

## CONSTITUENT COMPOSITION OF ESSENTIAL OIL FROM *Senecio subdentatus* GROWING IN UZBEKISTAN

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The genus *Senecio* belongs to the tribe Senecioneae of the family Asteraceae (Compositae), which is the largest tribe including >1500 species of aromatic herbs and bushes that are broadly distributed over the whole world [1, 2].

Species of *Senecio* L. have been used in folk medicine to treat wounds and as antiemetic, anti-inflammatory, and vasodilating preparations [3]. Species of *Senecio* are used in traditional medicine to treat asthma, cough, bronchitis, and stomachache and as hemocathartic and vulnerary agents [1, 4].

The chemical composition and antibacterial activity of essential oils from several *Senecio* species have now been studied [1, 4–8]. The volatile constituents of *Senecio* species contain mainly mono- and sesquiterpene hydrocarbons and their *O*-containing derivatives. Extracts of *Senecio* species are known to possess antibacterial, antifungal, antituberculosis, molluscicidal, and cytotoxic activity [9].

The genus *Senecio* is represented by 23 species in the flora of Central Asia [10], 10 of which grow in Uzbekistan. *S. subdentatus* (Bunge) Ledeb. is the most common of them [11].

*S. subdentatus* is little studied with respect to chemistry. It has been noted only that the flavonoids quercetin, isorhamnetin, and their glycosides were detected in its aerial part [12]. The chemical composition of *S. subdentatus* essential oil and its antimicrobial activity have not previously been studied.

The aim of the present work was to study the chemical composition and antibacterial activity of essential oil from the aerial part of *S. subdentatus* from the flora of Uzbekistan.

The aerial part of *S. subdentatus* was collected during flowering at the start of May 2022 in the Kyzylkum desert along the Khiva-Bukhara road in Bukhara Region, Republic of Uzbekistan.

Essential oil was obtained from the finely ground aerial part of *S. subdentatus* by hydrodistillation for 3–4 h. The oil was separated from H<sub>2</sub>O using *n*-hexane, dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>, and stored at 4°C in a tightly closed vial until analysis. The *S. subdentatus* essential oil was a pale-yellow liquid with a specific aroma (0.19% yield).

The qualitative and quantitative compositions of the essential oil were determined by GC-MS on an Agilent 5975C Inert MSD/7890 GC-MS (Agilent Technologies, USA). The GC-MS analysis conditions were analogous to those previously reported [13]. Constituents were identified by comparing mass spectral characteristics with data in electronic libraries, retention indices (Ris) of compounds determined relative to the retention times (RTs) of a mixture of *n*-alkanes (C<sub>9</sub>–C<sub>34</sub>), and mass spectral fragmentations to those reported in the literature [14].

Essential oil from *S. subdentatus* contained 72 identified compounds making up 90.8% of the whole oil. Eight constituents dominated the essential oil composition (Table 1).

The main constituents of the essential oil were the acyclic natural monoterpene hydrocarbons  $\beta$ -myrcene (26.8%), *cis*- $\beta$ -ocimene (12.6%), and *trans*- $\beta$ -ocimene (5.1%); the monoterpene alcohol terpinen-4-ol (7.5%); the monocyclic monoterpene  $\alpha$ -terpinolene (3.3%);  $\alpha$ -terpineol (3.1%); and monocyclic sesquiterpenes zingiberene (2.9%) and *m*-cymene (2.1%).

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TABLE 1. Chemical Composition of Essential Oil from *S. subdentatus*

