Analyse quantitative.
HPLC determination of α- and β-acids in hops

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(Extraits)

Abstract

The weight percents of six α- and β-acids found in common brewing hops were determined in three varieties of hops using HPLC analysis. The results confirmed data included by the hops supplier regarding the percent weight of hops present in each type. Data analysis indicated that multiple extractions should be used in order to increase extraction efficiency of α-acids.

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Introduction

The many characteristics of a beer are caused by variations in the brewing process and the ingredients used. All beers consist of grain, hops, yeast, and water at a minimum. The grain is often barley but is also commonly rice or wheat. The grain provides the sugar maltose and sweetness of the beer. The yeast turns the maltose into ethanol and carbon dioxide. The bitterness and aroma of the beer is provided by the hops, the female flower of the hop plant.
The chemical source of hops' bitterness are the α- and β-acids. The α-acids consist of humolone, cohumulone, and adhumulone. The β-acids consist of lupulone, colupulone, and adlupulone. α-acids undergo isomerization during the brewing process to produce the very bitter iso-α-acids, which are the primary chemical source of a beer's bitterness. α-acids are significantly less bitter than the β-acids and are generally considered to impart undesirable characteristics to the beer.
Considering the significant impact α- and β-acids have on the flavor of beer, it is important for brewers to be able to accurately measure their concentration in order to maintain standards for a known brand or to create a new brew with desired characteristics.
The average α- and β-acid weight percent varies among the varieties of hops but is typically between 3 and 15% with β-acid concentration between 2 and 8%.3 The concentrations of the α- and β-acids can be determined by a HPLC separation followed by UV-Vis detection. In this experiment the α- and β-acid concentration in the Chinook, Challenger, and Bullion varieties of hops using HPLC and international calibration extract III (ICE-III) for calibration are determined.

Results and discussion

Figures 1-4 show a standard chromatogram and the chromatograms for each of the samples. The peaks at ~2.8, 3.7, 4.9, and 6.3 matched the cohumulone, humulone/adhumulone, colupulone, and lupulone/adlupulone from Baker et. al. The samples show all four of these peaks as well as two peaks that elute in under 2 minutes.

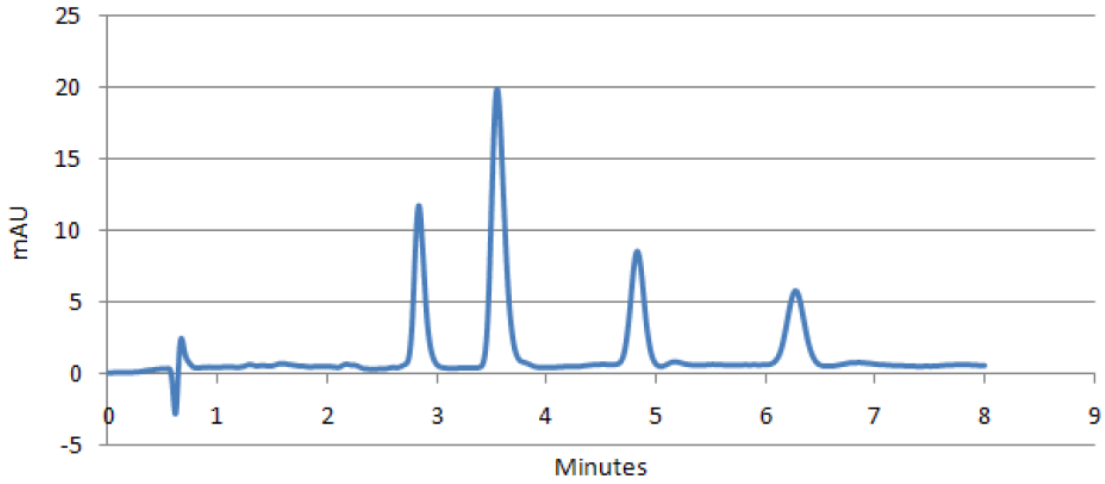

Figure 1. Standard 1 chromatogram showing the cohumulone peak at 2.8, the humulone/adhumulone peak at 3.7, the colupulone peak at 4.9, and the lupulone/adlupulone peak at 6.3.

