Fermentability Predictor

Using the Specshell Inline Brewing Analyzer (SIBA), not only can you measure standard parameters such as extract formation and carbohydrate profile without manual sampling processes, but you can now also determine wort fermentability as both unit of apparent and real degrees of fermentability!

The SIBA system will automatically quantify batch-to-batch variation in wort fermentability, preventing labor intensive methods with slow turnarounds. This breakthrough technology gives brewers the tools to deliver to-spec wort even more easily, improving recipe and mash schedules optimization.

Equip your brewhouse with the Fermentability Predictor as part of our robust in-line real-time process monitoring system

SIBA

and yield the benefits of lab-free attenuation control

Specshell ApS is a pioneer engineering company specialized in development, design, manufacturing and operation of advanced analytical inline systems based on Middle Infrared Spectroscopy.

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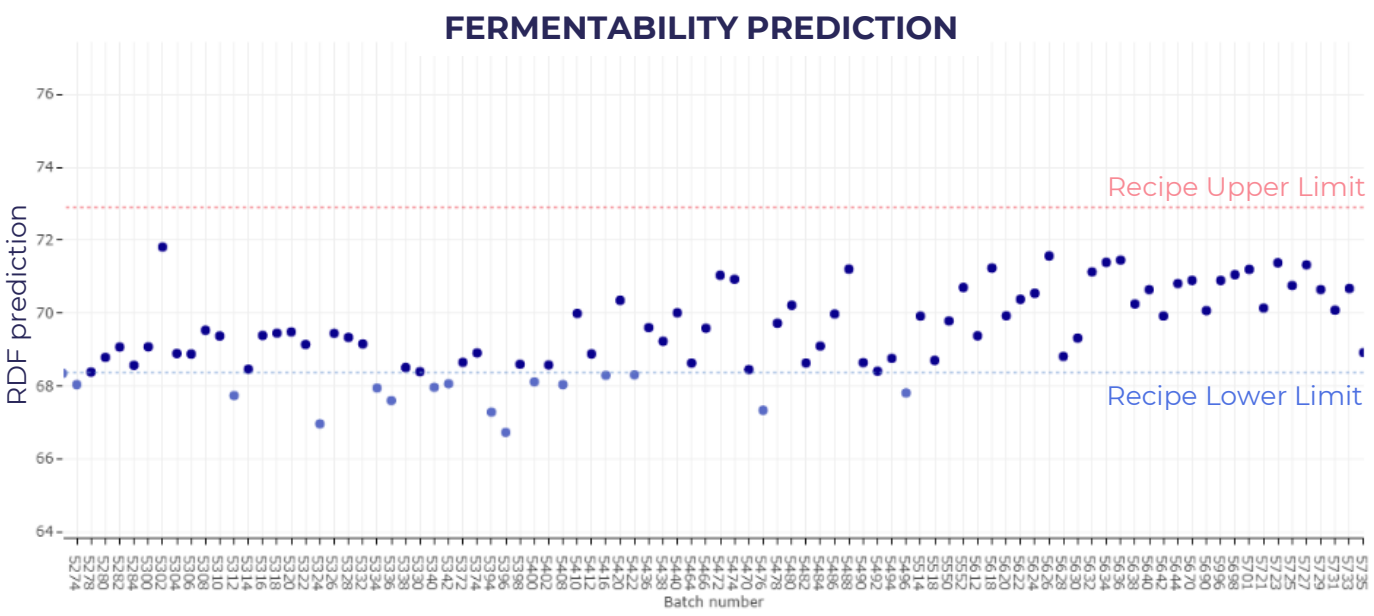

Fig1. Fermentability Prediction historic data for the several batches of a specific recipe. Recipe upper and lower limits set to recipe requirements by the brewery, showcasing the visual quality control feature of SIBA.

SPECSHELL

Fermentability Predictor

INTRODUCTION

The fermentability of a given batch of wort is a function of grist composition, ingredient quality, brewing configuration (infusion/decoction etc.), mash schedule, and the introduction of endogenous enzymes. Controlling the mashing process to maximize extract formation while controlling fermentability is essential for brewers to guarantee that the wort is produced up to specification.

Fermentability describes proportion of wort extract that yeast are able to ferment to alcohol. Several parameters other than sugar composition influences the fermentability of the given wort, but predominantly it is the sugars that determine this parameter.

Wort fermentability is measured in the brewing laboratory through forced fermentations of overpitched wort. This process is time consuming (24-48 hours), labor intensive, and can be subject to a number of user and systematic errors. This delay in data generation is subsequently limiting brewhouse optimization and daily QC, potentially resulting in several off-specification batches before issues can be addressed.

