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

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

Nicholas Viriyasiri  
*University of Missouri-St. Louis, nvp7c@mail.umsl.edu*

Hunter Campbell  
*University of Missouri-St. Louis, hcc4d@mail.umsl.edu*

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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-isocids (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 Bittering Units) which is based on the UV absorption of AA 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

Spectroscopic Determination of Bitterness

Comparison of IBU and PPM

HPLC – Famous St. Louis Lager

HPLC – Imperial IPA

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 IAAs 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.