APPLICATION NOTE – (NON)ALCOHOLIC BEER

Introduction

"Beer" refers to any fermented beverage made from grain. The basic ingredients of beer are malted barley, hops, water and yeast. Some brewers add wheat, oats, rice, or corn to create a lighter flavour.

Lagers and ales are the two families of beer, distinguished by the type of yeast and the temperature of fermentation. Lagers are fermented at cooler temperatures by so-called "bottom fermenting" yeast. Beers in the lager family need to be conditioned—or "lagered"—somewhere cool for a number of weeks before they are ready to drink. Ales are fermented at warmer temperature by top-fermenting yeast strains, and are ready to drink sooner.

There are many distinct styles of beer within the lager and ale families: for example, pilsner is one of the most popular lager styles; and porter and stout are examples of ale styles. And in both families, beers can run the gamut from light to dark-coloured, and from weak to strong alcohol.

And nowadays more and more low-alcoholic or non-alcoholic beers are available. Most in the lager family but there are some low-alcohol ales as well.

Often the measurements are still done by measuring the density accurately and use tables for determine the other parameters. NIR is often used to analyse the alcohol content. But also longer processes to analyse the "Apparent Extract after Final Attenuation" are often necessary.

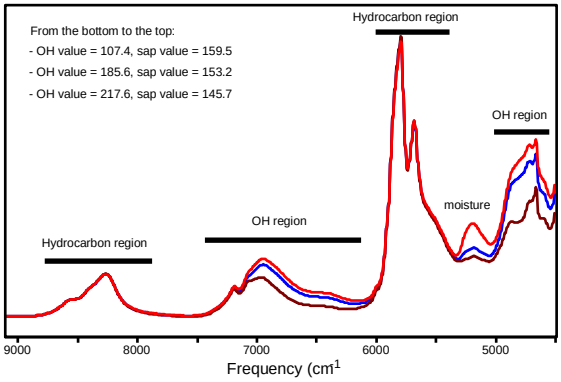
To analyse all parameters necessary for quality control in some minutes we have invented a special accessory based on a FTNIR analyser. Every kind of beer will be measured in their own bottle or canister and under a positive pressure, and as a consequence forming of bubbles will be avoided.

And above all in the same setup we can analyse all kinds of sugars in Wort as well.

The analyser

The BeverageQuant is an FT-NIR analyser, scanning from 14885 to 3700 cm^{-1} (e.g. 672- 2702 nm), with BK7 optics, a quartz halogen light source and a highly sensitive TE cooled InGaAs detector. The instrument has no scheduled maintenance for approx. 10 years, due to new technology use of maintenance free solid state lasers and a fully jacketed source (with electronic stabilisation) Quartz Halogen, 10 years expected lifetime.

Figure 1: The BeverageQuant



Calibration

Samples around the world were gathered and measured, as received. After scanning the samples, where after the primary values were determined via conventional techniques. The fresh calibration samples were collected at many production sites to ensure that the calibrations were based on reality. Partial Least Squares (PLS) models were developed based on the analytical and spectral data of all beers.

Calibration Performances

Table 1 shows the performance of the calibrations for different beers. Table 2 shows the feasibility of other parameters which needs improvement. The feasibility of wort analysis will be showed in table 3. Repeatability of the measurements is normally better than the Standard Error of Cross Validation (SECV) of the models.

Table 1: Parameters for (Non)Alcoholic Beer

Parameter	Range	NIR SECV
Alcohol by Volume	0.01 – 9.1	0.014
Alcohol by Weight	0.01 – 7.1	0.015
Original Extract	5.2 – 19.5	0.04
Specific Weight	1.0029 – 1.0566	0.000015
Real Extract	2.0 – 13.9	0.035
Apparent Extract	0.1 – 11.2	1.2
Apparent Extract after Final Attenuation	0.1 – 4.8	0.14
Delta Apparent Extract	0.1 – 11.2	0.14
Free Amino Nitrogen	2.0 – 169.0	8.8
Total Higher Alcohols	1.0 – 228.9	10.9

Table 2: Feasible Parameters, needs improvement of Beer

Parameter	Range	NIR SECV
Bitterness	7.1 – 68	2.24
EthylAcetate	0.1 – 97.1	4.7
IsoAmylAcetate	0.01 – 9.4	0.72
IsoButanol	0.3 – 53.4	2.9
Propanol	0.5 – 41.6	2.1
pH	3.2 – 4.8	0.11

Table 3: Parameters of Wort

Parameter	Range	NIR SECV
Glucose	0.02 – 10	0.4
Fructose	0.01 – 4	0.5
Sucrose	0.01 – 9	0.4
Maltose	0.05 – 15	0.5
Maltotriose	0.05 – 4	0.3

Conclusions

The BeverageQuant is a FT-NIR analyser designed for liquid sample measurements. To get the most representative sample and easy sampling handling, it is possible to measure directly in the bottle or can. Besides we can maintain a positive pressure to avoid bubbles.

It is intended to be placed in a laboratory or near the production line and measures various parameters in your (non)alcoholic beers and wort.

Many parameters have very good correlation, accuracy and repeatability. Some needs to be improved still, others can be developed on request.

Sometimes fine-tuning can be necessary to implement customers specific product variances.

No special education is necessary to operate the spectrometer and do the analysis.

10-years maintenance free FTNIR analyser with the best specs in the world.

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