Original Article

Chemical Composition of the Essential Oil of Three Tanacetum Species from North-West of Iran

Mohammad Bagher Rezaee*, Kamkar Jaimand and Mahmood Naderi

Phytochemistry Group, Department of Medicinal Plants & By-products, Research Institute of Forest and Rangelands, P.O.Box 1318, Tehran, Iran

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Abstract

The genus Tanacetum is one of the most important medicinal plants that contains 26 species in Iran, 12 of them are endemic. This paper reports the essential oil composition of Tanacetum angulatum Willd, Tanacetum canacens DC. and Tanacetum pinnatum Boiss. growing wild in Iran. Plant flowers and leaves were collected from different locations of North-West of Iran. Samples were hydro-distilled to produce the oils in the yields (v/w) of 0.4% for leaves and 0.02% for flowers for both T. angulatum Willd and T. canacens DC., collected from Azerbaijan province (Tabriz), in of 0.05% for leaves and 0.2% for flowers T. pinnatum from Zanjan province (Zanjan) Main oil components of T. angulatum Willd. identified by GC/MS for leaves were 1,8-cineole (75.3%), camphor (8.1%) and for flowers were 1,8-cineole (66.0%), camphor (9.0%). For Tanacetum canacens, main oil components of leaves were 1,8-cineole (25.3%), α-calacorene (7.9%) and for flowers were n-eicosane (19.7%), α-calacorene (13.3%). Main oil constituents of T. pinnatum leaves were camphor (24.2%), α-calacorene (13.3%), and for flowers were germacrene B (33.0%), n-eicosane (10.5%).

Key words: Tanacetum angulatum Willd., Tanacetum canacens DC., Tanacetum pinnatum Boiss., Essential oil, Hydrodistillation, 1,8-cineole, Camphor.

Introduction

The Asteraceae is the largest plant family. The family comprises more than 1600 genera and 23000 species [1,2]. The native flora of Iran comprises about 8000 angiosperm species. The genus Tanacetum (L.), formerly Pyrethrum (Zinn.), is a large, poorly defined classification group in the Asteraceae (Compositae) containing polymorph species, many of which have applications as herbal medicines [3]. Tanacetum polycephalum is used in folk medicine to treat many disorders [4], therefore, it seem interesting to investigate its biological activity and chemical analysis. Essential oils are a complex mixture of natural compounds, mainly monoterpenes, sesquiterpenes and their oxygenated derivatives, Asteraceae is a valuable source of essential oil-containing plants and there are many reports on the volatile constituents of the oils of these plants [5-7].

These oils have been shown to possess antibacterial [8] and antioxidant activity [9].

Materials and Methods

Plant materials

Plant materials were collected from different locations of north west of Iran from Azerbaijan province (Tabriz) and Zanjan provinces (Zanjan), in Azarbijan province, T. angulatum Willd. samples collected on August 2011, from Tabriz 10 Km to Marand, Azerbaijan province, and Tanacetum canacens DC. samples from Tabriz to Ahar Ghoejebil defile, Azarbijan province, collected on August 2011, and finally T. pinnatum Boiss. were collected on October 2011, old road Zanjan to Tabriz, from Mianeh 3 km fatigue to Ghareh Chaman from Zanjan, Azerbaijan province.

All samples were hydro-distilled produced the oils in the yields of T. angulatum Willd leaf were 0.4% and
flower 0.02% (V/W) from Tabriz and Tanacetum canacens DC. leaf were 0.4% and flower 0.02% (V/W) from Tabriz and T. pinnatum Boiss. leaf were 0.05% and flower 0.2% (V/W) from Zanjan, respectively, and analyzed by GC and GC/MS. Plant materials were identified at the Research Institute of Forests and Rangelands Herbarium.