The Fermentability Predictor offers brewers inline and automated quantification of the wort fermentability (apparent and real fermentability) at the end of each batch. Inline measurement of wort fermentability prediction allows digitalized QC for daily brewhouse operation and batch-to-batch optimizations to be made while eliminating laboratory workload. Improvements in wort fermentability can be translated into greater product yields, time savings in the brewhouse, and/or increase in adjunct use.

SIBA

Fermentability Predictor estimates both the ADF and RDF of each batch during mash out.

Automate RDF lab test for rapid QC and process optimization

MATERIALS AND METHODS

Specshell fermentation scientists have examined both EBC and ASBC methods, as well as the impact of several parameters and have established a reliable test bed for determining wort fermentability. This highly reproducible method was applied to worts brewed and measured using SIBA on Specshell's in-house pilot plant, to produce reliable calibration samples applicable to a wide range of OE and fermentabilities.

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Samples from each wort and each fermentation replicate were collected and measured in duplicate for extract (°Plato and specific gravity) using an AntonPaar densitometer DMA 4500 to 5 dp. The sugar profile and fermentation products quantified by high-performance liquid chromatography in triplicate per wort/fermentation sample.

For generation of the model, a calibration data set consisting of 60 worts ranging from 18 – 28 °P were produced from a range of raw materials and mash schemes, that were then fermented after dilution to between 14 – 18°P.

These produced samples with RDF ranging from 50 – 75% (60 – 95% ADF).

MODEL PERFORMANCE

Specshell data scientists utilized the in-house produced calibration samples to train multivariate models for prediction of the RDF/ADF. The models use advanced processing steps to highlight the key spectral features that contain information about the RDF/ADF. The trained models were tested with an independent validation data set consisting of mashes that were conducted and measured in-line using a SIBA instrument in Specshell's in-house pilot facility. The validation set contained samples with a wide range of RDF.

Model performance is robust, enabling accurate prediction of wort RDF across the whole validation range, with a very high accuracy (correlation coefficient R^2 = 0.999 and a root mean squared error in validation (RMSEV) = 0.0145 RDF units) and a high precision (the standard deviation of the residuals was 0.56 RDF units).

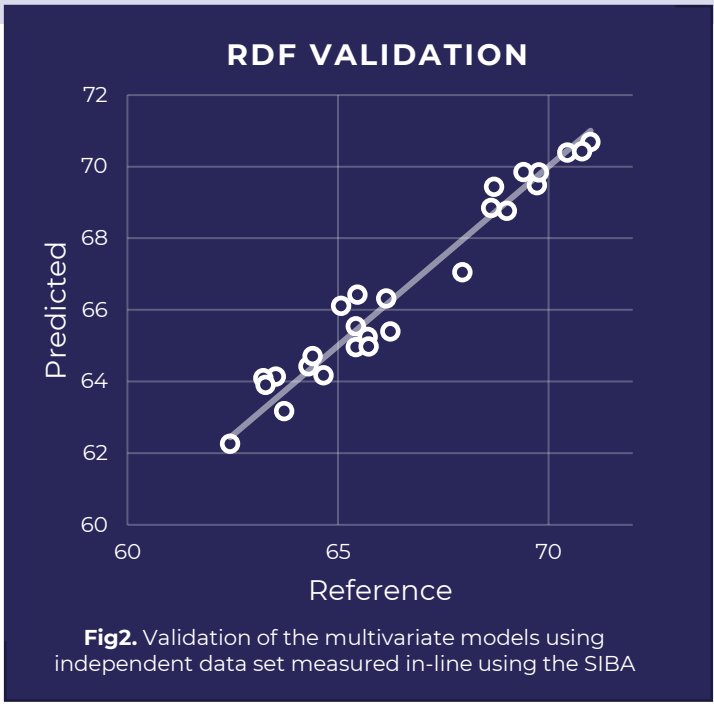

Fig2. Validation of the multivariate models using independent data set measured in-line using the SIBA

LIMITS OF USE

Since the SIBA is connected to the mash-tun, processes that influence fermentability that take place after wort is transferred from this vessel are not captured with the measurement system. Like the addition of syrups post mashing that will likely increase the fermentability of the wort. In these cases, the predicted fermentability value still has significant value as a benchmarking tool to assess mash performance or ingredient contributions between batches.

REFERENCES

European Brewing Chemists (EBC) 8.6.1 Fermentability, Attenuation Limit of Wort Reference Fermentation - 2002

European Brewing Chemists (EBC) 9.4 Original, real and apparent extract and original gravity of beer - 2004

American Society of Brewing Chemists (ASBC) Wort-5: Yeast Fermentable Extract