WHITE PAPER

INTRODUCTION TO THE "KOMBUCHA CORE FOUR"

BEYERS ANALYTICAL BREWING SCIENCES, LLC
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INTRODUCTION

Our attendance at KombuchaKon 2019 made it apparent that brewers desire affordable, comprehensive quality control programs to help dial-in the brewing process and maintain non-alcoholic kombucha. However, quality control testing has a stigma of being complicated, and out-of-reach for most brewers. The goal of introducing the Kombucha Core Four is to provide kombucha brewers with a tool kit and mindset that can be used to significantly improve brewing quality control. The only way to have a great product that meets legal requirements is to know your product throughout the brewing process.

PARAMETERS OF INTEREST

PH

pH is a measurement of free protons in solution. A brewer can test pH directly by using pH indicators or pH meters. The pH scale ranges between 0-14 and determines whether an environment is acidic or basic.

For example, **finished kombuchas have pH measurements ranging from ~3.0-4.2.** This parameter is the most commonly monitored parameter in kombucha because it is easy to measure and is generally required to validate food safety.

ALCOHOL (ETHANOL)

Alcohol is a key parameter to monitor because it is one of the end-products of fermentation. The primary alcohol relevant to kombucha is ethanol. Alcohol can be one of the most stressful parameters for the kombucha brewer because it is difficult to monitor without specialized equipment or dedicated kits. The low level of ethanol required for non-alcoholic kombucha necessitates quick, affordable, and reliable testing that can be used to measure levels at or below 0.5% alcohol by volume (ABV). Alcoholic kombucha relieves some of the stress associated with this parameter, but accurate testing is required none-the-less.

Common methods for monitoring alcohol include gas chromatography (GC), near-infrared spectrophotometry (Anton-Paar Alcolyzer), densitometry, and alcohol-specific kits, such as FermentaCheck. Testing frequency, ease-of-use, and required accuracy are the main variables to consider when deciding which testing option to pursue.

SUGAR (SUCROSE, GLUCOSE, AND FRUCTOSE)

Sugar is the critical input parameter for kombucha brewing. **The primary sugars relevant to kombucha are sucrose, glucose, and fructose.** Modulating initial sugar levels can have stark outcomes for ethanol and acidity content in the finished kombucha at the end of fermentation.

Sugar is ideally monitored using High Pressure Liquid Chromatography (HPLC), but high-quality enzyme kits can also be used as long as the acidity of the kombuchas is neutralized prior to analysis. If access to HPLC or enzyme kits is not available, sugar levels can be approximated using density, brix, or gravity. However, this is not ideal because kombucha becomes a complex matrix of sugars, acids, and alcohol by the end of fermentation. Additionally, density/brix/gravity measurements will not allow for the conversion of sucrose to glucose and fructose.

Beyers Analytical Brewing Sciences is currently developing a sugar monitoring kit designed specifically for monitoring kombucha sugar levels in-house.

TITRATABLE ACIDITY

Titratable acidity (TA) measurements are used to determine the concentration of acidic compounds in solution, including organic acids and free protons. This is important because organic acids are one of the end-products of kombucha fermentation and are **responsible for providing acidic flavor traits**. Additionally, research has shown that **TA better correlates with taste perception than pH**. TA can be tested via colorimetric and potentiometric titration methods. The RedCheck Titratable Acidity Kit was specifically designed to monitor titratable acidity in kombucha with accuracy equivalent to a potentiometric titration while reducing time and costs.

IN PRACTICE

The "Kombucha Core Four" parameters are pH, alcohol, sugar, and titratable acidity. Monitoring these parameters gives the kombucha brewer an excellent global view of their process (Equation 1).

$$\text{Tea} + \text{Sugar} \rightarrow \text{Alcohol} + CO_2 + \text{Organic Acids}$$

Equation 1: A basic input/output equation for kombucha brewing. Tea and sugar are the inputs. Alcohol, CO_2, and organic acids are the outputs.

Monitoring the inputs and outputs of kombucha fermentation allows for changes to formulation and brewing processes to be quantified to determine whether the changes were successful at maintaining desired levels of organic acids while ensuring kombucha is non-alcoholic. Additionally, once a recipe is tuned to give desired levels of alcohol and acidity, the collected data can be used to build robust quality control profiles to help ensure that each batch tastes the same every time.

QUESTIONS?

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ABOUT BEYERS ANALYTICAL BREWING SCIENCES

Beyers Analytical Brewing Sciences, LLC (BABS) is an analytical laboratory based in Fort Collins, Colorado that is dedicated to performing chemical and microbiological measurements for kombucha, beer, spirits, wine, and coffee producers. The analysts at BABS are certified chemists with the Alcohol and Tobacco Tax and Trade Bureau (TTB) and are qualified to provide accurate measurements of components within beverage products. BABS provides education for kombucha producers regarding analytical techniques that can be used to monitor their products.

ABOUT EVAN BEYERS, M.S.

DIRECTOR OF RESEARCH AND DEVELOPMENT

Evan received his Bachelor of Science degree in chemistry from Valparaiso University, and his Master of Science in biochemistry from Colorado State University. He worked as an analytical forensic chemist prior to this role. Evan is a TTB-certified beer chemist, and his analytical background includes gas/liquid chromatography, mass spectrometry, ultra-violet visible spectroscopy, number-crunching, and method development.

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