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Qualitative and quantitative analysis of the Albanian commercial *Satureja montana* essential oil

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Abstract

Saturea montana L., commonly known as winter savory or mountain savory, belongs to the Lamiaceae family, it inhabits arid, sunny, and rocky regions. *S. montana* L. is native to the Mediterranean and is frequently used as traditional medicinal herb and spice for food and teas. The chemical composition of the volatile oil of *Saturea montana* has been investigated. The essential oil was purchased as an Albanian commercial sample and its analyses were performed by capillary GC-MS with an HP-5 column and with an EI detector. Identification of the substances were made by comparison of mass spectra and retention indices with literature records [1]. *S. montana* L. is composed mainly of oxygenated monoterpenes (66.9%) and monoterpene hydrocarbons (16.5 %). Totally were identified (98.2%) of the chemical constituents and the principal were: thymol (47.0%), p-cymene (8.4%), γ-terpinene (8.0%) and carvacrol methyl ether (7.4%). Our ongoing research is also focused on the chemical analysis of hydrolates of *Saturea montana* produced from steam distillation industry in Albania and their use in cosmetic products.

Keywords: Essential oil; Saturea montana; GC-MS.

1. Introduction

Essential oils (EOs) are complex organic compounds with a wide variety of organic structures. They are volatile compounds synthesized by aromatic plants as secondary metabolites. These plants are characterized by the presence of structures specializing in the synthesis and secretion of EOs. These structures include: hairs (Lamiaceae), secretory bags (Myrtaceae) and secretory ducts (Apiaceae) [2]. EOs have shown several pharmacological properties such as antibacterial, antioxidant, antiviral, antileishmanial, anticancer, antimutagenic and anti-inflammatory properties [3,4,6,7,9,10]. Albania, like other Mediterranean countries, is rich in medicinal and aromatic plants that are mostly used in traditional medicine to fight against several diseases [11]. The various applications of essential oils account for the great interest in their study. Such applications may be found in the cosmetic industry, as ingredients of fragrances, decorative cosmetic, fine fragrances and flavouring, in the food industry, as aromas and flavours, in the pharmaceutical industry, as active components of medicines and as antibacterials/antimicrobials, and in aromatherapy. At present, there are many studies in which they are used as intermediaries in fine chemistry reactions, among other applications [16]. Lamiaceae herbs are a rich source of potentially health-beneficial antioxidant polyphenols [14]. This fact, combined with promising data on the antioxidant properties of phenolic compounds, has triggered both scientific and commercial interest towards this family of herbs. Moreover, the essential oils (EOs) of Lamiaceae herbs have indicated potential antimicrobial effects [4]. *S. montana* L., commonly known as winter savory or mountain savory, belongs to the Lamiaceae family, it inhabits arid, sunny, and rocky regions. *S. montana* L. is native to the Mediterranean and is found

throughout Europe, Russia, and Turkey [9]. It is frequently used as traditional medicinal herb [13] and spice for food and teas and has biological properties that are related to the presence of its major essential oil chemical compounds carvacrol and p-cymene [12]; thymol and carvacrol [13].

Figure 1. *S. montana*

2. Material and Methods

2.1. Sample collection

Essential oil of *S. montana* was purchased as a commercial sample from Filipi&Co.Ltd.

2.2. Gas Chromatography-Mass Spectrometry

Essential oil analyses was performed on a Shimadzu GC-2010-GCMS-QP2010 system operating at 70eV. This was equipped with a split/splitless injector (230 ºC) and a fused silica HP-5 MS capillary column (30 m x 0.25 mm i.d., film thickness 0.25 μm). The temperature program was from 50 ºC to 290 ºC, at a rate of 4 ºC/min. Helium was used as a carrier gas at a flow rate of 1.0 ml/min. Injection volume of the sample was 1.0 μl. Arithmetic indices for all compounds were determined according to Van den Dool and Kratz [15], using n-alkanes as standards. The identification of the components was based on comparison of their mass spectra with those of NIST21 and NIST107 [8], and by comparison of their retention indices with literature data [1]. Essential oil was subjected to co-chromatography with authentic compounds (Fluka, Sigma).

3. Results and Discussion

Essential oil of *S. montana* L. is composed mainly of oxygenated monoterpenes (66.9%) and monoterpene hydrocarbons (16.5 %). Totally were identified (98.2%) of the chemical constituents amounting to 56 compounds and the principal were: thymol (47.0%), p-cymene (8.4%), γ-terpinene (8.0%) and carvacrol methyl ether (7.4%). Previously, Ibraliu and colleagues have reported only the main constituents of Albanian *S. montana* from different locations south and north Albania: carvacrol (21.5-56.8%), thymol (0.7-27.3%), γ-terpinene (5.3-13.1%) and p-cymene (0.7-16.2 %) [5]. The essential oil of *S. montana* was assigned to thymol chemotype (47.0%). The results obtained by chemical analysis of wild *Satureja montana* L. EO is presented in Table 1.

