Note

Volatile Flavor Components of SINOMENI CAULIS ET RHIZOMA (Sinomenium acutum Rehder et Wilson)†

Mitsuo Miyazawa and Hiromu Kameoka

Department of Applied Chemistry, Faculty of Science and Engineering, Kinki University, Kowakae, Higashiosaka-shi, Osaka 577, Japan

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SINOMENI CAULIS ET RHIZOMA (Boui in Japanese) is the root of Sinomenium acutum Rehder et Wilson, and has been traditionally used in Chinese medicine for treating gout, palsy and dropsy. Sinomenine was isolated by Chu et al.1] as an anodyne, and in previous reports, di-syringeresinol,2) acutumine,3) acutumidine,3) N-acetylsinomenine,4) N-0-diacetylmichelabine5) and isosinomenine6) have been reported. Boui has a slightly sweet note, and a slightly mild, sour and minty-wine-like odor, as well as a medicinal one. However, no study of the essential oils and odor has yet been reported. In this study, therefore, the volatile constituents of Boui were investigated.

A gas chromatogram of the volatile oil is presented in Fig. 1. In order to identify the volatile components, GC, GC-MS and 1H-NMR analyses were conducted in detail. Sixty-eight components were identified in the volatile oil as shown in Table I. They include 3 pyrazines and pyrimidones, 6 methylesters of fatty acids, 1 ether, 1 lactate, 7 aldehydes, 5 ketones, 1 lactone, 13 acids, 17 hydrocarbons, 13 alcohols and phenols. Many of them were further confirmed by GC analyses of authentic samples and by our previous work.6~13) None of the compounds identified in this study have previously been reported as the components of Boui. Among them, salicyl aldehyde was recognized as the main component from the GLC peak area, and palmitic acid was recognized as a 10.2% peak area, having a pungent sour odor. The contents of the methyl esters and fatty acid in the volatile oil were about 11.4 and 48.3%, respectively (Table II). The noteworthy feature of this volatile oil was the presence of trimethylpyrazine (peak No. 12), tetramethylpyrazine (No. 18), 2-ethyl 6-methyl-4-pyrimidone (No. 23), paeonol (No. 62), ambrettidlactone (No. 73), amyl lactate (No. 41), and monoterpen ketones (Nos. 29, 32 and 59). These pyrazines and pyrimidone have a pungent sweet odor. Paeonol has a warm aromatic and botanpi-like odor, while ambrettidlactone has a floral-musky and sweet odor. Amyl lactate has a mild wine-like odor, and monoterpen ketones have a sharp-minty and spicy odor. A mixture of these compounds in ethanol showed a characteristic note (sharp minty, pungent sweet, warm aromatic, musky-wine-like odor) as a volatile oil, and a similar odor to that of Boui (Fig. 2).

Experimental

1H-NMR, GC-MS and GC were recorded in the same way as that described in the previous paper.6~13)

Plant material and volatile oil

Material. Commercially available air-dried root (SINOMENI CAULIS ET RHIZOMA) of Sinomenium acutum Rehder et Wilson (Takasago Yakugiyo Co., Ltd., Osaka) was used, having the Japanese name Boui.

Essential oil from Boui. The Boui (500 g) was macerated
Table I. COMPOSITION OF THE VOLATILE OIL FROM Boui

