The content of essential oil in ten sweet basil (Ocimum basilicum L.) cultivars and its composition

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Summary

The experiment was conducted in the Research Institute of Medicinal Plants in Poznań, Poland in 2005–2006 and concerned a collection of ten sweet basil cultivars such as: ‘Minette’, ‘Mittelgrossblättriges Grünes’, Piccolino’, ‘Rubin’, ‘Red Rubin’, ‘Genoveser’, ‘Martina’ and two Polish cultivars: ‘Wala’ and ‘Kasia’. Moreover, ‘Lemonette’ cultivar of Ocimum americanum L. was also included in the collection. The content of essential oil in the dried herb was estimated and its composition was analyzed. The content of essential oil in the dried herb without stems ranged from 0.23% ('Red Rubin') to 1.67% ('Kasia'). The main component of the oils that came from nine basil cultivars was linalool, (from 37.07% for ‘Piccolino’ to 76.22% for ‘Minette’). Considerable amounts of 1,8-cineol and eugenol, next β-pinene, α-terpinene and myrcene were also found. The content of 16 identified components in oil represented from 69.34% ('Piccolino') to 96.11% ('Wala') of the GC profiles. Both Polish cultivars were distinguished by high content of geraniol in essential oil.

Key words: sweet basil, essential oil, linaool, geraniol, 1,8-cineol, eugenol

INTRODUCTION

Sweet basil (Ocimum basilicum L.) is one of the 30 species belonging to Ocimum genus which performed a great variability of morphology and essential oil composition [1]. Basil herb (Herba basilicae) is used primarily as a spice, but also in aromatherapy, cosmetics as well as phytotherapy [1-3]. Basil herb shows significant differences in essential oil content and its composition, which depends on genotype, stage of development or environmental conditions. [2-5]. The aim
of this study was to compare chemical profiles of sweet basil cultivars commonly cultivated in Europe.

**MATERIAL AND METHODS**

The experiment was conducted in the Research Institute of Medicinal Plants in Poznań, Poland in 2005–2006, and concerned a collection of ten sweet basil cultivars. The following cultivars were analyzed: ‘Minette’, ‘Mittelgrossblättriges Grünes’, Piccolino’, ‘Rubin’, ‘Red Rubin’, ‘Genoveser’, ‘Martina’ and two Polish cultivars: ‘Wala’ and ‘Kasia’. The collection also included cultivar ‘Lemonette’ of *Ocimum americanum* L. The seeds used in the experiment came from commercial seed companies Juliwa Enza GmbH and M. Lewandowski as well as our own breeding.

In both years of the experiment the basil plantlets obtained in greenhouse were transplanted into the field. The experiments were performed in a randomized complete block design in three repetitions. Each plot measured 10 m$^2$. The herb was collected from each plot at the beginning of the blooming period from the area of 1.0 m$^2$. The herbs were dried in natural conditions in a shaded and well-ventilated place. The content of essential oil in all the samples of the dried herb was estimated and its composition analyzed.

**Oil isolation**

The essential oil was hydro-distillated from the herb without stems in the Dering’s apparatus following methods recommended by Polish Pharmacopoeia VI [6].

**GC data**

The hexane solution of the oil was analyzed with gas chromatography using Perkin Elmer Clarus 500 system. Chromatographic column (Elite–FFAP 30 m x) was used in a starting temperature of 60°C (2 min.), increased by 5°C/min. to 200°C, then kept constant for 15 min. The flow rate of carrier gas (helium) was set at 0.35 mL/min. Split-splitless injector had a split ratio of 1:20 mode at 240°C. The volume of each injected sample was 1 μL. The FID detector was operating at 250°C. The components of the tested solution: linalool (Fluka), geraniol (Dragoco), 1,8-cineole (Fluka), eugenol (Fluka), methylchavicol (Fluka), α-pinene (Fluka), β-pinene (Fluka), myrcene (Fluka), α-terpinene (Fluka), nerol (ROTH), geranyl acetate (ROTH), limonene (Fluka), sabinene (Fluka), carvacrol (Fluka), were located using retention time from the reference chromatogram solutions. The components were quantified according to the normalization procedure.
RESULTS AND DISCUSSION

