On-site Quality Control of Beer
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Introduction
This Application Note shows the analysis of isohumulones and reduced isohumulones (trans-tetrahydro-isoo-acids) in different types of beer. Beer is an alcoholic beverage produced by fermentation of the basic ingredients water, malt and often hop. The hop cones contain the bitter alpha and beta acids: humulones, cohumulones and adhumulones (alpha) and lupulones (beta). The humulones are thermally isomerized during the brewing process (Figure 1) leading to higher solubility and more intensive bitterness.

Due to direct injection of the beer samples and isocratic elution, also unexperienced HPLC users like brewers, for example, are able to measure their beer samples. With this simple setup, it is possible to perform easy on-site measurement of beer in a mobile laboratory.

Experimental

Systems
Agilent Infinity 1220 LC System with Diode Array Detector and 1220 Infinity Mobile Upgrade Kit.

Software
OpenLAB CDS ChemStation Edition for LC & LC MS Systems, Rev. C.01.04
OpenLAB CDS 3D UV Add-On software.

Solvents & Samples
All solvents were LC grade. DCHA-Iso, ICS-IS and Tetra ICS-TZ were purchased from Labor Venitas AG, Zurich, Switzerland. Different types of beer were bought in local stores. The beer samples were degassed by extensive stirring (10 min) with subsequent sonication (10 min) before injection to the HPLC system.

Chromatographic conditions
The analysis was carried out using Agilent Poroshell 120 EC-C18, 4.6 x 100 mm, 2.7 µm column.

Results and Discussion
All nine peaks of the isohumulone standards were well separated, see Figure 2. Three non-reduced isohumulone and six reduced isohumulone standards were used for the evaluation of precision and linearity.

The analysis was very precise and linear with correlation coefficients over 0.999 for all nine isohumulone standards. The international bitterness units (IBU) were determined in four top-fermented and ten bottom-fermented beer samples, where 1 IBU equals 1 mg dissolved iso-α-acid per liter. The amount of the isohumulone in mg was calculated using the standard curve.

Conclusions
Isohumulone standards and isohumulones in 14 beer samples (top- and bottom-fermented) were qualitatively and quantitatively analyzed using the Agilent 1220 Infinity Mobile LC Solution. A simple analytical setup with direct injection (without SPE) and isocratic elution allows also unexperienced users to perform isohumulone analysis in beer. The Agilent 1220 Infinity Mobile LC Solution, as a robust and rugged system enables easy on-site measurement of isohumulones in beer in a simple analytical setup.

References:
1. Statistisches Bundesamt, Germany.