Table 1. Composition of the commercial essential oils of *S. montana* (SM)

Compounds [a]	***AI*** [b]	***SM***	***ID*** [c]
α-Thujene	926	0.7	AI, MS
α-Pinene	931	0.8	AI, MS, Co-GC
Camphene	945	0.6	AI, MS

β-Pinene	973	0.2	AI, MS, Co-GC
Octen-3-ol	983	0.5	AI, MS
β-Myrcene	992	1.6	AI, MS, Co-GC
α-Phellandrene	1003	0.3	AI, MS
δ-2-Carene	1008	tr	AI, MS
δ-3-Carene	1015	1.9	AI, MS, Co-GC
p-Cymene	1024	**8.4**	AI, MS, Co-GC
Limonene	1027	0.9	AI, MS
Eucalyptol	1029	0.4	AI, MS
trans-Ocimene	1040	0.8	AI, MS
cis-Ocimene	1050	0.2	AI, MS
γ-Terpinene	1059	**8.0**	AI, MS, Co-GC
cis-Sabinenehydrate	1067	0.9	AI, MS
Terpinolene	1087	0.3	AI, MS
trans-Sabinenehydrate	1098	0.1	AI, MS
Linalool	1101	0.5	AI, MS, Co-GC
α-Thujone	1104	0.1	AI, MS
β-Thujone	1116	tr	AI, MS
cis-p-Menth-2-en-1-ol	1122	tr	AI, MS
Camphor	1143	0.3	AI, MS
Borneol	1164	2.4	AI, MS, Co-GC
δ-Terpineol	1169	tr	AI, MS
Terpinene-4-ol	1176	1.8	AI, MS, Co-GC
p-Cymen-8-ol	1187	tr	AI, MS
α-Terpineol	1191	0.4	AI, MS
Thymol methyl ether	1236	0.4	AI, MS
Carvacrol methyl ether	1244	**7.4**	AI, MS
Bornyl acetate	1286	0.2	AI, MS, Co-GC
Thymol	1294	**47.0**	AI, MS, Co-GC
Carvacrol	1304	3.7	AI, MS
Thymyl acetate	1356	0.5	AI, MS
α-Copaene	1375	0.1	AI, MS
β-Burbonene	1384	0.2	AI, MS
Geranyl acetate	1387	0.2	AI, MS
α-Gurjunene	1409	tr	AI, MS
β-Caryophyllene	1419	3.4	AI, MS, Co-GC
β-Copaene	1428	0.1	AI, MS
γ-Elemene	1434	tr	AI, MS
Aromadendrene	1438	0.8	AI, MS
Myltayl-4(12)-ene	1443	tr	AI, MS
α-Carryophyllene	1453	0.2	AI, MS, Co-GC
Allo-Aromadendrene	1460	0.1	AI, MS
Dauca-5,8-diene	1474	tr	AI, MS
γ-Muurolene	1477	0.3	AI, MS
β-Selinene	1486	tr	AI, MS
δ-Selinene	1488	tr	AI, MS
Viridiflorene	1495	0.7	AI, MS
α-Muurolene	1500	0.1	AI, MS
γ-Cadinene	1514	0.2	AI, MS
δ-Cadinene	1524	0.5	AI, MS
α-Cadinene	1538	tr	AI, MS
Spathulenol	1578	0.2	AI, MS
Carryophyllene oxide	1583	0.3	AI, MS, Co-GC
Total		**98.2**	

Monoterpene Hydrocarbons		16.5	
Oxygenated Monoterpenes		66.9	
Sesquiterpene Hydrocarbons		6.7	
Oxygenated Sesquiterpenes		0.5	

[a]Compounds listed in order of elution from an HP-5 MS capillary column; [b] AI: Arithmetic indices as determined on a HP-5 MS capillary column using a homologous series of n-alkanes (C9-C23); [c] Identification method: AI=Arithmetic Index, MS=mass spectrum, Co-GC=Coinjection with authentic compound. Concentrations below 0.05% are marked as tr (traces).

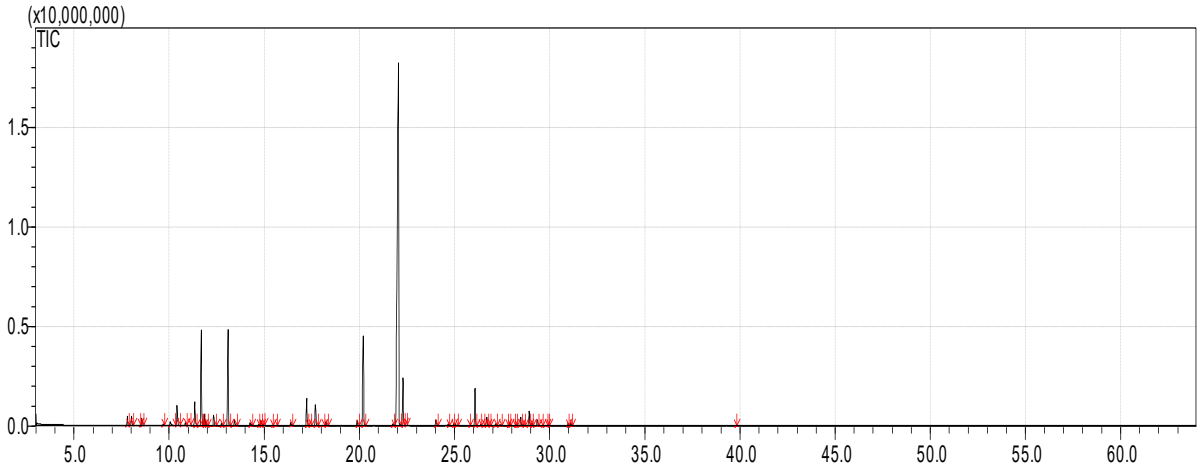

Figure 1. GC-MS chromatogram of *S. montana* EO

4. Conclusions

The essential oil of *S. montana* was chemically analyzed. The major compounds identified were thymol, p-cymene, γ-terpinene and carvacrol methyl ether. The future investigation regarding this project will be the examination of hydrolates from *S. montana* as a source of bioactive constituents with nice aroma also with beneficial effects and their uses in cosmetic industry. Work on the formulation of cosmetics products such as soaps, shampoo and creams is under way in our laboratory.

5. References

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