Essential oil composition from aerial parts of *Scolymus hispanicus* L.

Hüseyin Servi

Department of Pharmaceutical Botany, Faculty of Pharmacy, Altınbaş University, Istanbul, Turkey

Submitted: December 26, 2018; Accepted: January 20, 2019

**Abstract:** The volatile oil composition of *Scolymus hispanicus* L. was investigated. Essential oil of aerial parts were obtained through hydro-distillation and determined with GC-MS analyses. Fifteen compounds were determined in the oil (99.3%) of aerial part. The main compounds were heneicosane (19.4 %), hexahydrofarnesly acetone (17.0%) and phytol (17.0%). Saturated n-alkane derivatives (35.2%), oxygenated sesquiterpenes (25.6%) and diterpene (17.0%) were dominated in the oil. Also, the antibacterial activity of volatile oil was studied against *Escherichia coli* and *Staphylococcus aureus* bacteria. But the oil did not show activity against the tested microorganisms at 80-10 mg/mL concentrations. Here, it is reported for the first time on the volatile oil composition of *S. hispanicus*.

**Keywords:** *Scolymus hispanicus*; volatile oils; heneicosan; hexahydrofarnesyl acetone; phytol

**Address of Correspondence:** Hüseyin Servi - huseyin.servi@altinbas.edu.tr, ORCID: orcid.org/0000-0002-4683-855X

Tel: +90(212)7094528, Department of Pharmaceutical Botany, Faculty of Pharmacy, Altınbaş University, 34147, Bakırköy, Istanbul, Turkey

1. Introduction

*Scolymus hispanicus* L. (Golden thistle) is a member of Asteraceae family. *Scolymus hispanicus* is mainly found in Southern Europe and North Africa. There are three *Scolymus* L. species in Turkey (Davis, 1975). The plant has antisudorific and diuretic properties (Sari and Tutar, 2010). In Turkey, the root of the plant was used for kidney treatments between 1930-1990 years (Baser, 1993; Sari and Tutar, 2010; Sari et al., 2011). The plant also has been cultivated in Spain and Greece. There are a few research on the chemistry of *Scolymus hispanicus*. The methanol extract from aerial parts of *Scolymus hispanicus* was studied for the presence of phenolic compounds. The extract yielded one new flavonoid, six known flavonoids and four known phenolic acids (Sanz et al., 1993). The butanol extract from leaves of *Scolymus hispanicus* had two flavonol glycosides (Rubio et al., 1995). The flower extract of the plant included rosmarinic acid, orientin, quercetin 5-glucoside, and isorhamnetin 3-galactoside (Rubio et al., 1991). Also, nonacosane, α-amyrin, α-amyrin acetate, α-amyrin tetratriacontanoate, oleanolic acid, β-sitosterol, stigmasterol, fructose,
galactose, and mannitol were determined from the root bark of the plant (Erciys and Baysal, 1989). The methanol extract of Scolymus hispanicus was investigated for antioxidant properties by different chemical assays. The extract showed strong antioxidant properties (Çetin, 2012). Taraxasteryl acetate was isolated from the ethanolic extract of the root bark of Scolymus hispanicus. The ethanolic extract and taraxasteryl acetate showed strong antispasmodic and spasmodic activities (Kirimer et al., 1997). The aqueous-methanol extract of Scolymus hispanicus was studied on streptozotocin (STZ)-induced type 1 Diabetes Mellitus in rats as therapeutic potential. The extract remarkably improved fasting blood glucose level (Ozkol et al., 2013). The aerial part extracts (methanol and water) of Scolymus hispanicus were investigated for antiprotozoal and cytotoxic activities. Both extracts did not show any significant activity (Camacho et al., 2003). Fatty acid profiles of Scolymus hispanicus from Spain were studied. The main compounds of the plant were α-linolenic acid (30.55%), linoleic acid (26.44%) and palmitic acid (16.0%) (Morales et al., 2012). The total antioxidant capacity of 80% methanol extract of Scolymus hispanicus was studied by using CUPRAC, ABTS, FRAP and Folin assays. The extract showed a low total antioxidant capacity (Alpinar et al., 2009). Knowledge, use and ecology of Scolymus hispanicus from two localities in Central Spain were investigated. The result indicated that age and time living in the village showed differences in the knowledge and practice level (Polo et al., 2009).