GC analysis
GC analysis was performed on a Shimadzu 15A gas chromatograph equipped with a split/splitless injector and a flame ionization detector at 250°C. N₂ was used as a carrier gas (1 mL min⁻¹) and a DB-5 type was utilized as the capillary (50 m × 0.2 mm, film thickness 0.32 μm). Temperature within the column for 3 min was retained at 60°C, after that the column was heated at a rate of 5°C min⁻¹ until it reached at 220 °C and maintained in this condition for 5 min. The percentage of relative amounts was calculated from peak area using a Shimadzu C-R4A Chromatopac without applying correction factors.

Table 1 Identification chemical composition of essential oils of Tanacetum angulatum Willd., Tanacetum canescens DC. and Tanacetum pinnatum Böiss.

<table>
<thead>
<tr>
<th>Compound</th>
<th>T. angulatum</th>
<th>T. canescens</th>
<th>T. pinnatum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tabriz Leaf</td>
<td>Tabriz Flower</td>
<td>Zanjan Leaf</td>
</tr>
<tr>
<td>2-heptanone</td>
<td>897</td>
<td>1.3</td>
<td>-</td>
</tr>
<tr>
<td>α-pinene</td>
<td>932</td>
<td>0.9</td>
<td>1.3</td>
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<tr>
<td>Camphene</td>
<td>950</td>
<td>0.8</td>
<td>0.8</td>
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<tr>
<td>3-octanone</td>
<td>985</td>
<td>-</td>
<td>-</td>
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<tr>
<td>β-myrcene</td>
<td>992</td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>α-terpinene</td>
<td>1017</td>
<td>1.0</td>
<td>1.4</td>
</tr>
<tr>
<td>1,8-cineole</td>
<td>1030</td>
<td>75.3</td>
<td>66.0</td>
</tr>
<tr>
<td>trans-linalool oxide</td>
<td>1071</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>trans-sabinene hydrate</td>
<td>1099</td>
<td>1.5</td>
<td>2.8</td>
</tr>
<tr>
<td>α-terpinene</td>
<td>1113</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Chrysanthenone</td>
<td>1130</td>
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<td>3.6</td>
</tr>
<tr>
<td>Camphor</td>
<td>1141</td>
<td>8.1</td>
<td>9.0</td>
</tr>
<tr>
<td>neo-3-thujanol</td>
<td>1154</td>
<td>1.1</td>
<td>0.8</td>
</tr>
<tr>
<td>δ-terpinol</td>
<td>1165</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>trans-chrysanthemyl acetate</td>
<td>1245</td>
<td>2.0</td>
<td>3.4</td>
</tr>
<tr>
<td>cis-ethyl chrysanthemumate</td>
<td>1271</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Bornyl acetate</td>
<td>1282</td>
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<tr>
<td>Methyl decanoate</td>
<td>1325</td>
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<tr>
<td>Neryl acetate</td>
<td>1362</td>
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<td>-</td>
</tr>
<tr>
<td>Viridiflorene</td>
<td>1496</td>
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<tr>
<td>β-sequiophellandrene</td>
<td>1522</td>
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<td>trans-calamene</td>
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<td>α-calacorene</td>
<td>1546</td>
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<tr>
<td>Germacrene B</td>
<td>1560</td>
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<td>-</td>
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<tr>
<td>n-tridecanol</td>
<td>1570</td>
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<tr>
<td>Geranyl isovalerate</td>
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<tr>
<td>Humulene epoxide II</td>
<td>1612</td>
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<td>β-cedrene epoxide</td>
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<td>γ-eudesmol</td>
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<td>α-muurolol</td>
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<tr>
<td>Dihydro-eudesmol</td>
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<td>0.4</td>
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<tr>
<td>Germacrene</td>
<td>1694</td>
<td>-</td>
<td>0.3</td>
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<tr>
<td>(Z.Z)-farnesol</td>
<td>1718</td>
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<td>-</td>
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<tr>
<td>Curcumeneol</td>
<td>1735</td>
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<td>0.6</td>
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<tr>
<td>(E.Z)-farnesol</td>
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<td>Cyclopentadecanolide</td>
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<td>n-hexadecanol</td>
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<td>n-nonadecane</td>
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<td>Methyl hexadecanoate</td>
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<td>Phytol</td>
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<tr>
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<td>1960</td>
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<tr>
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<td>-</td>
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<tr>
<td>Iso-bergaptene</td>
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<td>n-octadecanol</td>
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<td>n-heneicosane</td>
<td>2106</td>
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<tr>
<td>Grandiflorene</td>
<td>2177</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>n-tricosane</td>
<td>2288</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- 98.7 98.3 88.2 98.5 99.2 94.2
Gas Chromatography - Mass Spectrometry
The GC/MS unit consisted of a Varian Model 3400 gas chromatograph coupled to a Saturn II ion trap
detector was used. The column was same as GC, and
the GC conditions were as above. Mass spectrometer
conditions were: ionization potential 70 eV; electron
multiplier energy 2000 V.

