Comparison of Essential Oil Yield and Components in Two Parts of Garden Thyme Shoot

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ABSTRACT

Garden thyme (Thymus vulgaris L.), member of Lamiaceae family, is one of the important medicinal plant species. The green part of thyme plant constitutes the most popular herbal medicine and spice, used in all developing countries. The study was conducted using the two years old thyme plants. Above section of shoots were divided in two 10 cm parts (top and bottom). Hydrodistillation was used to isolate the essential oils and chemical analyses were performed by GC and GC-MS with four replications. The yield of essential oils extracted from top and bottom parts of shoots were 0.87% and 0.75% respectively. Thirty three components were identified. The major components of essential oils in top part were thymol (73.54%), carvacrol (4.03%), \( \beta \)-cymene (3.32%), terpinolene (3.13%), \( \beta \)-caryophyllene (2.79%), \( \gamma \)-terpinene (2.22%), and linalool (1.45%). Similarly the major components of essential oils in bottom part were thymol (60.77%), \( \beta \)-cymene (12.22%), \( \gamma \)-terpinene (4.25%), carvacrol (3.70%), terpinolene (3.13%), linalool (2.44%) and \( \beta \)-caryophyllene (2.24%).

Key words: Thymus vulgaris, thymol, carvacrol, \( \beta \)-cymene, GC-MS.

Introduction

Thyme (Thymus vulgaris L.) belongs to the Lamiaceae family and is an aromatic and medicinal plant of increasing economic importance. Thyme volatile phenolic oil has been reported to be among the top 10 essential oils, showing numerous effects [17,22]. The green part of thyme plant constitutes the most popular herbal medicine and spice, used in all developing countries. The beneficial effects of thyme are well known from ancient times and consumption of its extract is recommended all over the world [1]. It is used as water extracts for its pharmacological activities and thus, have a very important role in phytotherapy [36]. Recently, thyme has become one of the most important medicinal plants used as a natural additive in poultry and livestock feeding studies [6,14]. Such studies have shown that thyme plant could be considered as an alternative natural growth promoter for poultry instead of antibiotics [23]. Essential oil content of thyme have been reported from 0.32% [30] to 4.9% [8]. Thymol and carvacrol, which are the principal constituents of thyme oil [3,13] have been reported to act as antioxidant [10,19,21], antimicrobial agent [9,33], antifungal agent [20] treatment for respiratory tract diseases [16], wound healing, a stomachic carminative, diuretic, urinary disinfectant and vermifuge [7]. The composition and quantity of essential oil from a particular species of thyme plant could be markedly affected by harvesting season [3], geographical and environmental conditions and other agronomical factors [18,25,34,39]. A wide range of medicinal plant parts is used for extract as raw drugs and they possess varied medicinal properties [35]. Sharafzadeh et al. showed different oil yield and components in leaf and stem of garden thyme and lemon balm [37,38]. The objective of this study was to determine oil yield and constituents in two different parts of thyme shoot.

Materials and Methods

Plant Material and Experimental Conditions:

The study was conducted using the two years old thyme plants collected from experimental field of Islamic Azad University, Estahban Branch, Iran.

(29°63' N, 54°14' E; 1760 m above sea level). Plants were harvested at full bloom stage. Above section of shoots were divided in two 10 cm parts (top and bottom) and were dried at room temperature.

Essential Oil Extraction:

Isolation of essential oils was performed using hydrodistillation of 50 g sample of dried shoots using a Clevenger-type apparatus over 3 hours. The oils were dried over sodium sulphate and the yield of the essential oils (w/w) was calculated.

Gas Chromatography (GC):

Gas Chromatography analysis was performed on an Agilent technologist model (7890A) equipped with flame ionization detector and capillary column HP-5 (30 m × 0.32 mm, 0.25 μm film thicknesses). The chromatographic conditions were as follows: The oven temperature increased from 60 to 210°C at a rate of 3ºC/min then 210 to 240 ºC at a rate of 20ºC/min. The injector and detector temperatures were 280 and 290ºC, respectively. N₂ used as the carrier gas (1 ml/min).

Gas Chromatography-Mass spectrometry (GC-MS):

Essential oil was also analysed by Hewlett-Packard GC-MS (model 6890 series II) operating at 70e V ionization energy. Equipped with a HP-5 capillary column (phenyl methyl siloxane (30 m × 0.25 mm, 0.25 μm film thickness) with He as the carrier gas and a split ratio of 1:50. The retention indices for all the components were determined according to the Van Den Doll method using n-alkanes as standard. The compounds were identified by comparison of retention indices (RRI- AP-5) with those reported in the literature and by comparison of their mass spectra with the Wiley and mass finder 3 libraries or with the published mass spectra.

