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HARD SELTZER PRODUCTION METHODS

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The sale of hard seltzers is growing [i] and projected to keep growing for the near future [ii, iii]. Although initially pegged as a summer drink that would mostly appeal to millennial women, it now shows strong sales year-round [iv] to more than just millennials [v] and to both sexes [vi]. Many breweries are adding hard seltzer to their lineup and finding them profitable.

Characteristics of Hard Seltzer

There is a fair amount of variation among hard seltzers. However, the “classic” hard seltzer — as typified by White Claw, Truly, Bon and Viv and many other brands — is a clear, usually colorless, alcoholic beverage with 4–5% alcohol by volume. Hard seltzers of this type typically have 90–100 Calories per 12-oz. (355 mL) serving, with the vast majority of Calories coming from the alcohol. Most have only a few grams of carbohydrate per serving and many are advertised as being gluten-free. Their primary appeal is thought to be the public’s impression of them being a healthy alternative to more Caloric beverages such as beer or wine. Hard seltzers are very fizzy, most often showing 2.8 volumes of carbon dioxide (CO_2). Their pH is low, often adjusted to 3.1 with citric or malic acid.

The basic procedure for making a hard seltzer is to ferment a sugar solution to make a strong alcoholic base beverage. The fermented sugar wash is filtered to yield a clear, odorless, flavorless, and colorless solution. This solution is diluted to working strength and flavoring is added. The flavoring may be accentuated with citric or malic acid and a small amount of sugar. The beverage is then stabilized, carbonated, and packaged. Before attempting a production-scale batch, brewers should try multiple pilot batches to settle on a yeast strain and level of yeast nutrients capable of producing an ordered fermentation.

The Sugar Wash

The initial sugar wash is made from sugar and water. Acid may be added to adjust its pH and yeast nutrients must be supplied.

As 95% or more of the beverage is water, it is imperative that the water tastes good. The addition of a small amount of calcium chloride, calcium sulfate, or both, may improve the taste of water that is extremely low in minerals. Additions that contribute to a total concentration of 50–100 ppm should be sufficient.

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The most commonly used sugars are sucrose or glucose (also called dextrose). These are added at a rate of (5.4 lbs. · °Brix) per barrel for sucrose or (6.7 lbs. · °Brix) per barrel for glucose. In other words, 5.4 lbs. (2.5 kg) of sucrose added to one US barrel makes a solution with density of 1 °Brix. Degrees Brix is the density of a solution of sucrose in water, expressed as a percent. In other words, a solution of 10% sucrose (w/w) sugar has a density of 10 °Brix. The scale is similar to °Plato. [7]. The weight difference is due to the fact that sucrose is sold an anhydrous crystal whereas glucose is most commonly sold as glucose or dextrose monohydrate ($C_6H_{12}O_6 \cdot H_2O$). Anhydrous glucose is available, but would be prohibitively expensive and offer no benefits compared to glucose monohydrate. When mixing, be aware that 13.5 lb. (6.12 kg) of sugar displaces 1.0 gallon (3.8 L) water. The initial density of the solution should be 8.0–10 °Brix for sugars washes intended to produce 4–5% ABV solutions after fermentation. Most frequently, however, a high-gravity solution — 18 °Brix or higher — is mixed. The resulting strong alcoholic solution is diluted to working strength before packaging.

The water used for brewing hard seltzers should be treated as ordinary brewery water is to remove any choline compounds, especially monochloramine. The mineral content can vary and could be adjusted for flavor.

Sugar is not an acid, base, or buffer. As such, the sugar and water mixture should have the same pH as the water. In order to provide a more hospitable environment for the yeast, the pH can be adjusted to mimic the pH of fresh wort (around pH 5) or wine must (around pH 3.8). The amount of acid required will be small, but the exact concentration is dependent on the minerals in the water. Waters with higher concentrations of bicarbonate will require more acid. To adjust the pH, brewers should add small aliquots of acid, stir and take the pH of the solution, then repeat until they hit their target.

A sugar and water solution provides a carbon source for the yeast, but no nitrogen or other nutrients required for a healthy fermentation. Most yeast strains require 250–300 ppm free amino nitrogen (FAN) and a variety of other nutrients. These can be supplied by boiling a complete yeast nutrient mixture. These are almost always mixtures of diammonium phosphate (DAP) — a source of nitrogen — and yeast hulls. Amino acids may also be added and zinc — a required micronutrient — is commonly added. If a yeast nutrient mix contains vitamins, it should not be boiled. The amount of nutrients supplied — and the conditions in general — bed to be sufficient to yield an ordered fermentation. However, “overstimulated” fermentations resulting from too many yeast nutrients will cause problems down the line. These include an overproduction of yeast cells and biological instability as a result of nutrients not consumed by the yeast.

Boiling, Cooling, Yeast, and Fermentation

The sugar wash should be boiled for 15 minutes. Then it should be cooled to a fermentation temperature appropriate to the yeast strain being used. The brewer should oxygenate the chilled mixture to a level appropriate for the yeast strain, most often 6–8 ppm.

