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Chemical Composition of Essential Oil of *Senecio vernalis* Waldst. Et Kit. (Asteraceae) from Turkey

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Abstract: The chemical composition of essential oil of *Senecio vernalis* (Asteraceae) from Turkey was analyzed by GC and GC-MS system. The yield of the oil is 0.4 ml. The essential oil composition of *S.vernalis* was studied and thirty nine components representing 91.5 % of the total oil were identified. The main constituents of *S.vernalis* were β-phellandrene (12.6 %), 1,8-cineole (9.2 %), caryophyllene oxide (7.3 %), β-selinene (6.3 %) and limonene (6.2 %). The chemical distribution of essential oil compounds in the genus pattern were discussed in means of chemotaxonomy and natural products.

Key words: *Senecio*; Asteraceae; Essential oil; β-phellandrene; 1,8-cineole.

Introduction

The Asteraceae is one of the largest plant families [1]. And this family constitutes a group of plants spread widely across the world, comprising about 25,000 species. Various botanists have established their appropriate classification for the family [2-5], i.e., the subdivision of family into groups is not strictly the same for different botanists. Furthermore Asteraceae family has been studied worldwide from the botanical [1] and chemical [6] stand points. The genus *Senecio* (family Asteraceae; tribe Senecioneae) is one of the largest genera of flowering plants with over 1500 species and certainly the most widely dispersed [7]. It is represented with approximately 50 taxa in Flora of Turkey [18]. This species has scattered occurrences in the mountain range, and also grows in similar habitats in the Eastern Anatolian Region of Turkey. Many species of the genus *Senecio* have been reportedly used in South Africa as traditional remedies for colds and sore throats, coughs, burns and wounds, enemas in chest complaints, nausea and vomiting, stomach ache, hiccups, purgatives and also for anal protrusion in children, blood purifiers for skin eruptions and treatment of venereal diseases [9,10].

Essential oils obtained from plants have a number of potential uses, including food additivation, as preservative from spoilage, and pharmaceuticals, owing to their notable antimicrobial [11] and antioxidant [12] properties. Some members of Asteraceae family have traditionally been used in balsams, cosmetics, dyes, insecticides, medicines and preservatives as herbal remedy [13-15]. They have also been used as anti-helmintic for migraine, neuralgia, rheumatism and loss of appetite [16].

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Literature reports on the phytochemistry of this genus shows a large variety of pyrrolizidine alkaloids and sesquiterpenoids, diterpenoids [17], triterpenoids [18], shikimic acid and cacalolide derivatives [19,20]. Pyrrolizine alkaloids, many of which possess toxic properties, are widespread among plants of the *Senecio* genus [21].

Furthermore, biological activities such as antimicrobial and cytotoxic activities, and biosynthesis of algal pheromones have been reported for these plants [22], Also in traditional medicine, the use of *Senecio* species for bronchitis, asthma and eczema have been reported [23,24]. *Senecio* species also as an emenagogue, digestive and cough suppressant [25]. Moreover, the genus *Senecio* contains species that are highly toxic [26], while others are used in traditional medicine as antiemetic, anti-inflammatory, vasodilator and for the treatment of wounds [27]

In the context of essential oil studies in our laboratuary [28-31], we try to analyse some of genera patterns in family Asteraceae. To the best of our knowledge, this paper reports for the first time the chemical composition essential oil aerial part of *Senecio vernalis* collected from Eastern Anatolian region of Turkey.

Experimental

Plant material

Samples were collected from their natural habitats. *S. vernalis* were collected from Elazig-Keban, Turkey, on june 2010 an altidude of 1250 m. Kilic, 1600. *S. vernalis* voucher specimen kept at the Firat University Herbarium (FUH-10250) and Plant Products and Biotechnology Research Laboratory.

Isolation of volatile oil

Air-dried aerial parts of the plant samples were subjected to hydrodistillation using a Clevenger-type apparatus for 3 h.

Gas chromatographic (GC) analysis

The essential oil was analyzed using HP 6890 GC equipped with FID detector and an HP- 5 MS (30 m × 0.25 mm i.d., film tickness 0.25 μm) capillary column was used. The column and analysis conditions were the same as in GC-MS. The percentage composition of the essential oil was computed from GC-FID peak areas without correction factors.

