Essential Oil of One of the Iranian Skullcaps

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Z. Naturforsch. **58c**, 316–318 (2003); received December 20, 2002/January 17, 2003

The hydro-distilled essential oil from dried aerial parts of one of widespread Iranian skullcaps, *Scutellaria pinnatifida* A. Hamilt. ssp. *alpina* (Bornm.) Rech. grown in Khorassan province was analyzed by GC and GC/MS. Thirty components were characterized representing 93.8% of the total components detected. The major components of the oil were germacrene-D (39.7%) and beta-caryophyllene (15.0%).

Key words: Scutellaria pinnatifida ssp. *alpina*, Essential Oil, Germacrene-D

Introduction

The skullcaps, belonging to *Scutellaria* genus, Scutellaroideae tribe, Lamiaceae family, have been distributed in some parts of the world (Evans, 1989; Rechinger, 1982; Zargari, 1990). There are about 300 known species belonging to this genus (Evans, 1989). The Iranian flora comprises more than 20 species of *Scutellaria* and one of them is *Scutellaria pinnatifida* A. Hamilt. ssp. *alpina* (Bornm.) Rech. This plant which is widespread in several regions of Iran, is growing in rich woods, thickets, bluffs, along roadsides and on the banks of rivers and lakes (Mozaffarian, 1996; Rechinger, 1982). The Persian name of the plant is "Boshghabi" that means "dish like" (Mozaffarian, 1996). Skullcaps are well known among people as powerful medicinal herbs. These plants are used in traditional and folk medicines of different parts of the world for the treatment of hypertension, arteriosclerosis, inflammatory diseases, hepatitis, allergy, cancer and diarrhea and have sedative, antioxidant, antithrombotic, cytotoxic, antispasmodic, antimicrobial and antiviral properties (Duke, 1989; Graham *et al.*, 2000; Hui *et al.*, 2002; Kim *et al.*, 2001; Stojakowska and Kisiel, 1999; Zargari, 1990). There are some reports on the phytochemical analysis of species belonging to *Scutellaria* found in the literature but only a very small number of these species have so far been studied chemically for their essential oils. Phytochemical studies on skullcaps revealed that flavonoids, essential oils, iridoids, tannins, lignins, phenolics, diterpenes and triterpenes were present in different parts of the plant (Duke, 1989; Ezer *et al.*, 1998; Hui *et al.*, 2002; Kim *et al.*, 2001; Skaltsa *et al.*, 2000; Stojakowska and Kisiel, 1999; Yaghmai, 1988; Zargari, 1990). To the best of our knowledge, there is no previous report on the chemical composition of the essential oil of *S. pinnatifida* ssp. *alpina.* Therefore the present paper deals with the detailed analysis of the oil by capillary GC and GC/MS. Aerial parts of this plant have been used in some parts of Iran as gastrointestinal remedy.

Methods and Materials

Plant material

Aerial parts of wild-growing *S. pinnatifida* ssp. *alpina* were collected during the full flowering period from an area between Bojnoord and Shoghan (Khorassan Province, Eastern North of Iran) at an altitude of ca. 2150 m in June 2002. The plant identity was confirmed by the Herbarium Department of School of Pharmacy, Mashad University of Medical Sciences, Mashad, Iran. A voucher specimen of the plant (HN-874) was deposited in this Herbarium.

Essential oil isolation

The air-dried aerial parts of the plant were powdered and the volatile fraction was isolated by hy-

0939–5075/2003/0500–0316 $ 06.00

drodistillation for 3 h (British Pharmacopoeia, 1998). The oil was dried over anhydrous sodium sulfate and stored at 4 °C.

Essential oil analysis

The oil was analyzed by GC and GC/MS. GC analysis was carried out on a Perkin-Elmer gas chromatograph model 8500, equipped with a FID detector and a BP-1 capillary column (30 m × 0.25 mm, film thickness 0.25 μm). The operating conditions were as follows: carrier gas, helium with a flow rate of 2 ml/min; column temperature, 60–275 °C at 4 °C/min; injector and detector temp, 280 °C; volume injected, 0.1 μl of the oil; split ratio, 1:50.