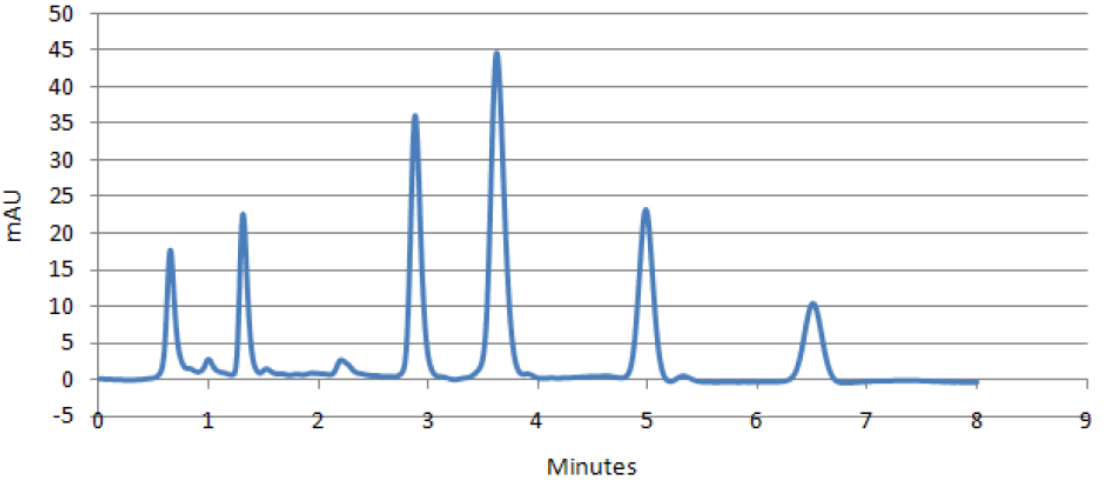

Fig. 2. Bullion chromatogram showing the same peaks as standard 1 with two unidentified peaks before 2 minutes.

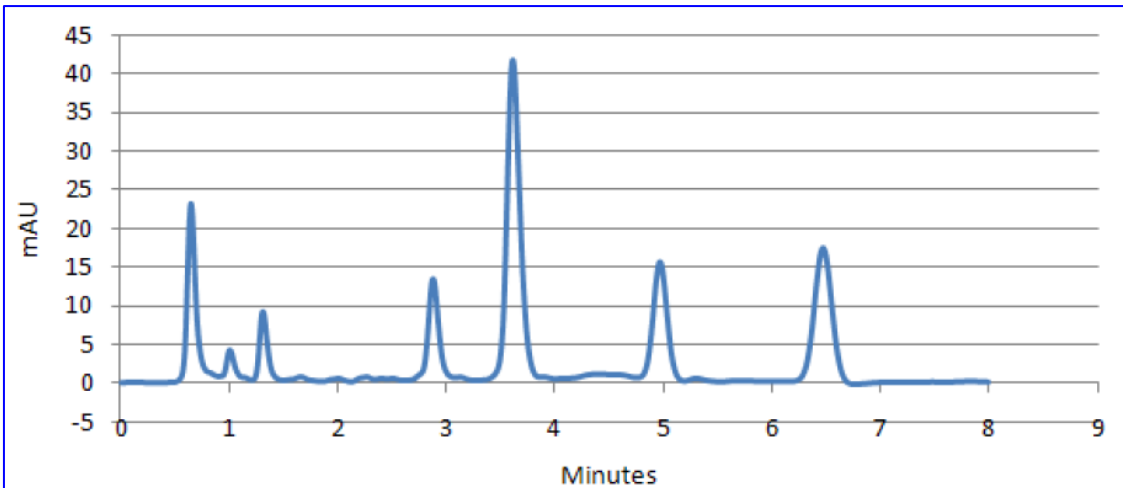

Figure 3. Challenger chromatogram showing peaks at the same times as Bullion and Chinook.

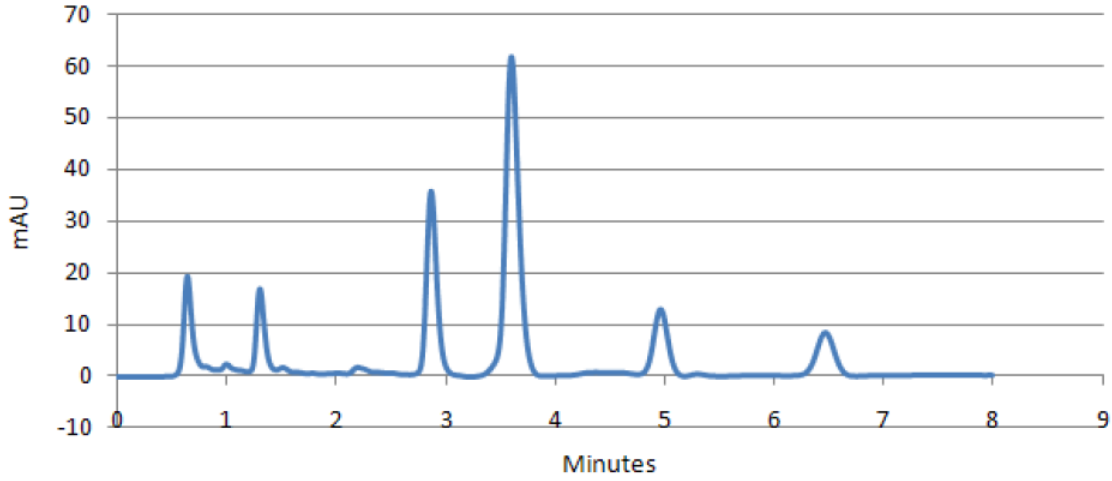

Figure 4. Chinook chromatogram showing peaks at the same time as bullion and challenger.

