

The genus *Bougainvillea* is a native to South America and derived its name from Louis Antione de Bougainville (1729-1811), an admiral in the French Navy who encountered the plant in Brazil in 1768 and it was introduced to the rest of the world ¹. The genus *Bougainvillea* in the Nyctaginaceae (4 O' clock) family of plants has 18 species, with three that are horticulturally important (in ornamental sense) *B. spectabilis*, *B. glabra* and *B. peruviana* ². *Bougainvillea* species are not native to Montenegro, and they are primarily used as decorative plants in gardens.

Bougainvillea species have been shown to possess alkaloids, flavonoids, cardiac glycosides, saponines ³ and beta-cyanins ⁴. Momordin IIc and two quercetin glycosides were isolated from *B. glabra* ⁵. Phytochemical investigation of leaves from *B. spectabilis* showed presence of anti-diabetic compound pinitol ⁶ and triterpenoidal saponins which possess strong antibacterial

activities ⁷. In addition, *n*-octacos-9-enoic acid ⁸ was isolated from the roots of *B. spectabilis*. The *B. spectabilis* leaves are reported to have medicinal properties, such as anti-diabetic ^{3, 6, 9}, antiviral ¹⁰, antibacterial ^{2, 7, 11}, anti-inflammatory ¹², larvicidal ¹³ and anti-fertility potential ¹⁴.

In the present study, the chemical composition of the essential oil of this plant is reported for the first time.

Experimental

Plant material

The aerial parts (leaves and branches) of *Bougainvillea spectabilis* were collected in June 2011 from natural populations in the region of Montenegro, Herceg Novi, Bay of Kotor (position: 42° 27' 26" N, 18° 33' 35" E, altitude: 150 m, exposition: SE, substratum: limestone, phytogeographical affiliation: Adriatic province of eu-Mediterranean region). The voucher specimen has been deposited at the Herbarium of

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the Department of Botany, Faculty of Biology, University of Belgrade (BEOU 16505).

Essential oil extraction

Air dried aerial parts (500 g) of *B. spectabilis* were submitted for 3 h to water-distillation using a Clevenger-type apparatus (yield 0.19 % v/w). The obtained yellowish essential oil was dried over anhydrous sodium sulphate and kept at 4°C.

GC-MS and GC analysis

Analyses were carried out in a Agilent 6890N gas chromatograph fitted with a HP-5MS fused silica column (5 % phenyl methyl polysiloxane 30 m × 0.25 mm i.d., film thickness 0.25 µm), interfaced with an Agilent mass selective detector 5975B (Agilent Technologies, USA) operated by HP Enhanced ChemStation software. For GC-MS detection an electron ionization system with ionization energy of 70 eV was used. Helium was the carrier gas, at a flow rate of 1 mL/min. Injector and transfer line temperatures were set at 250 and 280°C, respectively. Column temperature was initially kept at 60°C for 5 min, then gradually increased to 130°C at 4°C/min rate, and finally raised to 240°C at 4°C/min. Diluted sample in *n*-hexane (10 % solution) of 2.0 µL was injected in the split mode at a ratio of 1:50.

The chromatographic conditions and column for GC analyses (Agilent 6890N gas chromatograph with FID detector) were the same as for GC-MS analyses.

The identity of the components of the essential oil was assigned by comparison of their retention indices, relative to a series C₆-C₂₄ *n*-alkane indices

^{15, 16} on the HP-5MS capillary column and GC-MS spectra from the Wiley7Nist data and literature data ¹⁷ and whenever possible, by co-injection with authentic compounds (Sigma, Aldrich, Fluka).

The quantification of the components was performed on the basis of their GC peak areas on HP-5MS column.