<table>
<thead>
<tr>
<th>Peak No.*</th>
<th>Compound</th>
<th>Identification**</th>
<th>Peak No.*</th>
<th>Compound</th>
<th>Identification**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ethyl acetate</td>
<td>0.2 % o C(^{14})</td>
<td>39</td>
<td>Octanoic acid</td>
<td>6.1 % o C(^{13})</td>
</tr>
<tr>
<td>2</td>
<td>Ethanol</td>
<td>0.1 % o C(^{14})</td>
<td>40</td>
<td>Unknown</td>
<td>0.1 % o C(^{13})</td>
</tr>
<tr>
<td>3</td>
<td>Benzene</td>
<td>0.1 % o C(^{14})</td>
<td>41</td>
<td>Amyl lactate</td>
<td>tr. o C(^{14})</td>
</tr>
<tr>
<td>4</td>
<td>Toluene</td>
<td>tr. o C(^{14})</td>
<td>42</td>
<td>Benzyl alcohol</td>
<td>tr. o C(^{13})</td>
</tr>
<tr>
<td>5</td>
<td>Hexanal</td>
<td>tr. o C(^{14})</td>
<td>43</td>
<td>2-Methyl naphthalene</td>
<td>tr. o C(^{14})</td>
</tr>
<tr>
<td>6</td>
<td>Butanol</td>
<td>5.5 % o C(^{14})</td>
<td>44</td>
<td>Phenethyl alcohol</td>
<td>0.3 % o C(^{11})</td>
</tr>
<tr>
<td>7</td>
<td>Pentanol</td>
<td>tr. o C(^{14})</td>
<td>45</td>
<td>Nonadecane</td>
<td>tr. o C(^{13})</td>
</tr>
<tr>
<td>8</td>
<td>Propionic acid</td>
<td>5.0 % o C(^{14})</td>
<td>46</td>
<td>Pelargonic acid</td>
<td>5.6 % C(^{13})</td>
</tr>
<tr>
<td>9</td>
<td>Tridecane</td>
<td>tr. o C(^{14})</td>
<td>47</td>
<td>1,2-Dimethyl naphthalene</td>
<td>tr. o C(^{13})</td>
</tr>
<tr>
<td>10</td>
<td>4-Ethyl cyclohexanone</td>
<td>tr. o C(^{14})</td>
<td>48</td>
<td>Unknown</td>
<td>0.2 % o C(^{13})</td>
</tr>
<tr>
<td>11</td>
<td>Hexanol</td>
<td>0.4 % o C(^{14})</td>
<td>49</td>
<td>Phenol</td>
<td>0.1 % o C(^{13})</td>
</tr>
<tr>
<td>12</td>
<td>Trimethyl pyrazine</td>
<td>tr. o C(^{14})</td>
<td>50</td>
<td>1,3-Dimethyl naphthalene</td>
<td>0.2 % o C(^{14})</td>
</tr>
<tr>
<td>13</td>
<td>Tetradecane</td>
<td>tr. o C(^{14})</td>
<td>51</td>
<td>Unknown</td>
<td>0.2 % o C(^{13})</td>
</tr>
<tr>
<td>14</td>
<td>Heptanol</td>
<td>tr. o C(^{14})</td>
<td>52</td>
<td>Eicosane</td>
<td>0.3 % o C(^{13})</td>
</tr>
<tr>
<td>15</td>
<td>Butanoic acid</td>
<td>0.1 % o C(^{14})</td>
<td>53</td>
<td>Decanoic acid</td>
<td>3.7 % o C(^{11})</td>
</tr>
<tr>
<td>16</td>
<td>Furfural</td>
<td>0.2 % o C(^{14})</td>
<td>54</td>
<td>Cinnamic aldehyde</td>
<td>tr. o C(^{14})</td>
</tr>
<tr>
<td>17</td>
<td>Decanal</td>
<td>tr. o C(^{14})</td>
<td>55</td>
<td>Elemol</td>
<td>0.3 % C(^{13})</td>
</tr>
<tr>
<td>18</td>
<td>Tetramethyl pyrazine</td>
<td>0.5 % o C(^{14})</td>
<td>56</td>
<td>Unknown</td>
<td>0.1 % o C(^{13})</td>
</tr>
<tr>
<td>19</td>
<td>Benzaldehyde</td>
<td>0.1 % o C(^{14})</td>
<td>57</td>
<td>Undecanoic acid</td>
<td>6.7 % o C(^{11})</td>
</tr>
<tr>
<td>20</td>
<td>Pentadecane</td>
<td>tr. o C(^{11})</td>
<td>58</td>
<td>Heinecosane</td>
<td>tr. o C(^{14})</td>
</tr>
<tr>
<td>21</td>
<td>Unknown</td>
<td>0.1 % o C(^{11})</td>
<td>59</td>
<td>Piperitenone</td>
<td>3.5 % o C(^{14})</td>
</tr>
<tr>
<td>22</td>
<td>Linalool</td>
<td>0.1 % o C(^{11})</td>
<td>60</td>
<td>(\beta)-Eudesmol</td>
<td>2.3 % o C(^{13})</td>
</tr>
<tr>
<td>23</td>
<td>2-Ethyl-6-methyl-4-pyrimidone</td>
<td>0.2 % o C(^{14})</td>
<td>61</td>
<td>Methyl palmitate</td>
<td>6.5 % o C(^{14})</td>
</tr>
<tr>
<td>24</td>
<td>5-Methyl-2-furfural</td>
<td>0.1 % o C(^{14})</td>
<td>62</td>
<td>Paeonol</td>
<td>6.9 % o C(^{14})</td>
</tr>
<tr>
<td>25</td>
<td>Propyl methyl furan</td>
<td>0.1 % o C(^{14})</td>
<td>63</td>
<td>Lauric acid</td>
<td>0.6 % o C(^{10})</td>
</tr>
<tr>
<td>26</td>
<td>Unknown</td>
<td>0.3 % o C(^{14})</td>
<td>64</td>
<td>Docosane</td>
<td>tr. o C(^{14})</td>
</tr>
<tr>
<td>27</td>
<td>m-Xylene</td>
<td>tr. o C(^{14})</td>
<td>65</td>
<td>Hexadecahydroxyrene</td>
<td>0.4 % o C(^{14})</td>
</tr>
<tr>
<td>28</td>
<td>Menthol</td>
<td>3.7 % o C(^{14})</td>
<td>66</td>
<td>Methyl stearate</td>
<td>tr. o C(^{13})</td>
</tr>
<tr>
<td>29</td>
<td>Pulegone</td>
<td>0.2 % o C(^{14})</td>
<td>67</td>
<td>4-Methyl tolane</td>
<td>tr. o C(^{14})</td>
</tr>
<tr>
<td>30</td>
<td>Hexanoic acid</td>
<td>2.5 % o C(^{10})</td>
<td>68</td>
<td>Methyl oleate</td>
<td>0.2 % o C(^{14})</td>
</tr>
<tr>
<td>31</td>
<td>Salicyl aldehyde</td>
<td>11.2 % o C(^{14})</td>
<td>69</td>
<td>Tridecanoic acid</td>
<td>2.2 % o C(^{10})</td>
</tr>
<tr>
<td>32</td>
<td>Verbenone</td>
<td>0.7 % o C(^{14})</td>
<td>70</td>
<td>Methyl linoleate</td>
<td>4.1 % o C(^{14})</td>
</tr>
<tr>
<td>33</td>
<td>M.T.A. M(^+) = 154</td>
<td>0.1 % o C(^{14})</td>
<td>71</td>
<td>Methyl linolelaidate</td>
<td>0.1 % o C(^{14})</td>
</tr>
<tr>
<td>34</td>
<td>Heptanoic acid</td>
<td>2.1 % o C(^{14})</td>
<td>72</td>
<td>Methyl linolenate</td>
<td>0.3 % o C(^{14})</td>
</tr>
<tr>
<td>35</td>
<td>S.T.H. M(^+) = 204</td>
<td>tr. o C(^{14})</td>
<td>73</td>
<td>Ambretiolide</td>
<td>0.4 % o C(^{14})</td>
</tr>
<tr>
<td>36</td>
<td>3-Curcumene</td>
<td>0.1 % o C(^{14})</td>
<td>74</td>
<td>Myristic acid</td>
<td>2.8 o C(^{10})</td>
</tr>
<tr>
<td>37</td>
<td>Octadecane</td>
<td>tr. o C(^{14})</td>
<td>75</td>
<td>Pentadecanoic acid</td>
<td>0.7 % o C(^{10})</td>
</tr>
<tr>
<td>38</td>
<td>Damasenone</td>
<td>0.9 % o C(^{14})</td>
<td>76</td>
<td>S.T.A. M(^+) = 220</td>
<td>0.1 % o C(^{10})</td>
</tr>
</tbody>
</table>
| 39        | and placed in a 10-l glass vessel together with 31 of distilled water. Steam distillation was carried out under atmospheric pressure, and the distillate was collected by cooling with a freezing mixture. After 4 hr of distillation, the distillate was extracted with diethyl ether. The extracted solution was then concentrated at low temperature (about 38 °C) to obtain the whole volatile oil (0.15 g, 0.03%). The properties of the volatile oil were \(d_4^20\) 0.9714 and \([\alpha]_D^{20} + 46\). The components were identified by \(^1H\)-NMR, MS and retention time (\(t_R\)) on GLC as compared with those of authentic samples, and from samples isolated from plants according to our previous papers.\(^5\)\(^\sim\)\(^13\)
Volatile Flavor Components of Boui 1715