The content of essential oil in the dried herb without stems ranged from 0.23% ('Red Rubin') to 1.67% ('Kasia') (tab. 1). Other high-essential-oil cultivars were 'Piccolino' and 'Minette' (1.53%), as well as 'Wala' (1.27%). The data published by Marotti et al. [3] showed a low essential oil content (0.3–0.8%) in dried herb of the 10 tested cultivars. The content of essential oil found in the herbs of Polish cultivars was higher than in those characterized by Seidler-Łożykowska [7]. Dachler and Pelzmann [1] indicated that the content of essential oil in sweet basil herb ranged from 0.5% to 1.5%.

<table>
<thead>
<tr>
<th>content of essential oil and its components [%]</th>
<th>Genovese</th>
<th>Martina</th>
<th>Piccolino</th>
<th>Rubin</th>
<th>Minette</th>
<th>Red Rubin</th>
<th>Lemonette</th>
<th>Gross-blättriges Grüner</th>
<th>Kasia</th>
<th>Wala</th>
</tr>
</thead>
<tbody>
<tr>
<td>essential oil</td>
<td>0.61</td>
<td>0.48</td>
<td>1.53</td>
<td>0.35</td>
<td>1.53</td>
<td>0.23</td>
<td>0.59</td>
<td>0.38</td>
<td>1.67</td>
<td>1.27</td>
</tr>
<tr>
<td>linalool</td>
<td>43.96</td>
<td>52.47</td>
<td>37.07</td>
<td>57.24</td>
<td>76.22</td>
<td>60.66</td>
<td>14.27</td>
<td>52.96</td>
<td>61.35</td>
<td>75.24</td>
</tr>
<tr>
<td>geraniol</td>
<td>0.11</td>
<td>0.11</td>
<td>0.06</td>
<td>0.47</td>
<td>0.14</td>
<td>0.24</td>
<td>0.75</td>
<td>0.21</td>
<td>12.79</td>
<td>9.83</td>
</tr>
<tr>
<td>1,8-cineole</td>
<td>15.35</td>
<td>16.21</td>
<td>15.11</td>
<td>13.15</td>
<td>-</td>
<td>13.54</td>
<td>-</td>
<td>12.90</td>
<td>7.08</td>
<td>5.80</td>
</tr>
<tr>
<td>eugenol</td>
<td>3.90</td>
<td>2.54</td>
<td>8.23</td>
<td>3.90</td>
<td>1.09</td>
<td>3.13</td>
<td>0.08</td>
<td>5.55</td>
<td>3.43</td>
<td>2.45</td>
</tr>
<tr>
<td>methylchavicol</td>
<td>-</td>
<td>0.59</td>
<td>0.47</td>
<td>0.40</td>
<td>0.31</td>
<td>0.17</td>
<td>0.68</td>
<td>0.37</td>
<td>0.35</td>
<td>0.28</td>
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<tr>
<td>β-pinene</td>
<td>1.68</td>
<td>1.90</td>
<td>1.56</td>