Figure 5 shows the calibration plots of cohumulone, humulone/adhumulone, colupulone, and lupulone/adlupulone versus signal peak area. Each graph shows a positive linear relation between concentration and signal peak area as expected.

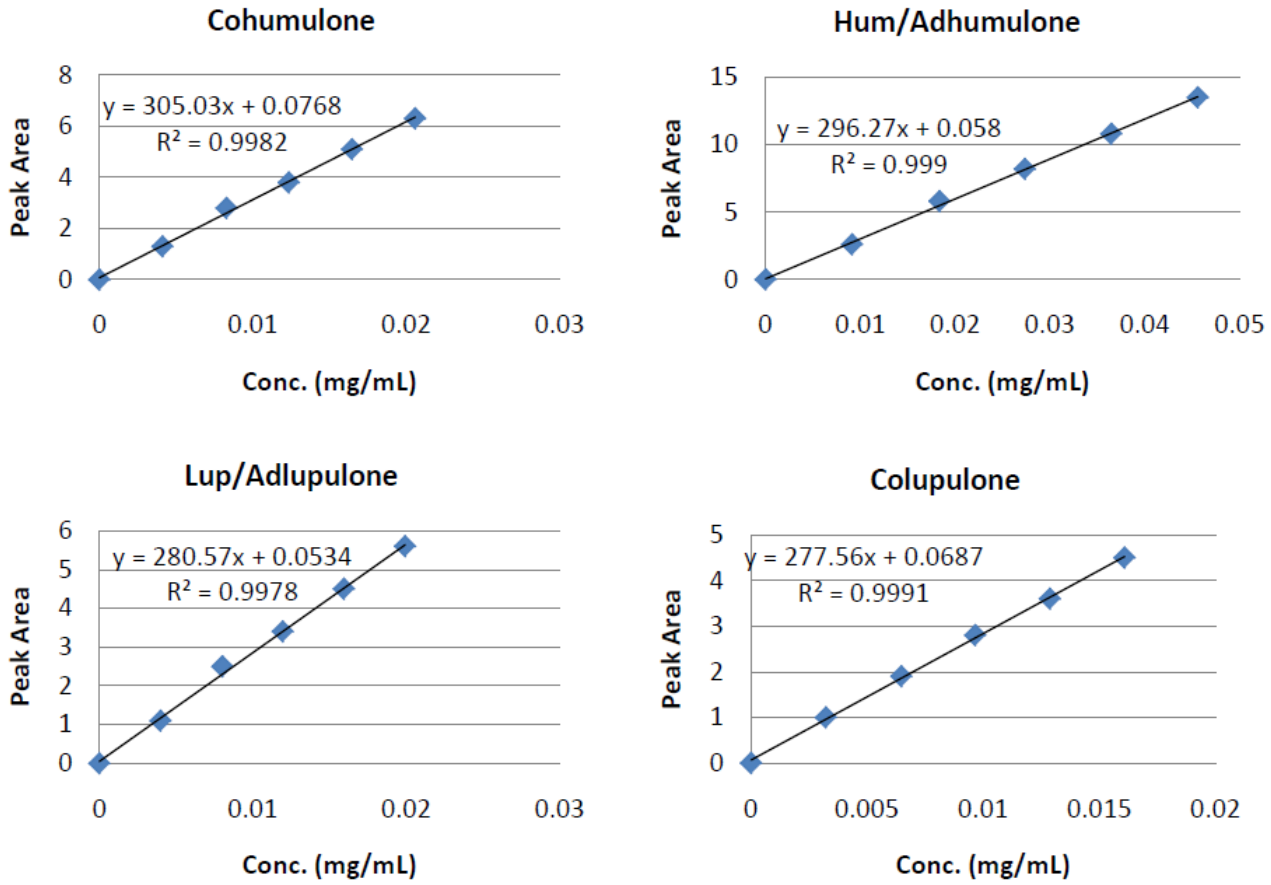

Figure 5. Calibration curves for all four acids.

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