Gas chromatography/mass spectrometry (GC-MS)

The oil was analyzed by GC-MS, using a Hewlett Packard system. HP-Agilent 5973 N GC-MS system with 6890 GC in Plant Products and Biotechnology Research Laboratory (BUBAL) in Firat University. HP-5 MS column (30 m × 0.25 mm i.d., film tickness (0.25 μm) was used with helium as the carrier gas. Injector temperature was 250°C, split flow was 1 mL/min. The GC oven temperature was kept at 70°C for 2 min. and programmed to 150°C at a rate of 10°C/min and then kept constant at 150°C for 15 min to 240°C at a rate of 5°C / min. Alkanes were used as reference points in the calculation of relative retention indices (RRI). MS were taken at 70 eV and a mass range of 35-425.

Component identification was carried out using spectrometric electronic libraries (WILEY, NIST). The identified constituents of the essential oil and the chemical class distribution of the essential oil components of *S. vernalis* is shown in (Table 1).

Results and discussion

The chemical composition of the essential oil of dried aerial parts of *S. vernalis* were analyzed by GC and GC-MS. 0.4 ml essential oil was obtained in 100 g. aerial parts of the plant material. The chemical compounds of this plant is shown in Table 1. Thirty nine components representing 91.5 % of the total oil were identified. β-phellandrene (12.6 %), 1,8 cineole (9.2 %), caryophyllene oxide (7.3 %), β-selinene (6.3 %) and limonene (6.2 %) were identified as the major components of this native plant.

β-phellandrene (12.6 %) was found one of the predominant compound in the essential oil of *S. vernalis* studied. It is reported that, this compound wasn't determined as major compound in the essential oils of *S. othonnae* Bieb., *S. racemosus* Bieb., *S. nemorensis* L. flowers from Turkey [32]; *S. squalidus* L. from southern Serbia [33] and chemical profiles of flower, leaf, stem and root oils of *S. aegyptius* var. *discoideus* Boiss. [22]. Also, β-phellandrene has not been detected as the main compound in *S. vernalis* from Iran [34] and in *S. farfarifolius* growing in Turkey [35].

It is reported that, 1,8-cineole was one of the main constituent of the essential oils of *S. vernalis* (19 %) [34], and stems (9.3 %), leaves (11.4 %) of *S. polyanthemoides* Sch. Bip. from South Africa [36], and in *S. farfarifolius* (10.3 %) [35]. However the absence of this compound in flower, leaf, stem and root oils of *S. aegyptius* var. *discoideus* [22] is noteworthy. The essential oil of *S. farfarifolius* is reported that to contain α-pinene (48.3 %) and 1,8-cineole (10.3 %) as the predominant constituents of the oil [35]. α-pinene (48.3 %) is also reported as one of the major component in its oil [35]. It is also determined as major in *S. vernalis* (4.2 %) studied. β-pinene (13 %) was reported as the main compound of flower essential oil of *S. vernalis* from Turkey [36]. But it is also found as minor compound in this essential oil studied (1.5 %). Also p-cymene (29.3 %) was reported as the main compound in the essential oil of *S. squalidus* [33]. But it is determined as minor in the *Senecio* species studied (2.5 %). While limonene (6.2 %) was a major component in *S. vernalis* [36] and in the oil of *S. polyanthemoides* (3.1 % - 43 %) [37], it was not among the major components of *S. farfarifolius* oil [35].

From the sesquiterpenes, caryophyllene oxide (7.3 %) was reported one of the major constituent of *S. vernalis* studied here, and in the essential oil of *S. othonnae* flowers [32] and in flowers (4.1 %) and leaves (13.4 %) of *S. polyanthemoides* [37]. But, it was not reported in the flower, leaf, stem and root oils of *S. aegyptius* var. *discoideus* [22]. Even though, β-*selinene* (6.3 %) detected as major component in *S. vernalis* (Table 1) and in *S. polyanthemoides* (32.7 %) essential oils [38], it is not determined in the essential oil of *S. aegyptius* var. *discoideus* [22]. Spathulenol (22.9 %) was reported as one of the major component in essential oil of *S. rowleyanus* [38], but it is also determined as minor in our studied *S. vernalis* (0.8 %). Germacrene D (12.4 %) in *S. rowleyanus* [38] and β-farnesene (21.6 %) in *S. racemosus* [32] were the main constituents in their essential oils, but they are not found in the essential oil of *S. vernalis* studied here.