Fig. 2. Structure and Characteristic Note of the Main Volatiles from Boui.

Table II. Components of the Volatile Oil

<table>
<thead>
<tr>
<th>Compound</th>
<th>Peak area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aliphatic</td>
<td>78.6</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>1.8</td>
</tr>
<tr>
<td>(Monoterpenoid)</td>
<td>—</td>
</tr>
<tr>
<td>(Sesquiterpenoid)</td>
<td>1.0</td>
</tr>
<tr>
<td>Alcohols</td>
<td>12.7</td>
</tr>
<tr>
<td>(Monoterpenoid)</td>
<td>3.9</td>
</tr>
<tr>
<td>(Sesquiterpenoid)</td>
<td>2.7</td>
</tr>
<tr>
<td>Aldehydes &amp; ketones</td>
<td>4.4</td>
</tr>
<tr>
<td>(Monoterpenoid)</td>
<td>4.4</td>
</tr>
<tr>
<td>(Sesquiterpenoid)</td>
<td>—</td>
</tr>
<tr>
<td>Acids</td>
<td>48.3</td>
</tr>
<tr>
<td>Esters</td>
<td>11.4</td>
</tr>
<tr>
<td>Aromatic</td>
<td>19.8</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>0.4</td>
</tr>
<tr>
<td>Phenolic</td>
<td>7.0</td>
</tr>
<tr>
<td>Heterocyclic</td>
<td>1.0</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>11.4</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Acknowledgment. The authors are grateful to Mr. K. Mori (Takasago Yakugiyo Co., Ltd.) for providing the materials and collecting the root of Sinomenium acutum Rehder et Wilson (SINOMENI CAULIS ET RHIZOMA).

References