There are no reports on the volatile oil composition of S. hispanicus in the literature. Here, it is reported for the first time on the volatile oil composition of S. hispanicus.

2. Materials and Methods

2.1. Plant Materials

Scolymus hispanicus was collected in İkitelli (Ziyagökalp)-Başakşehir, İstanbul, Turkey at 100 m altitudes on 27 June 2017 by Hüseyin Servi Ph.D. Identification of plant was done by Hüseyin Servi Ph.D. A herbarium specimen was kept in the Herbarium of Department of Pharmaceutical Botany, Faculty of Pharmacy, Marmara University (Herbarium no. MARE 18451).

2.2. Isolation of the Volatile Oil

The volatile oil of Scolymus hispanicus (400 g) was obtained by Clevenger apparatus (3 h) with hydrodistillation method. S. hispanicus aerial parts produced 0.04% (v/w) essential oil yields. The oil was kept with 1 mL n-hexane and hold in amber vials under -20°C till analyses day.

2.3. Gas Chromatography-Mass Spectrometry Analysis

The GC-MS analysis was employed with an Agilent 5975C Inert XL EI/CI MSD system in EI mode. Essential oil of aerial part was kept in n-hexane was injected (1 µL) in splitless mode. The temperatures of the injector and MS transfer line were adjusted at 250°C. Innowax FSC column (60 m x 0.25 mm, 0.25 µm film thickness) and helium as carrier gas (1 mL/min) were utilized in GC/MS analyses. The temperature of oven was adjusted to 60°C for 10 min. and increased to 220°C at a rate of 4°C/min. The temperature
kept stable at 220°C for 10 min. and then increased to 240°C at a rate of 1°C/min. Mass spectra were saved at 70 eV with the mass range m/z 35 to 425. The relative percentage quantities of the separated compounds were calculated from integration of the peaks in MS chromatograms. The analysis was realized in triplicate.

2.4. Identification of Essential Oil Components

The determination of volatile oil compounds was realized by comparison with their relative retention indices got by a series of n-alkanes (C5 to C30) to the literature (Baser et al., 2000; Demirci et al., 2006; Demirci et al., 2013; Dregus and Engel, 2003; Kirimer et al., 2000; Kürkcüoglu et al., 2003) and with mass spectra comparison to the in-house libraries (Wiley W9N11, NIST11).

2.5. Antibacterial Activity

Antibacterial activity of the essential oil was studied against two strains; *Staphylococcus aureus* (ATCC 25923) and *Escherichia coli* (ATCC 25922). Luria-Bertani broth was used as a growth medium for bacteria for the antibacterial tests.

In order to evaluate antibacterial activity, minimum inhibition concentration (MIC_{50}) values were detected by using the broth dilution method. Dimethylsulfoxide (DMSO) was used in the stock solution of volatile oil. The stock solutions were prepared on a 96 well plate as serial dilutions. After incubation at 37°C for 24 h, bacterial suspension concentrations were standardized to McFarland No:0.5. Volatile oil was mixed with bacterial cultures in the range of 1000-1,95 µg/mL as final concentration. It was paid attention to not exceed 1% final concentration for DMSO. After treatment, the bacteria were incubated at 37°C for 24 h. As a negative control, volatile oil-free solutions were utilized. Each test was repeated for three times. Growth analysis was done by using spectrophotometric measurements for MIC determination. Minimum inhibitory concentrations (MIC_{50}) were detected as the minimum concentration at which at least 50% of bacterial growth was missing.