Brewers who make hard seltzers employ a wide variety of yeast strains. If your brewery has a neutral ale strain, your first approach should be to try a few test batches with this. If that doesn’t work, any neutral ale yeast strain, wine yeast strain, or distiller’s yeast can be tried. If you select an ale strain, the usual pitching rate — 1 million cells per mL per °Plato — should work well. Slightly overpitching, up to 20% can be tried, too.

An ordered fermentation should start promptly, proceed steadily without stalling or becoming sluggish, and finish at an appropriately low density. For most hard seltzers, this will be -1.8 to -2.0 °Brix. Some fermentations may require help in finishing. In those cases, rousing the yeast or raising the fermentation temperature may help the yeast finish their job. Late aeration or late addition of yeast nutrients is not recommended. In cases of a fermentation that has stalled at an unacceptably high density, fining with activated carbon followed the addition of fresh yeast may help.

Many yeast strains will stop performing well under a pH of 3.5. If a fermentation is struggling or has stalled, check the pH. If it is below 3.5, adjust to a higher value with sodium bicarbonate (baking soda). The farther the density is from its target gravity, the higher the pH should be. But do not raise the pH more than is required to allow the fermentation to finish. (Often, the pH is adjusted downward to 3.1 before packaging. So raising it excessively at this stage will simply require a larger correction later.) If sodium bicarbonate is needed to raise the pH in test fermentations, record the amount required per unit volume to make the correction. Sodium bicarbonate can then be added at that rate to the initial sugar wash in subsequent brews to prevent the pH from dropping too low.

Clean Up

The fermented sugar wash must be stripped of any aromas, flavors, and colors other than those expected in a solution of water and ethanol. In the largest breweries, "ordinary" filtration to remove yeast and haze, followed nanofiltration of reverse osmosis filtration may be employed. In smaller production breweries, the fermented sugar wash may be filtered through plate filters impregnated with activated carbon. The brewer would begin with "ordinary" filtration to remove the yeast and large haze particles. Filtration through a filter pad with a 4 mm depth and 25 micrometer pore size (or less) should clarify the solution to the necessary degree. Brewpubs may not have a plate filtration system and may have to rely on fining the solution with activated carbon. Alternatively, the solution be could recirculated through a grant containing a bed of activated carbon.

Unwanted aromas can be removed from the fermented base by bubbling carbon dioxide (CO_2) through the solution. After fermentation, the solution will be saturated with CO_2 so brewers should agitate the solution to knock some CO_2 out before bubbling. Otherwise, a cascade of released CO_2 could occur and the solution could overflow the vessel.

Dilution and Flavoring

If a high-gravity sugar was fermented, it will need to be diluted to working strength with deaerated water. Large breweries that employ high gravity brewing for their beer will have the equipment to produce deaerated water with oxygen content as low as 80 parts per billion (ppb). Smaller breweries can boil their dilution water for 20 minutes, which should reduce the oxygen content to less than 1 part per million (ppm). Staling is less of a problem in hard seltzers as the most abundant precursors to staling found in beer — including lipids and oxidized fatty acids (from malt), which can be further oxidized to form trans-2-nonenol — are not found in hard seltzers.

Flavoring is added to the working strength blank base beverage, generally at a rate of 5.0–13 fl. oz. (150–380 mL) per barrel for the most common flavors [vii]. Flavorings need to have TTB approval and any alcohol in them needs to be accounted for in calculations to estimate the alcohol content (ABV). A small amount of citric or malic acid may be added to accentuate the fruit flavor and to make a final pH of 3.1. This low pH will render the beverage contribute to the biological stability of the beverage.

Hard seltzers may be slightly back sweetened. As they are intended to be low-Calorie, low-carb beverages, sweetening is typically held to less than 2.0 g per 12-oz serving. This translates to less than 23 oz. (660 g) per barrel. Sweetened hard seltzers must be stabilized so the added. The beverages may be pasteurized or stabilized by the addition of potassium sorbate.

Carbonation

The brewer should finish the beverage by carbonating it. Most hard seltzers contain about 2.8 volumes of CO_2. This is higher than most American-style Pilsners and craft beers, which are frequently in the ballpark of 2.5 volumes of CO_2, but less carbonated than typical German weizenbiers, which typically contain 4–5 volumes of CO_2.

Hard seltzers are typically canned in sleek cans, with are taller and more slender than a standard beer can. In an online seminar for this year's Craft Brewers Conference (CBC), one brewer recommended that other brewers stress test their cans for corrosion prior to deciding on a specific can lining [viii]. Brewpubs may dispense their hard seltzers from their tap system at their usual level of carbonation to circumvent problems with balancing the system.

Conclusion

Running an ordered fermentation is the most challenging aspect of making a hard seltzer. Finding the correct concentration of yeast nutrients for your yeast strain, substrate concentration, pitching rate, and oxygenation level is the biggest hurdle facing most brewers. These variables may have to be tweaked even after several production batches.

By Dr. Chris Colby

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