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Chemical Constituents of the Essential Oils from Flower, Leave and Stem of the *Salvia brachycalyx* Boiss. from Iran

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The water-distilled essential oil produced from different parts of *Salvia brachycalyx* Boiss., endemic in Iran, was analyzed by GC/MS. 27 Compounds have been identified and the major components include geraniol, benzyl benzoate, spathulenol, 1,8-cineole and citral.

Key Words: *Salvia brachycalyx*, Lamiaceae, Essential oil, Geraniol, Benzyl benzoate, 1,8-Cineole.

INTRODUCTION

The genus Salvia (Lamiaceae) is comprised of about 700 herbs and shrubs, growing in the temperate and warmer zones of the world. 58 Species are found in Iran, 17 of which are endemic[1]. Some species of the genus Salvia are used as medicinal, aromatic and ornamental plants. Salvia officinalis is one of the most widespread species and is known over the world from oldest times as a spice, condiment and for its medicinal value[2-7]. Previous chemical investigations on different species of salvia, have shown the presence of flavonoids, diterpenoids and sesterterpenes[8-14]. In contrast to the oils of many salvia species that have been analyzed[15-21], the oil of *S. brachycalyx* has not been the subject of previous analyses. As a part of our research on aromatic flora of Iran, we decided to investigate the chemical composition of the oil isolated from *S. brachycalyx* by means of GC/MS in combination with retention indices.

EXPERIMENTAL

Different parts of the plant were collected from the Zagruse mountain in Lorestan state in South west of Iran in June 2005, at flowering stage. A voucher specimen has been deposited at the Herbarium of the Faculty of Pharmacy, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Dried different parts (100 g) were water distilled for 4 h using a Clevenger-type apparatus to produce an oil in (f: 0.04 %, l:0.025 %, s: 0.03 %)† w/w yield. The oil was analyzed by GC/MS using a gas chromatography analysis GC analysis of the oil was conducted using a Varian CP-3800

†f = flower, l = leave, s = stem.

instrument equipped with a DB-1 fused silica column (60 m × 0.25 mm id., film thickness 0.25 μm). Nitrogen was used as the carrier gas at the constant flow of 1.1 mL/min. The oven temperature was kept at 60°C for 1 min, then programmed to 250°C at a rate of 4°C/min, and kept constant at 250°C for 10 min. The injector and detector (FID) temperatures were kept at 250°C and 280°C, respectively. GC-MS analysis was carried out on a Thermoquest-Finnigan Trace and DB-Wax columns under the same conditions. GC-MS

TABLE-1
COMPOSITION OF THE ESSENTIAL OIL STEM, LEAF AND FLOWER OF *Salvia brachycalyx* Bioss.

Compound	RI	Area (%) (stem)	Area (%) (leaf)	Area (%) (flower)
p-Cymene	1014.0	–	0.09	0.27
1,8-Cineole	1024.0	–	0.09	0.97
Z-β-Ocimene	1049.0	–	0.13	–
Linalool	1082.0	0.42	0.81	0.95
β-Terpineol	1137.0	–	–	0.21
α-Terpineol	1160.0	–	0.12	0.43
Isoborneol	1164.0	–	0.12	–
α-Pinene epoxy	1175.0	0.09	0.20	–
trans-Carveol	1194.5	–	0.09	–
Nerol	1210.0	0.35	0.28	0.33
Citronellol	1216.0	0.45	0.36	0.49
Geraniol	1237.0	71.95	73.60	63.13
Citral	1244.0	0.83	0.46	0.80
trans-Anethole	1264.0	–	–	0.43
Geranyl formate	1280.0	0.18	0.16	0.24
n-Tridecane	1295.0	–	0.09	–
Tetradecane	1371.0	–	0.45	–
β-Elemene	1395.0	0.16	–	–
Buthyl hydroxyl toluene	1493.0	0.63	0.31	0.41
Pentadecane	1496.0	–	–	0.45
Spathulenol	1571.0	0.29	0.15	1.66
Caryophyllene oxide	1579.0	–	–	0.42
Geranyl pentanate	1584.0	–	0.10	0.46
Hexadecane	1594.0	0.23	0.10	–
Benzyl benzoate	1733.0	2.84	0.66	1.91
Palmetic acid	1943.0	0.69	–	–
Geranyl linalool	1989.0	0.18	–	0.68

RI= Retention time on a DB-1 column in minutes. KI = Kovat's retention indices as determined on as DB-1 column using the homologous series of *n*-hydrocarbons.

instrument equipped with a DB-1 fused silica column (60 m × 0.25 mm i.d., film thickness 0.25 μm). The oven temperature was raised from 60 to 250°C at a rate of 5°C/min, and then held at 250°C for 10 min; transfer line temperature was 250°C. In this case, the oven temperature was raised from 40 to 250°C at a rate of 4°C/min, then held at 250°C for 10 min with the transfer line temperature adjusted at 250°C. The flow rate of helium as carrier gas was 1.1 mL/min, split ratio was 1/50. The mass spectrometer was scanned over the 45-465 amu with an ionizing voltage of 70 eV and an ionization current of 150 μA. The constituents of the oil were identified by calculation of their retention indices under temperature-programmed conditions for identification of individual *n*-alkanes (C_6-C_{24}) and the oil on DB-1 compounds was made by comparison of their mass spectra with those of the internal reference mass spectra library (Wiley 7.0) or with authentic compounds or with those of reported in the literature[22]. Quantitative data was obtained from FID area percentages without the use of correction factors. The list of compounds identified in the oil of *S. brachycalyx* is given in Table-1.

RESULTS AND DISCUSSION

The results of the GC/MS analysis of the oil of different parts of *S. brachycalyx* (at flowering) are listed in Table-1. Among the 27 compounds identified, geraniol (s; 71.95 %, l; 73.6 %, f; 63.13 %), benzyl benzoate (s; 2.84 %, l; 0.66 %, f; 1.94 %), spathulenol (f; 1.66 %), citral (s; 0.83 %, l; 0.46 %, f; 0.8 %) and 1,8-cineol (l; 0.09 %, f; 0.97 %) were the major constituents. Thus the oil consisted mainly of oxygenated monoterpenes (s; 74.26 %, l; 76.89 %, f; 67.98 %), sesquiterpenes (s; 1.08 %, l; 0.46 %, f; 2.95 %) and diterpenes (s; 0.18 %, f; 0.68 %). Comparing these results with previous studies on Salvia species revealed that in contrast to the oil of *S. nethiopis*, *S. hypoleuca* and *S. hydrangea* (18,19), in *S. brachycalyx* oil, monoterpenes predominated over sesquiterpenes, the same as *S. multicaulis* and *S. sahendica* oil[20] .

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