3. Results and Discussion

*Scolymus hispanicus* aerial parts afforded 0.04% (v/w) amount of essential oils. Fifteen compounds were determined in the oil (99.3%) of aerial part. The main compounds were heneicosane (19.4 %), hexahydrofarnesly acetone (17.0%) and phytol (17.0%). Saturated n-alkane derivatives (35.2%), oxygenated sesquiterpenes (25.6%) and diterpene (17.0%) were dominated in the oil. Also, the antibacterial activity of volatile oil was studied against *Escherichia coli* and *Staphylococcus aureus* bacteria. The antibacterial activity of the oil evaluated with MIC values between 80-10 mg/mL. But the oil did not show activity against the tested microorganisms at 80-10 mg/mL concentrations.
Figure 1. GC-MS Chromatogram of *Scolymus hispanicus* essential oil.

Table 1. The volatile oil composition of *Scolymus hispanicus*

<table>
<thead>
<tr>
<th>RRI¹</th>
<th>RRI Lit.²</th>
<th>Compound</th>
<th>I ( genus)</th>
<th>II (%)</th>
<th>III (%)</th>
<th>Average³ (%)</th>
<th>SD⁵</th>
<th>Identification method⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>1680</td>
<td>1687</td>
<td>Estragole</td>
<td>5.6</td>
<td>5.7</td>
<td>5.3</td>
<td>5.5</td>
<td>0.2</td>
<td>RI, MS</td>
</tr>
<tr>
<td>1733</td>
<td>1737</td>
<td>β-Bisabolene</td>
<td>1.4</td>
<td>1.4</td>
<td>1.3</td>
<td>1.4</td>
<td>0.1</td>
<td>RI, MS</td>
</tr>
<tr>
<td>1861</td>
<td>1864</td>
<td><em>Trans</em>-geranyl acetone</td>
<td>3.6</td>
<td>3.5</td>
<td>3.3</td>
<td>3.5</td>
<td>0.2</td>
<td>RI, MS</td>
</tr>
<tr>
<td>1951</td>
<td>1958</td>
<td><em>Trans</em>-β-ionone</td>
<td>4.7</td>
<td>4.6</td>
<td>4.4</td>
<td>4.6</td>
<td>0.2</td>
<td>RI, MS</td>
</tr>
<tr>
<td>2044</td>
<td></td>
<td><em>Cis</em>-davanone</td>
<td>2.5</td>
<td>2.3</td>
<td>2.4</td>
<td>2.4</td>
<td>0.1</td>
<td>MS</td>
</tr>
<tr>
<td>2100</td>
<td>2100</td>
<td>Heneicosane</td>
<td>20.0</td>
<td>19.5</td>
<td>18.6</td>
<td>19.4</td>
<td>0.7</td>
<td>RI, MS, Ac</td>
</tr>
<tr>
<td>2131</td>
<td>2131</td>
<td>Hexahydro farnesyl acetone</td>
<td>16.4</td>
<td>16.6</td>
<td>18.1</td>
<td>17.0</td>
<td>0.9</td>
<td>RI, MS</td>
</tr>
<tr>
<td>2300</td>
<td>2300</td>
<td>Tricosane</td>
<td>7.7</td>
<td>7.6</td>
<td>7.4</td>
<td>7.6</td>
<td>0.2</td>
<td>RI, MS, Ac</td>
</tr>
<tr>
<td>2374</td>
<td>2380</td>
<td>α-Hexyl cinnamaldehyde</td>
<td>1.7</td>
<td>1.6</td>
<td>1.5</td>
<td>1.6</td>
<td>0.1</td>
<td>RI, MS</td>
</tr>
<tr>
<td>2380</td>
<td>2384</td>
<td>Farnesyl acetone C</td>
<td>3.3</td>
<td>3.3</td>
<td>1.2</td>
<td>2.6</td>
<td>1.2</td>
<td>RI, MS</td>
</tr>
<tr>
<td>2501</td>
<td>2500</td>
<td>Pentacosane</td>
<td>5.2</td>
<td>5.2</td>
<td>5.1</td>
<td>5.2</td>
<td>0.1</td>
<td>RI, MS, Ac</td>
</tr>
<tr>
<td>2551</td>
<td>2592</td>
<td>Diisobutyl pthalate</td>
<td>3.7</td>
<td>3.6</td>
<td>3.6</td>
<td>3.6</td>
<td>0.1</td>
<td>RI, MS</td>
</tr>
<tr>
<td>2614</td>
<td>2622</td>
<td>Phytol</td>
<td>17.3</td>
<td>17.1</td>
<td>16.5</td>
<td>17.0</td>
<td>0.4</td>
<td>RI, MS</td>
</tr>
<tr>
<td>2701</td>
<td>2700</td>
<td>Heptacosane</td>
<td>2.9</td>
<td>3.1</td>
<td>3.1</td>
<td>3.0</td>
<td>0.1</td>
<td>RI, MS, Ac</td>
</tr>
<tr>
<td>2909</td>
<td>2931</td>
<td>Hexadecanoic acid</td>
<td>4.0</td>
<td>5.0</td>
<td>6.2</td>
<td>5.1</td>
<td>1.1</td>
<td>RI, MS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oxygenated sesquiterpene</td>
<td>25.8</td>
<td>25.9</td>
<td>25.0</td>
<td>25.6</td>
<td></td>
<td>RI, MS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n-alkane derivatives</td>
<td>35.8</td>
<td>35.4</td>
<td>34.2</td>
<td>35.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diterpene</td>
<td>17.3</td>
<td>17.1</td>
<td>16.5</td>
<td>17.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fatty acid and esters</td>
<td>4.0</td>
<td>5.0</td>
<td>6.2</td>
<td>5.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monoterpenes</td>
<td>3.6</td>
<td>3.5</td>
<td>3.3</td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Others</td>
<td>13.5</td>
<td>13.2</td>
<td>12.8</td>
<td>13.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
<td><strong>100.0</strong></td>
<td><strong>98.0</strong></td>
<td><strong>99.3</strong></td>
<td><strong>1.2</strong></td>
<td></td>
</tr>
</tbody>
</table>