Constituent	RI	%	Reference*
<i>β</i> -Myrcene	1145	26.8	9, 15–20
<i>α</i> -Terpinene	1157	0.8	16, 18, 20
D-Limonene	1177	1.8	15, 18, 19, 21–23
<i>β</i> -Phellandrene	1186	1.1	9, 15, 17, 19, 21, 23, 24
<i>trans</i> -2-Hexanal	1195	0.1	
<i>cis</i> - <i>β</i> -Ocimene	1215	12.6	8, 9, 16–18, 21, 24–26
<i>γ</i> -Terpinene	1222	1.7	15, 16, 18–21, 23–25
<i>trans</i> - <i>β</i> -Ocimene	1229	5.1	8, 9, 15–18, 21, 24–26
<i>m</i> -Cymene	1242	2.1	
<i>α</i> -Terpinolene	1256	3.3	8, 9, 16, 17, 20, 21, 25
5-Methyl-3-hepten-2-one	1308	1.1	
Hexan-1-ol	1323	0.2	
(4 <i>E</i> ,6 <i>Z</i> )- <i>allo</i> -Ocimene	1345	0.1	
<i>cis</i> -3-Hexen-1-ol	1347	0.4	
2-Butoxyethanol	1362	0.1	
<i>trans</i> -2-Hexen-1-ol	1369	0.5	
Perylene	1382	0.1	20
4-Isopropenyltoluene	1399	0.1	
<i>cis</i> -Linalool oxide	1405	0.1	25
Furfural	1414	1.1	
1,5,7-Trimethyl-1,2,3,4-tetrahydronaphthalene	1438	0.1	
Elixene	1481	0.1	
Linalool	1514	0.5	16, 25
<i>trans</i> -2-Menthenol	1523	0.4	15
<i>β</i> -Elemene	1553	0.9	16, 18–20, 23, 24
Terpinen-4-ol	1560	7.5	9, 15–18, 20, 21, 24, 25
Terpinyl acetate	1576	0.2	
Benzeneacetaldehyde	1580	0.2	
<i>cis</i> -2-Menthenol	1584	0.6	15
2-Furanmethanol	1604	0.1	
<i>α</i> -Caryophyllene	1620	0.6	
<i>γ</i> -Selinene	1630	0.2	
<i>cis</i> - <i>β</i> -Farnesene	1634	0.4	16, 18, 24–27
<i>cis</i> - <i>p</i> -Mentha-2,8-dien-1-ol	1638	0.2	
<i>γ</i> -Muurolene	1643	0.4	15, 20, 23
<i>β</i> -Himachalene	1650	1.0	
<i>α</i> -Terpineol	1653	3.1	18, 20, 24, 25
<i>β</i> -Selinene	1668	0.5	19, 24, 25
<i>α</i> -Selinene	1675	0.2	8, 23, 25
<i>α</i> -Zingiberene	1682	2.9	
( <i>Z,E</i> )- <i>α</i> -Farnesene	1693	0.6	15, 16, 25
<i>δ</i> -Cadinene	1710	0.9	8, 9, 16, 17, 19, 23–26, 28
<i>α</i> -Farnesene	1713	0.7	15, 16, 24–26
<i>α</i> -Curcumene	1727	0.9	15
<i>β</i> -Damascenone	1763	0.9	16, 26
Carveol	1784	0.2	26, 27
<i>p</i> -Cymen-8-ol	1795	0.4	15, 18
<i>trans</i> -Geraniol	1801	0.2	16
Benzenemethanol	1811	0.1	
Benzeneethanol	1845	0.3	
<i>trans</i> -Nerolidol	1999	0.1	15, 24, 25
Caprylic acid	2004	0.3	
Spathulenol	2065	0.1	9, 15, 19, 20, 23, 25, 26
Chinosol	2071	0.1	
<i>tau</i> -Cadinol	2111	0.2	18, 25

Table 1 (continued)

Constituent	RI	%	Reference*
4-Vinylguaiaicol	2121	0.5	
<i>tau</i> -Muurolol	2128	0.2	16, 20, 23
<i>m</i> -Cumamol	2155	0.1	
$\delta$ -Cadinol	2169	0.2	
Selin-6-en-4 $\alpha$ -ol	2185	1.0	
4- <i>sec</i> -Butylphenol	2234	0.8	
1-Bisabolone	2238	0.2	15, 27
<i>n</i> -Tricosane	2300	0.3	16, 28
Dihydrobenzofuran	2314	0.1	
2,5,8-Trimethyl-1,2,3,4-tetrahydro-1-naphthalenol	2319	0.4	
Phytol	2573	0.4	15, 16, 20, 22, 25
Myristic acid	2636	0.1	
1-(6-Hydroxy-2-isopropenyl-1-benzofuran-7-yl)ethanone	2776	0.2	
Palmitic acid	2846	0.4	
Diisooctyl phthalate	3114	0.3	
Linoleic acid	3133	0.1	
Linolenic acid	3195	0.2	
Total identified		90.8	
Monoterpene hydrocarbons		53.3	
Oxygenated monoterpenes		13.5	
Sesquiterpene hydrocarbons		10.3	
Oxygenated sesquiterpenes		3.4	
Diterpenoids		0.4	
Fatty acids		1.1	
Others		8.8	

RI = retention index; \*plants of the genus *Senecio* containing these essential-oil constituents.

A comparative analysis of the data obtained by us and the literature [8, 9, 15–28] showed that essential oils from representatives of the genus *Senecio* consisted of a variety of compounds although the main constituents were monoterpene hydrocarbons.

An *in vitro* investigation of the antibacterial and antifungal properties of essential oil from the aerial part of *S. subdentatus* using a modified method of agar diffusion [29] did not reveal antimicrobial activity of this sample against microorganism strains of *Bacillus subtilis* (RKMuz-5), *Staphylococcus aureus* (ATCC 25923), *Pseudomonas aeruginosa* (ATCC 27879), *Escherichia coli* (RKMuz-221), and *Candida albicans* (RKUMz-247) [30].

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