Results and discussion

Thirty nine components, accounting for 97.2 % of the oil, were identified: two aromatic compounds (2.1 %), 4 aldehydes (0.7 %), one ketone of non-terpenic type (0.7 %), two acids (0.7 %), 11 esters (27.1 %), 7 monoterpenes (25.9 %), 5 norisoprenoides (23.5 %), 5 sesquiterpenes (10.4 %) and two diterpenes (2.5 %) (Table 1). The dominant compound was methyl salicylate (21.8 %). Within monoterpene fraction, terpinolene (8.2 %) was identified as the main compound, while α-copaene (4.9 %) and aromadendrene (4.7 %) were the most abundant sesquiterpenes. The main compounds from the group of norisoprenoides were α-(E)-ionone (9.8 %) and dihydroedulan II (5.6 %). In addition, diterpene phytol (1.6 %) was found in a relatively high concentration. In conclusion, for the first time we here presented data about chemical composition of essential oil from aerial parts from this plant species.

Acknowledgments

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Table 1. Composition of the essential oil of *Bougainvillea spectabilis*

No.	Compound	RI ^a	GC area (%)	Method of identification ^b
1	Toluene	773	0.8	MS, KI, CoI ^b
2	Methyl 2-methylbutanoate	780	0.7	MS, KI ^c
3	2-Methylpropanoic acid	785	0.5	MS, KI ^c
4	Butyl formate	787	0.9	MS, KI, CoI ^b
5	Hexanal	800	1.7	MS, KI ^c
6	Butyl acetate	812	0.3	MS, KI, CoI ^b
7	2-Furfural	830	0.2	MS, KI, CoI ^b

table 1. (continued).

No.	Compound	RI ^a	GC area (%)	Method of identification ^b
8	Ethyl (E)-crotonate	835	1.2	MS, KI ^c
9	(Z)-2-Hexenal	841	1.5	MS, KI ^c
10	o-Xylene	894	1.3	MS, KI, CoI ^b
11	Heptanal	899	1.0	MS, KI, CoI ^b
12	<i>cis</i> -Linalool oxide	1074	4.9	MS, KI ^c
13	Terpinolene	1087	8.2	MS, KI, CoI ^b
14	Linalool	1098	3.8	MS, KI, CoI ^b
15	Ethyl 3-hydroxy-hexanoate	1133	0.2	MS, KI ^c
16	Terpinen-4-ol	1177	3.5	MS, KI, CoI ^b
17	Methyl salicylate	1190	21.8	MS, KI, CoI ^b
18	<i>trans</i> -Dihydrocarvone	1200	0.5	MS, KI ^c
19	Verbenone	1204	3.0	MS, KI ^c
20	Pulegone	1237	2.1	MS, KI ^c
21	Dihydroedulan II	1285	5.6	MS, KI ^c
22	Theaspirane B	1299	3.6	MS, KI ^c
23	Dehydroionene	1348	0.5	MS, KI ^c
24	α -Copaene	1376	4.9	MS, KI, CoI ^b
25	(E)- β -Damascenone	1381	4.1	MS, KI ^c
26	α -(E)-Ionone	1426	9.8	MS, KI ^c
27	Aromadendrene	1439	4.7	MS, KI, CoI ^b
28	Cadina-1,4-diene	1532	0.2	MS, KI ^c
29	Dodecanoic acid	1580	0.2	MS, KI, CoI ^b
30	(Z)-3-Hexenyl salicylate	1670	0.6	MS, KI ^c
31	α -Santalol	1682	0.5	MS, KI ^c
32	(Z,Z)-Farnesole	1713	0.1	MS, KI, CoI ^b
33	Methyl linolenate	1893	0.2	MS, KI, CoI ^b
34	2-Heptadecanone	1900	0.7	MS, KI ^c
35	Methyl hexadecanoate	1926	0.6	MS, KI, CoI ^b
36	Ethyl hexadecanoate	1993	0.5	MS, KI ^c
37	Isophytol	1955	0.9	MS, KI ^c
38	Propyl hexadecanoate	2091	0.1	MS, KI ^c
39	Phytol	2104	1.6	MS, KI ^c

^a Retention indices (RI) calculated on non-polar HP-5MS capillary column

^b Compound identified by mass spectra (MS) comparison with Wiely7Nist library Kovats index (KI) and co-injection (CoI) with authentic compound

^c Compound identified by mass spectra (MS) comparison with Wiely7Nist library and Kovats index (KI)

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