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Investigations of beer carbohydrates with increased 13C sensitivity

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Complex carbohydrates are an integral part of foods and the structural assignment of these complex oligo- or polysaccharides is a necessary step for understanding their biological functions and biosynthetic pathways. NMR is a powerful and often used technique in this structure determination and it often relies on natural ¹³C abundance, which comes with severe limitations – low sensitivity and highly overlapping spectra. Insight into the multifaceted mixture of different carbohydrates at natural ¹³C isotopic abundance was achieved through ¹³C projections from two-dimensional ¹H-¹³C HSQC experiments using high-resolution in the second dimension, thereby providing a highly detailed mapping of a central compound class that is not easily amenable to other detection modalities. Carbohydrate structures were investigated by use of the anomeric reporter signals (Figure 1A). Multivariate data analysis techniques were used to examine the carbohydrate profile of ale, lager and Lambic beer types to identify differences (Figure 1B), which could stem from differences in the fermentation processes. Moreover, the carbohydrate profiles are correlated to the beer alcohol content, thereby providing information about biological and biotechnological processes in beer production.

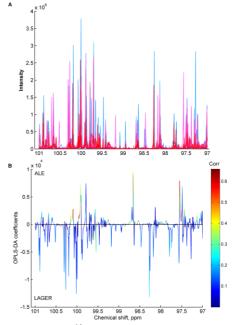


Figure 1. A) ¹³C spectra created from positive projection of F1 in ¹H-¹³C HSQC spectra of 42 beers. b) S-line plot from an OPLS-DA model on ¹³C projected spectra of beers (ale and lager).