Results and Discussion

The yield of essential oils extracted from top and bottom parts of shoots were 0.87% and 0.75% respectively. The flowers of thyme produce in the top of shoots and flowers have high amounts of oil. Thirty three components were identified by qualitative analysis of essential oils which representing 96.98% of the oil of top part and 97.44% of the oil of bottom part (Table 1). Thymol was the major component of both top and bottom part. Thymol was higher (73.54%) in top part when compared to bottom part (60.77%). On the other hand, p-cymene and γ-terpinene had higher values (12.22% and 4.25% respectively) in bottom part. Several reports have shown that γ-terpinene converts to p-cymene then thymol synthesizes during hydroxylation of p-cymene [24,26]. This can explain why p-cymene and γ-terpinene had low amounts in oil extracted from top parts.

Researchers have revealed that major volatile constituents obtained from the aerial parts of the plant are geranial, linalool, carvacrol, thymol and trans-thujan-4-ol/terpinen-4-ol [2,27,28,29,31,32]. The percentage and composition of essential oil could be markedly affected by the geographical environment, places that plants is grown, physical and chemical characteristics of soil, seed source, plant age, parts of plant that which is used for oil isolation and oil isolation method.

Ozguven and Tansi [30] indicated that different ecological conditions and harvesting time affect the yield and components of thyme oil. In samples of thyme were collected during the flowering period in eastern Morocco (Taforalt) in May, essential oil yield was 1.0% and camphor (38.54%), camphene (17.19%), α-pinene (9.35%), 1,8-cineole (5.44%), borneol (4.91%) and β-pinene (3.90%) were the major oil components [15]. However, characteristic compounds of T.vulgaris essential oil are thymol (44.4 – 58.1 %), p-cymene (9.1-28.5%), γ-terpinene (6.9 – 18.9%) and carvacrol (2.4-4.2%) [4,5,11,12].

Table 1: Amounts of the chemical components of thyme oil in top and bottom parts of shoot.

<table>
<thead>
<tr>
<th>No</th>
<th>Component name</th>
<th>RI</th>
<th>% in oil of top part</th>
<th>% in oil of bottom part</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>α-Thujene</td>
<td>928</td>
<td>0.24 ±0.05</td>
<td>0.32 ±0.04</td>
</tr>
<tr>
<td>2</td>
<td>α-Pinene</td>
<td>934</td>
<td>0.16 ±0.11</td>
<td>0.40 ±0.04</td>
</tr>
<tr>
<td>3</td>
<td>Camphene</td>
<td>950</td>
<td>0.11 ±0.07</td>
<td>0.41 ±0.04</td>
</tr>
<tr>
<td>4</td>
<td>Sabine</td>
<td>973</td>
<td>t</td>
<td>0.13 ±0.01</td>
</tr>
<tr>
<td>5</td>
<td>1-Octen-3-ol</td>
<td>976</td>
<td>0.59 ±0.01</td>
<td>0.76 ±0.01</td>
</tr>
<tr>
<td>6</td>
<td>β-Pinene</td>
<td>978</td>
<td>0.39 ±0.05</td>
<td>0.71 ±0.03</td>
</tr>
<tr>
<td>7</td>
<td>Myrcene</td>
<td>990</td>
<td>t</td>
<td>0.12 ±0.00</td>
</tr>
<tr>
<td>8</td>
<td>α-Pheillandrene</td>
<td>1002</td>
<td>t</td>
<td>1.14 ±0.04</td>
</tr>
<tr>
<td>9</td>
<td>α-Terpinene</td>
<td>1015</td>
<td>0.44 ±0.05</td>
<td>0.64 ±0.03</td>
</tr>
<tr>
<td>10</td>
<td>P-Cymene</td>
<td>1024</td>
<td>3.32 ±1.93</td>
<td>12.22 ±0.32</td>
</tr>
<tr>
<td>11</td>
<td>1,8-Cineole</td>
<td>1033</td>
<td>0.44 ±0.01</td>
<td>0.79 ±0.01</td>
</tr>
<tr>
<td>12</td>
<td>γ-Terpinene</td>
<td>1057</td>
<td>2.22 ±1.47</td>
<td>4.25 ±0.12</td>
</tr>
<tr>
<td>13</td>
<td>(E)-Sabine hydrate</td>
<td>1061</td>
<td>1.14 ±0.04</td>
<td>1.06 ±0.02</td>
</tr>
<tr>
<td>14</td>
<td>Terpinolene</td>
<td>1087</td>
<td>3.13 ±0.10</td>
<td>3.13 ±0.02</td>
</tr>
<tr>
<td>15</td>
<td>Linalool</td>
<td>1098</td>
<td>1.45 ±0.04</td>
<td>2.44 ±0.03</td>
</tr>
<tr>
<td>16</td>
<td>Camphor</td>
<td>1143</td>
<td>0.55 ±0.00</td>
<td>0.51 ±0.01</td>
</tr>
<tr>
<td>17</td>
<td>Borneol</td>
<td>1161</td>
<td>0.18 ±0.05</td>
<td>0.22 ±0.01</td>
</tr>
</tbody>
</table>
All data are means of four replications ± SD

References