GC/MS analysis was performed on a Hewlett Packard 6890 mass selective detector coupled with a Hewlett Packard 6890 gas chromatograph, equipped with a cross-linked 5% PH ME siloxane HP-5MS capillary column (30 m × 0.25 mm, film thickness 0.25 μm) and operating under the same conditions as described above. The MS operating parameters were as follows: ionization potential, 70 eV; ionization current, 2 A; ion source temperature, 200 °C; resolution, 1000. Identification of components in the oil was based on GC retention indices relative to *n*-alkanes and computer matching with the WILEY 275.L library, as well as by comparison of the fragmentation patterns of the mass spectra with those reported in the literature (Adams, 1995; Mclafferty and Stauffer, 1991; Sandra and Bicchi, 1987; Swigar and Silverstein, 1981). The relative percentage of the oil constituents was calculated from the GC peak areas.

Results and Discussion

Aerial parts of *S. pinnatifida* ssp. *alpina* yielded 0.2% of a yellowish oil with a pleasant aroma. Thirty components were characterized, representing 93.8% of the total oil components detected. These are listed in Table I with their percentage composition. The major constituents of the oil were germacrene-D (39.7%), beta-caryophyllene (15.0%), delta-cadinene (5.3%) and alpha-copaene (5.0%). Other components were present in amounts less than 5%. The oil was rich in hydrocarbon sesquiterpenes. The monoterpene portion of the essential oil accounts for only 1.9%. Many of the unidentified compounds were present in trace amounts. Contrary to the earlier reports that linalool and trans-nerolidol were present in the oil of *S. albida* ssp. *albida* (Skaltsa *et al.*, 2000) and alpha-cadinene, calamenene and beta-elemene in the oil of *S. lateriflora* (Yaghmai, 1988) as major constituents, in the present study some of these compounds could not be found. Linalool and alpha-cadinene contents of this oil were 1.1% and 0.6% respectively. According to our literature surveys germacrene-D, beta-caryophyllene, delta-cadinene and alpha-copaene have been previously detected in other taxa belonging to Lamiaceae family but their predominance has not been recorded within this family. Germacrene-D, the most prominent component of the oil has been found in relatively high amounts in the essential oils of some other taxa of Lamiaceae family such as *Hyssopus*, *Teucrium*, *Acinus* and *Micromeria* (Blazevic *et al.*, 1992; Fleisher and Fleisher, 1991; Kerrola *et al.*, 1994; Velasco-Negueruela *et al.*, 1993). Beta-

Table I. Composition of the essential oil of *Scutellaria pinnatifida* ssp. *alpina.*

Compound	Percentage	Retention Index
Limonene	0.2	1027
1,8-Cineole	0.1	1030
γ-Terpinene	0.5	1058
Linalool	1.1	1096
α-Longipinene	0.8	1348
α-Copaene	5.0	1375
β-Bourbonene	0.9	1382
β-Cubebene	0.4	1389
α-Gurjunene	0.3	1406
β-Caryophyllene	15.0	1416
trans-α-Bergamotene	0.7	1434
Aromadendrene	0.9	1438
α-Humulene	0.7	1454
trans-β-Farnesene	2.0	1457
Alloaromadendrene	0.3	1462
Germacrene-D	39.7	1478
Bicyclogermacrene	4.8	1494
β-Himachalene	1.9	1501
β-Bisabolene	0.2	1511
γ-Cadinene	1.8	1516
cis-γ-Bisabolene	0.5	1518
δ-Cadinene	5.3	1527
α-Cadinene	0.6	1540
α-Calacorene	0.4	1543
Germacrene-B	0.9	1558
Spathulenol	2.0	1578
Caryophyllene oxide	2.5	1584
Viridiflorol	0.8	1594
α-Muurolol	1.3	1651
α-Cadinol	2.2	1656

caryophyllene, which was found as a second major component of the oil, has been reported in the several oils of Lamiaceae family species (Bourrel *et al.*, 1993; Duke, 1989).

Acknowledgments

We are grateful to Dr. Seyed Ahmad Emami (Department of Pharmacognosy, Faculty of Pharmacy, Mashad University of Medical Sciences, Mashad, Iran) for his help in gathering of plant material.

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