Comparison of Hop Derived Humulone Constituents in Beer Using UV-Vis, HPLC, and LC-MS

Aaron I. Boland  
*University of Missouri-St. Louis, aibkcc@mail.umsl.edu*

Nicholas Viriyasiri

Lorna Espinosa

Hunter Campbell

Kurt Driesner

Follow this and additional works at: [https://irl.umsl.edu/urs](https://irl.umsl.edu/urs)

Part of the Chemistry Commons

Recommended Citation

Boland, Aaron I.; Viriyasiri, Nicholas; Espinosa, Lorna; Campbell, Hunter; and Driesner, Kurt, "Comparison of Hop Derived Humulone Constituents in Beer Using UV-Vis, HPLC, and LC-MS" (2019). *Undergraduate Research Symposium*. 22.  
[https://irl.umsl.edu/urs/22](https://irl.umsl.edu/urs/22)

This Poster is brought to you for free and open access by the UMSL Undergraduate Works at IRL @ UMSL. It has been accepted for inclusion in Undergraduate Research Symposium by an authorized administrator of IRL @ UMSL. For more information, please contact marvinh@umsl.edu.
Introduction

Humulones, or α-acids (AA), are significant components of the hop cones or strobile representing between 2-20% of the dried weight. During beer brewing, AA are extracted from the hops added during boiling and converted to the isomeric isohumulones, or α-isoaids (IAA). These IAA contribute to beer bitterness and provide a balance to the malt flavors from the grains. Beer bitterness is often described as IBU (International Bitterness Units) which is based on the UV absorption IAA at 275nm. Historically this approach worked well for traditional lagers and lightly hopped beers. However, with the advent of late hopping and dry hop routines, modern craft beers often contain significant amounts of AA and oxidized derivatives which also absorb in the UV region. As a result, the measurement of IBU by UV absorption can be significantly obscured by these additional, hop derived components. In this experiment, the use of UV spectroscopy, HPLC and selected ion LCMS methods are compared from profiling the concentrations of hop derived constituents and determining contributions to beer bitterness.

Methods

Beer samples were obtained from CHEM 1021: Beer Brewing – Chemical & Biochemical Principles. Beers were analyzed by the industry standard method, ‘Beer 23’, for determination of IBU by UV spectroscopy. Extracts obtained by this method were analyzed by HPLC and LCMS. For comparison, beer samples were also analyzed chromatographically by direct injection.

Results

Results (cont’d.)

Spectroscopic Determination of Bitterness

<table>
<thead>
<tr>
<th>Beer</th>
<th>Calc IBU</th>
<th>IBU (UV)</th>
<th>IAA ppm (HPLC)</th>
<th>AA ppm (HPLC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imperial IPA</td>
<td>56</td>
<td>120</td>
<td>15</td>
<td>24</td>
</tr>
<tr>
<td>English Brown</td>
<td>31</td>
<td>30</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Blonde Ale</td>
<td>15</td>
<td>20</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Weibacher</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>St. Louis Lager</td>
<td>17</td>
<td>7</td>
<td>8</td>
<td>0</td>
</tr>
</tbody>
</table>

* Value obtained online: [https://untappd.com/b/anheuser-busch/5000-variants](https://untappd.com/b/anheuser-busch/5000-variants)

Comparison of CHEM 1021 Beer Samples

Discussion and Conclusions

- The ‘Beer-23’ UV spectroscopic method for measurement of IBU is limited in scope to traditional lager beer styles.
- Hop additions late in the boil or post-boil result in significant deviation from IBU or concentration of IAA as determined by HPLC, extracted ion LCMS or sensory profiling.
- Knowing possible interferences is important to brewers from a reproducibility perspective and also in the growing marketplace demand for product transparency.

References:


American Society of Brewing Chemists. Methods of Analysis, 14th ed. Beer-23 Beer bitterness; American Society of Brewing Chemists, Saint Paul, MN.