FIRST KEY
Consultants to the Brewing Industry

MAKING KOMBUCHA AT YOUR BREWERY?

As kombucha volume continues to rise, and growth rate in craft beer sales slows down, brewers are looking for new ways to profitably grow. One option to consider is producing kombucha. Kombucha shares some of the process steps of beer making, e.g. brewing, fermentation and packaging, although with some major differences.

Brewing.

The brewing of the unfermented “liquid” is significantly different in beer vs kombucha brewing. The need for milling of the grains, mashing and lautering in beer brewing does not exist in kombucha brewing. For kombucha, the base ingredients are water, sugar and tea. Tea can come in its raw solid form or in the form of tea extract. All that is needed is to ensure the tea flavor is adequately extracted (somewhat similar to what is done for hops), and that the sugar is well dissolved, and the sweet tea is rendered sterile through boiling. This can take place in the same kettle where beer brews are made. From there, this sweet tea (kombucha’s “wort”) is then chilled before fermentation.

Fermentation

Other than in the case of sour beer production, a pure yeast culture is used in most beer fermentations. The yeast culture is chosen on the basis of the desired flavors and its process performance. In kombucha, a mixed culture is used. The yeast cells live in symbiosis with bacterial cells in a mixed culture called a SCOBY (symbiotic culture of bacteria and yeast).

A pellicle of cellulose is grown by the dominant bacteria (*Acetobacter* or *Gluconacetobacter*) and the yeasts (*Brettanomyces bruxellensis* and *Saccharomyces* species). These live in the pellicle and also hang from the bottom of it. A "starter liquid" from a previously fermented kombucha, also known as "backslop", is then added to the sweet tea mixture. Alternatively, a SCOBY can be procured from commercial laboratories: different SCOBYs will result in different flavor profiles in the final product.

The yeast in kombucha prefer simple sugars. Sucrose ("table sugar"), which is made up of glucose and fructose, is ideal. If more complex sugars are used, this can lead to over-souring and off flavors.

Fermentation temperature is key to the health of the organisms and to flavor development. Compared to lager yeasts which work best around 48 to 58 ^{o}F (9 to 14 ^{o}C), or ale yeasts which produce good results around 68 to 72 ^{o}F (20 to 22 ^{o}C), kombucha fermentations are often warmer around 75 to 85 ^{o}F (24 to 29 ^{o}C).

These warmer temperatures speed the formation of ethanol which spikes early in the fermentation process. Then, when exposed to oxygen, some of the ethanol is converted into organic acids which lower the pH of the kombucha. This lower pH gives kombucha is signature tang, and it is not conducive to some of the microbial growth, including mold growth.

Another point of difference between beer and kombucha fermentations is oxygen exposure, which for beer fermentations only takes place at the very start of fermentation to enable yeast growth. Beer fermentations are most often (although not always) done in closed fermenters. Open fermenters increase the chances of microbial contamination from the ambient air, which can compete with the pure yeast culture and create off-flavors. An exception to this would be the production of some sour beers, which similarly to kombucha, have a higher acidity and lower pH.

In addition to fostering yeast growth, oxygen exposure can also drastically change the beer flavor stability. In the case of kombucha, the presence of oxygen during fermentation is desirable and important. Fermenters are open, with just a tightly woven cloth above them, which allows CO_2 to escape and oxygen and microorganisms to enter. Oxygen is a vital ingredient for kombucha because it helps in the conversion of some of the ethanol produced by the yeast into various compounds including organic acids previously mentioned.

Beer's sensitivity to potential microbial spoilage from other organisms requires good cleaning and sanitation procedures. These requirements also apply to kombucha production. Microbial contamination from other non-intended microorganisms can alter the flavor of a kombucha batch.

Scale-up in kombucha production can be tricky. Just as adjustments in yeast pitch rate, wort oxygenation and fermentation temperature are needed to match the desired beer flavor at different fermenter volumes, process adjustments may be needed when scaling up kombucha fermentation

Producing Kombucha at a Beer Brewery

Just as the production of some sour beers represent a risk to the production of "regular" (i.e. non-sour beers), it is likewise for the production of kombucha. For instance, the presence of *Brettanomyces* yeast is considered a spoilage organism for most beers (an exception being a Lambic style beer, for instance) as it can cause a "barnyard" flavor. Microbial cross-contamination can easily happen through ambient air, and any crevices in the tanks, hoses, seals, etc.

A way to mitigate this risk is to designate a totally separate area (ideally a separate building) for kombucha production. When this is not possible, dedicated tanks, hoses, lines, valves and CIP system will also help reduce the risk. However, the challenge remains when equipment is shared between the two product streams (e.g. tanks or fillers). Because of these risks, some beer breweries opt not to produce or handle kombucha in their breweries.

Culture Management

SCOBYs are famous for being highly reproductive and a sign of a good quality batch is that the SCOBY will grow when left at room temperature. Every batch of kombucha, when brewed with the right ingredients and temperature conditions will yield a culture that can be used again (similarly to a good beer fermentation yielding a good crop of yeast that can be re-pitched). The SCOBY also will grow to the size of the vessel such that the larger the opening of the tank, the larger the resulting SCOBY will be. This effectively prevents contamination from external organisms by essentially creating a "lid" (which also helps create a more anaerobic fermentation condition underneath the SCOBY).

One of the best practices for kombucha breweries is to keep some extra cultures on hand in a "SCOBY Hotel". This stock needs to be carefully maintained (e.g. with added kombucha or sweet tea) so as to maintain its viability. SCOBYs are more resilient than lager or ale yeasts (which lose viability more rapidly and need to be stored at colder temperatures). The stored SCOBYs are like an "insurance policy" in case of microbial contamination, poor SCOBY performance, or when volume scale up is needed.

Often SCOBY pieces or disks will be used to start a larger-sized batch, but given time, the new layers can get quite large and unwieldy. They also continue to thicken if left for extended periods of time. When brewing kombucha in large tanks, the vessels need to have a manway that operators can safely go into the tank and physically remove the excess culture for cleaning by pushing it out the opening. It is quite heavy as it is hydrophilic and can absorb over 100x its weight in liquid!

Excess culture has a variety of uses and can be offered as compost or animal feed to local farms, used to make SCOBY-based food products (e.g. SCOBY fruit leather) or even used for beauty treatments. While SCOBYs could potentially be sold as a byproduct, most companies don't have a way to monetize it at this time and usually give it away to anyone who will use it.

Some Key Product Quality Metrics

In addition to sensory evaluation of every batch, the kombucha brewer pays close attention to the product's final gravity, pH, titratable acidity, carbonation and alcohol by volume (ABV). Not unlike for beer, close ABV control is needed, and this is particularly critical if the product will be sold as a non-alcohol beverage (i.e. with an alcohol content of <0.5% by volume). Other parameters might become critical depending on the brand (e.g. color).

Some Recent Commercial Examples

There has been increased activity in the kombucha field by some high-volume and craft beer brewers. Examples include: KomBREWcha, which is a 3% ABV Kombucha owned by Anheuser-Busch InBev; Molson-Coors' Clearly Kombucha (which produces a line of beverages with an ABV of <0.5%), Boston Beer Company (e.g. Wild Ginger Blueberry Kombucha with 4% ABV), and Deschutes Brewing Co. (e.g. Humm Zinger Kombucha Radler with 4.3% ABV). Leveraging the knowhow and creativity of beer and kombucha brewers alike, more offerings and further volume growth is expected.