¹RRI: Relative retention time; ²RRI Lit.: Relative retention time in the literature; ³The analysis results; ⁴The average % area of analysis with ± standard deviation (SD); ⁵Identification method.

According to recent genetic analyses, the genus *Scolymus* is related to with some genus such as *Gundelia*, *Hymenonema*, and *Catananche* (Liveri et al., 2016). Previously, essential oils with high content of thymol (11.2%), γ-terpinene (9.8%), germacrene D (6.6%) and *p*-cymene were reported for *Gundelia tournefortii* from Iran (Dastan and Yousefzadi, 2016). And another study from Iran, palmitic acid (12.48%), lauric acid (10.59%), α-ionene (6.68%), myristic acid (4.45%), 1-hexadecanol,2-methyl (3.61%), phytol (3.6%), and
β-turmerone (3.4%) were major components of volatile oil of *Gundelia tournefortii* (Farhang et al., 2016). Additionally, essential oils of two varieties of *Gundelia tournefortii* from Turkey were studied. The main compounds were determined thymol (24.5%) in *G. tournefortii var. tournefortii* oil, germacrene D (21.6%) in *G. tournefortii var. armata* oil (Bağcı et al., 2010). The main compounds of *Scolymus hispanicus* were not detected in the oil of *Gundelia tournefortii* from Iran and Turkey (Dastan and Yousefzadi, 2016; Bağcı et al., 2010). But these main compounds were contained low amounts in the oil of *Gundelia tournefortii* from Iran and the results of the essential oil analysis of two species, some similarities observed in their compositions (Farhang et al., 2016).

**Conclusion**

The volatile oil composition of *S. hispanicus* from Turkey was studied for the first time. There is no research on the volatile oil of *Scolymus* genus, that's why it is hard to give a comment on the chemo-systematic situation of *Scolymus hispanicus* depending on the present study. The results will help further research on the chemistry of *Scolymus* genus.

**Conflict of Interests**

Author declares no conflict of interests.

**References**