Analysis of the oil shows that it was predominantly monoterpenoid in nature, like some other species in genus *Senecio*. The oil was characterized by large amount of monoterpenes (49.4 %) (Table 1) with a high amount of sesquiterpenes (33.3 %). The aerial parts of *S. vernalis* could be a good source of β-phellandrene and 1,8-cineole, considering the compositional concentration.

The volatile oils from the aerial parts of *S. nutans* Sch. Bip collected from two different localities in Peru, Southern America, showed that monoterpene hydrocarbons predominated in all the oils [39]. From these, the Arequipa location samples, has rich in sabinene and α-terpinene; whereas the Luara location samples has α-phellandrene and p-cymene in their essential oils. The leaves oil of *S. squalidus* L. from France was found to contain p-cymene (29.3 %) and α-phellandrene (24.7 %) as the major components [33]. Some of these compounds; spathulenol and α-phellandrene were also reported in the essential oils of *S. vernalis* studied, but in amounts less than one percent (Table 1). The volatile oils of *S. glaucus* subsp. *coronopifloius* from Belgium has myrcene (24 %) and dehydrofukinone (21 %) as the major components [40]. The essential oils of *S. aegyptius* var. *discoideus* Boiss from Egypt have 1,10 epoxyfuranoeremophilane as the main component of the oils [22]. It is possible to say that the differences in the quality and quantity of *Senecio* genus patterns essential oils originated from genetical, ecological, harvesting time and some other conditions.

In conclusion this paper reports the chemical composition of *S. vernalis* collected from eastern Anatolian region in Elazig from Turkey. Some research with *Senecio* species showed different type of essential oil, like α-pinene/1,8- cineole in *S. farfarifolius* [35] p-cymene/α-phellandrene in *S. squalidus* [33], spathulenol /1,8-cineole in *S.vernalis* [34]; spathulenol/germacrene B/myrcene in *S. rowleyanus* [38] and 1,10-epoxyfuranoeremophilane /mrycene in different parts of the *Senecio aegyptius* var. *discoideus* respectively [22] mentioned as above. Regarding our research with *S. vernalis*, it is possible to say that, it has β-phellandrane/1,8-cineole chemotype from Eastern Anatolian Region of Turkey.

Table 1. Chemical profiles of *Senecio vernalis* Waldst. Et Kit.

No	Compounds	RRI	Percentage(%)
1	2-Hexenal	964	0.1
2	α-Thujene	1015	0.1
3	α-Pinene	1021	4.2
4	β-Phellandrene	1052	12.6
5	β-Pinene	1056	1.5
6	β-Mrycene	1064	5.1
7	α-Phellandrene	1077	0.1
8	*p*-Cymene	1093	2.5
9	1,8-Cineole	1095	9.2
10	Limonene	1100	6.2
11	1,3,6-Octatriene	1108	0.1
12	γ-Terpinene	1119	3.2
13	Bicyclo (4,2,0) oct-1-ene	1178	0.9
14	Verbenene	1181	0.6
15	Pinocarvone	1193	0.4
16	Benzene, 1-methyl-2	1210	0.2
17	Bicyclo (3,3,1) hept-2-ene	1216	1.5
18	1,3-Nonadiyne	1220	0.2
19	Benzaldehyde	1248	0.1
20	β-Elemene	1350	2.5
21	α-Cubebene	1360	0.4
22	β-Bourbonene	1366	0.2
23	α-Humulene	1418	3.1
24	(+)-Aromadendrene	1421	0.1
25	Germacrene D	1435	3.0
26	Spathulenol	1495	0.8
27	δ-Cadinene	1458	0.3
28	β-Selinene	1485	6.3
29	Caryophyllene oxide	1498	7.3
30	Isolongifolene	1518	1.6
31	Zingiberene	1522	1.8
32	Isocaryophyllene	1528	1.5
33	Azulene	1549	3.7
34	Dehydro-aromadendrene	1558	1.8
35	α-Cadinol	1585	2.7
36	Acetyl cedrene	1596	2.4
37	Isopropyl myristate	1601	0.8
38	2-Pentodecanone	1625	0.1
39	Ethanone	1694	2.3
	Monoterpenes		49.4
	Sesquiterpenes		33.3
	Others		8.4
	Total		91.5

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