<td>1.49</td>
<td>0.20</td>
<td>1.55</td>
<td>0.34</td>
<td>1.40</td>
<td>0.45</td>
<td>0.52</td>
</tr>
<tr>
<td>myrcene</td>
<td>1.38</td>
<td>1.35</td>
<td>0.41</td>
<td>1.24</td>
<td>0.13</td>
<td>1.32</td>
<td>-</td>
<td>0.97</td>
<td>0.35</td>
<td>0.32</td>
</tr>
<tr>
<td>α-terpinene</td>
<td>1.54</td>
<td>1.43</td>
<td>1.62</td>
<td>1.18</td>
<td>0.42</td>
<td>1.47</td>
<td>1.33</td>
<td>1.34</td>
<td>0.71</td>
<td>0.60</td>
</tr>
<tr>
<td>nerol</td>
<td>0.03</td>
<td>-</td>
<td>0.02</td>
<td>-</td>
<td>0.03</td>
<td>2.91</td>
<td>-</td>
<td>0.19</td>
<td>0.12</td>
<td>-</td>
</tr>
<tr>
<td>geranyl acetate</td>
<td>0.03</td>
<td>-</td>
<td>0.18</td>
<td>-</td>
<td>-</td>
<td>0.64</td>
<td>-</td>
<td>0.86</td>
<td>0.53</td>
<td>-</td>
</tr>
<tr>
<td>α-pinene</td>
<td>0.88</td>
<td>0.97</td>
<td>0.89</td>
<td>0.81</td>
<td>0.41</td>
<td>0.73</td>
<td>0.26</td>
<td>0.69</td>
<td>0.23</td>
<td>0.23</td>
</tr>
<tr>
<td>limonene</td>
<td>0.51</td>
<td>0.49</td>
<td>0.55</td>
<td>0.56</td>
<td>1.77</td>
<td>0.43</td>
<td>1.33</td>
<td>0.36</td>
<td>0.31</td>
<td>0.14</td>
</tr>
<tr>
<td>sabinene</td>
<td>0.15</td>
<td>0.14</td>
<td>0.11</td>
<td>0.13</td>
<td>0.13</td>
<td>0.08</td>
<td>1.33</td>
<td>0.12</td>
<td>0.06</td>
<td>0.05</td>
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<tr>
<td>carvacrol</td>
<td>0.04</td>
<td>0.65</td>
<td>0.18</td>
<td>0.46</td>
<td>0.12</td>
<td>0.31</td>
<td>0.03</td>
<td>0.04</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>camphene</td>
<td>0.17</td>
<td>0.13</td>
<td>0.29</td>
<td>-</td>
<td>0.15</td>
<td>-</td>
<td>0.08</td>
<td>0.04</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>camphor</td>
<td>1.23</td>
<td>-</td>
<td>2.65</td>
<td>0.13</td>
<td>0.45</td>
<td>0.45</td>
<td>0.10</td>
<td>0.70</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>total</td>
<td>70.94</td>
<td>78.38</td>
<td>69.34</td>
<td>81.42</td>
<td>81.64</td>
<td>83.80</td>
<td>23.89</td>
<td>77.41</td>
<td>88.94</td>
<td>96.11</td>
</tr>
</tbody>
</table>

