Chemical composition of the essential oil from the aerial parts of *Boltonia asteroides* from North Alabama

Sims K Lawson, Layla G Sharp, Prabodh Satyal and William N Setzer

Abstract

The aerial parts of *Boltonia asteroides*, growing wild in north Alabama, have been collected, the essential oil obtained by hydrodistillation, and the essential oil analyzed by gas chromatography – mass spectrometry. The major components of *B. asteroides* were germacrene D (47.4%), dehydrolachnophyllum ester A (15.4%), and β-pinene (7.3%).

Keywords: False aster, false chamomile, Asteraceae, germacrene D, dehydrolachnophyllum ester

1. Introduction

*Boltonia asteroides* (L.) L’Hér. (false aster or false chamomile, Asteraceae, tribe Astereae) is a rhizotomaceous perennial herb native to eastern North America, and is found from the Dakotas south through Louisiana, Mississippi, and Alabama [1]. The plant has small (ca. 2 cm) daisy-like flowers with white ray florets with yellow disk florets (Figure 1) [2, 3]. A phytochemical study by Díaz and co-workers from plants collected from South Carolina revealed the aerial parts to contain several menthane and acyclic monoterpenoids, cadinane sesquiterpenoids, and acetylenic lactones [4]. As part of our continuing investigations on the essential oils of north Alabama Asteraceae [5–7] we have collected and analyzed the essential oil from the aerial parts of *B. asteroides*. To our knowledge, the essential oil from this plant has not been previously examined.

![Fig 1: Boltonia asteroides (L.) L’Her. Photograph by S.K. Lawson.](image)

2. Materials and Methods

2.1 Plant Material

The aerial parts of *B. asteroides* were collected on 12 August 2018 from the Flint River Greenway in north Alabama (34°38ʹ40ʺN, 86°27ʹ22ʺW, elev. 180 m). The plant was identified by S.K. Lawson; a voucher specimen (20180812-110757) has been deposited in the University of Alabama in Huntsville herbarium. The fresh plant material (49.09 g) was hydrodistilled using a Likens-Nickerson apparatus, with continuous extraction with CH₂Cl₂, for 3 h to give a pale-yellow essential oil (1.0 mg).

2.2 Gas Chromatographic – Mass Spectral Analysis

The essential oil of *B. asteroides* was analyzed by GC-MS, as described previously [8,9], using a Shimadzu GC-MS-QP2010 Ultra fitted with a Phenomenex ZB-5ms column. Identification of the essential oil components was determined by comparison of their retention indices and
their mass spectral fragmentation patterns with those in the literature\textsuperscript{10} or in our in-house library.

3. Results and Discussion
The essential oil from hydrodistillation of the aerial parts of \textit{B. asteroides} was obtained in very low yield (0.002\%). The chemical composition of \textit{B. asteroides} essential oil is compiled in Table 1. The essential oil was dominated by sesquiterpene hydrocarbons, including germacrine D (47.4\%), the diacetylene (\textit{Z,E})-matricaria ester (15.4\%), and the monoterpane β-pinene (7.3\%). The presence of the diacylenic compounds (\textit{Z})-lachnophyllum ester and (\textit{Z,E})-matricaria ester is consistent with the acetylenic compounds matricaria lactone, 8-decen-6-yn-4-olide, and 9-hydroxy-7-decen-5-yn-4-olide, that were previously characterized by Díaz and co-workers\textsuperscript{4}. Diacetylenes have been found in several species of the Asteraceae, particularly in the tribes Anthemideae, Astereae, and Lactuceae\textsuperscript{11}. The C\textsubscript{10} diacetylenes lachnophyllum ester and matricaria ester have been reported in the genera \textit{Conyz\textit{a}}\textsuperscript{12}, \textit{Erigeron}\textsuperscript{13}, and \textit{Matricaria}\textsuperscript{14}. Additionally, germacrene D has been found to dominate the leaf essential oils of several species of Asteraceae\textsuperscript{5,7,15–17}. In spite of the common name of \textit{B. asteroides}, false chamomile, the essential oil chemistry of \textit{B. asteroides} is very different from chamomile, \textit{Matricaria chamomilla}\textsuperscript{18}. On the other hand, there are species of \textit{Aster} that are rich in germacrene D, including \textit{A. novae-angliae}\textsuperscript{5}, \textit{A. spathulifolius}\textsuperscript{19}, and \textit{A. albanicus}\textsuperscript{20}.

<table>
<thead>
<tr>
<th>RI</th>
<th>Compound</th>
<th>%</th>
<th>RI</th>
<th>Compound</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>795</td>
<td>2-Methylhept-2-ene</td>
<td>0.2</td>
<td>1494</td>
<td>Bicyclogermacre</td>
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<tr>
<td>802</td>
<td>Hexanal</td>
<td>0.9</td>
<td>1502</td>
<td>(\textit{E,E})-α-Farnesene</td>
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<tr>
<td>851</td>
<td>(2E)-Hexenal</td>
<td>2.6</td>
<td>1514</td>
<td>(\textit{Z})-Lachnophyllum ester</td>
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<tr>
<td>932</td>
<td>α-Pinene</td>
<td>1.0</td>
<td>1517</td>
<td>δ-Cadinene</td>
<td>0.9</td>
</tr>
<tr>
<td>977</td>
<td>β-Pinene</td>
<td>7.3</td>
<td>1524</td>
<td>(\textit{Z,E})-Matricaria ester</td>
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<tr>
<td>988</td>
<td>Myrcene</td>
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<td>1559</td>
<td>(\textit{E})-Nerolidol</td>
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<td>1024</td>
<td>p-Cymene</td>
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<td>1580</td>
<td>Caryophyllolide</td>
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<tr>
<td>1028</td>
<td>Limonene</td>
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<td>1654</td>
<td>α-Cadinol</td>
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</tr>
<tr>
<td>1112</td>
<td>(\textit{E})-4,8-Dimethylhinalona-1,3,7-triene</td>
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<td>Green leaf volatiles</td>
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<td>1388</td>
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<td>1417</td>
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<td>1418</td>
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<tr>
<td>1429</td>
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<td>1431</td>
<td>trans-α-Bergamotene</td>
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<td>Others</td>
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<td>α-Humulene</td>
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<tr>
<td>1480</td>
<td>Germacrene D</td>
<td>47.4</td>
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</table>

4. Conclusions
This is the first report of the essential oil composition from \textit{Boltonia asteroides}, and, as far as we are aware, the first report of an essential oil from any \textit{Boltonia} species. The essential oil of \textit{B. asteroides} was rich in sesquiterpene hydrocarbons and C\textsubscript{10}diacetylenes, but the essential oil yield was very poor.

5. Acknowledgments
This work was carried out as part of the activities of the Aromatic Plant Research Center (APRC, https://aromaticplant.org/).

6. Conflicts of Interest
The authors declare no conflicts of interest.

7. References