The identity of the oil components was established
from their GC retention indices, relative to C_{17}-C_{25} n-
alkanes, by comparison of their MS spectra with those
reported in the literature [10-12], and by computer
matching with the Wiley 5 mass spectra library,
whenever possible, by co-injection with standards
available in the laboratories.

Results and Discussion

The yield of essential oil obtained by hydro-
distillation from flower and leaves of the dried plant
in full flowering stage is between 0.02 up to 0.4%.
The composition of the essential oil of three
tanacetum species was listed in Table 1. For T. angulatum Willd. Azerbaijan province (Tabriz), were
hydro-distilled to produce the oils yields in leaf were
0.4% and flower 0.02% (V/W), from leaf sixteen
compounds were identified main compounds were
1,8-cineole (75.3%), camphor (8.1%) and in flowers
twenty three compounds were identified main compounds were
1,8-cineole (66.0%), camphor (9.0%), and seconds samples T. canacens DC. from
Azerbaijan province (Tabriz), were to produce the
oils yields in leaf were 0.4% and flower 0.02%
(V/W), from leaf twenty eight compounds were
identified main compounds were camphor (25.3%),
α-calacorene (7.9%) and in flowers twenty four compounds were identified main compounds were n-
eicosane (19.7%), α-calacorene (13.3%), and the last samples T. pinnatum Boiss. from Zanjan province
(Zanjan), with yield in leaf were 0.05% and flower
0.2% (V/W), from leaf twenty seven compounds were
identified main compounds were camphor (24.2%), α-calacorene (13.3%), and for flower twenty eight compounds were identified majoro compounds
were germacrene B (33%), n-eicosane (10.5%).

With Comparing of our study two samples T. angulatum Willd. and T. canacens DC. from
Azerbaijan provonce (Tabriz), identified for first time
but for last samples T. pinnatum Boiss. from Zanjan
proveince (Zanjan), we have refrences from Esmaeili
and Amiri, 2011, the samples of T. pinnatum Boiss.
were collected during the flowering stage from
Khoramabad, Province of Lorestan, Iran, in June
2008, have a paper on “the in vitro antioxidant and antibacterial activities of T. pinnatum Boiss. grown in
Iran” identification of 25 compounds, representing
98.7% of the oil content. The main components in the
oils were camphor (23.2%), α-pinene (8.5%),
camphene (7.7%), 1,8-cineole (7.3%), β-eudesmol (5.8%) and caryophyllene oxide (5.6%). The possible
antioxidant and antibacterial activity of the samples
was studied using the DPPH and the β-carotene-
linoeic acid assays and the disc agar diffusion test,
respectively. In general, the nonpolar extract of T. pinnatum Boiss. exhibited the greatest antioxidant
activity in the DPPH test system. The essential oil
displayed the highest antioxidant activity in the β-
carotene-linoeic acid assay; it showed the best
antibacterial activity against Staphylococcus aureus
[13]. Comparing the results of different studies on
essential oil composition of T. pinnatum Boiss.
reveals that their constituents are variable according
to their habitat that may be regarded to different
chemotyps.

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composition of a new T. argyrophyllum (C. Koch)