The main component of the oils derived from nine basil cultivars was linalool, ranging from 37.07% ('Piccolino') to 76.22% ('Minette'). Both Polish cultivars of the herb contained a lot of linalool, but the essential oil of 'Wala' cultivar contained more linalool than the oil of 'Kasia' cultivar. Considerable amounts of 1,8-cineol and eugenol, next β-pinene (0.20–1.90%), α-terpinene (0.42–1.62%) and myrcene (0.13–1.38%) were also found. The content of 1,8-cineol ranged from 5.80% ('Wala') to 16.21% ('Martina') and eugenol content was from 1.09% ('Minette') to 8.23% ('Piccolino'). The oils obtained from Polish cultivars were richer in geraniol (from 9.83% for 'Wala' and 12.79% for 'Kasia') as compared to other tested cultivars. Mo-
reover, the oil of ‘Kasia’ cultivar contained more geraniol, 1,8-cineol and eugenol than the oil of ‘Wala’ cultivar.

Other minor components of the oil were methylchavicol, nerol, geranyl acetate, α-pinene, limonene, sabinene, carvacrol, camphene and camphor. The content of 16 identified components of oil represented from 69.34% (‘Piccolino’) to 96.11% (‘Wala’) of the GC profiles.

The main compound of the essential oil from ‘Lemonette’ cultivar was linalool (14.27%), nerol (2.91%) and other minor compounds which made up only 23.89% of the GC profile. The ‘Lemonette’ cultivar belongs to a species *Ocimum americanum*, whose main component of essential oil is methyl cinnamate [8].

Pessala et al. [9] reported that the composition of essential oil varied and the highest content of linalool (78.5%) was found in the oil of Hungarian cultivar ‘Keskenylevelu’. Marotti et al. [3] reported that 40 compounds of 10 basil cultivars oil were identified and represented 98% of the GC profile. Considering the main compounds, 10 cultivars were characterized by high content of linalool (41.2–76.2%), 1,8-cineol (0.9–12.3%) and cadinol (2–8%). Eugenol content was from traces to 2.2%. The content of geraniol was not analyzed. Authors also characterized three different groups by the composition of oil (chemotypes): “linalool”, “linalool and methylchavicol” and “linalool and eugenol”.

Grayer et al. [2] examined six varieties from 16 accessions and distinguished five major chemotypes based on the essential oil profiles: “linalool”, “methylchavicol”, “linalool and methylchavicol”, “linalool and eugenol” and “methylchavicol and methyl eugenol”. Considering these characterizations, both Polish cultivars represent “linalool and eugenol” type.

Vernin and Metzger [5] presented basil classification based on predominant compound of essential oil and geographical origin:
1. European chemotype (Italy, France, Bulgaria) - contains linalool and methylchavicol
2. Eastern chemotype (Thailand, Madagascar, Vietnam) – contains methylchavicol
3. Tropical chemotype (India, Guatemala, Pakistan) – contains methyl cinnamate

According to the classification it can be stated that the tested cultivars belong to European chemotype, although their oil contained very low (or did not contain at all) amount of methylchavicol.

Putievsky et al. [4] reported that in the essential oil of 14 basil collection objects linalool content was very high (2–60%) and all the oils contained methylchavicol and eugenol. The authors emphasized that the same basil forms of different origins had different composition of their oil. The analysis of the oil composition of F₁ and F₂ progenies showed that all the investigated objects were heterogenic, regarding the composition of essential oil.
Özcan and Chalchat [10] obtained 49 components which were identified and accounted to 88.1% of the oil GC profile of sweet basil herb collected in Turkey. The main compounds of this oil were methyl eugenol (78.02%), α-cubebene (6.17%) and nerol (0.83%).

CONCLUSIONS

1. The main compound of nine sweet basil cultivars oils was linalool.
2. All the investigated cultivars (with an exception of 'Lemonette') belong to "linalool and eugenol" chemotype.
3. Both Polish cultivars were distinguished by high content of geraniol in essential oil.

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S t r e s z c z e n i e

W latach 2005–2006 w Instytucie Roślin i Przetworów ZIELARSKICH badano kolekcję składającą się z 10 odmian bazylii pospolitej: 'Minette', 'Mittelgrossblättriges Grünes', Piccolino', 'Rubin', 'Red Rubin', 'Genoveser', 'Martina', 'Wala', 'Kasia' oraz odmiany 'Lemonette' należącej do gatunku Ocimum americanum. W suchym, otartym zielu oznaczano zawartość olejku eterycznego oraz jego skład. Zawartość olejku wynosiła od 0,23% ('Red Rubin') do 1,6% ('Kasia'). Głównym składnikiem olejków pochodzących z 9 odmian był linalol (od 37,07% w 'Piccolino' do 76,22% w 'Minette'). Inne składniki olejku o znacznym udziale to 1,8-cineol, eugenol, β-pinene, α-terpinen oraz mircen. Obie polskie odmiany 'Wala' i 'Kasia' wyróżniały się wysoką zawartością geraniolu w olejku.

Słowa kluczowe: bazylia pospolita, olejek eteryczny, linalol, geraniol, 1,8-cineol, eugenol