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SEPTEMBER-OCTOBER 2026, VOL. 32, NO. 5

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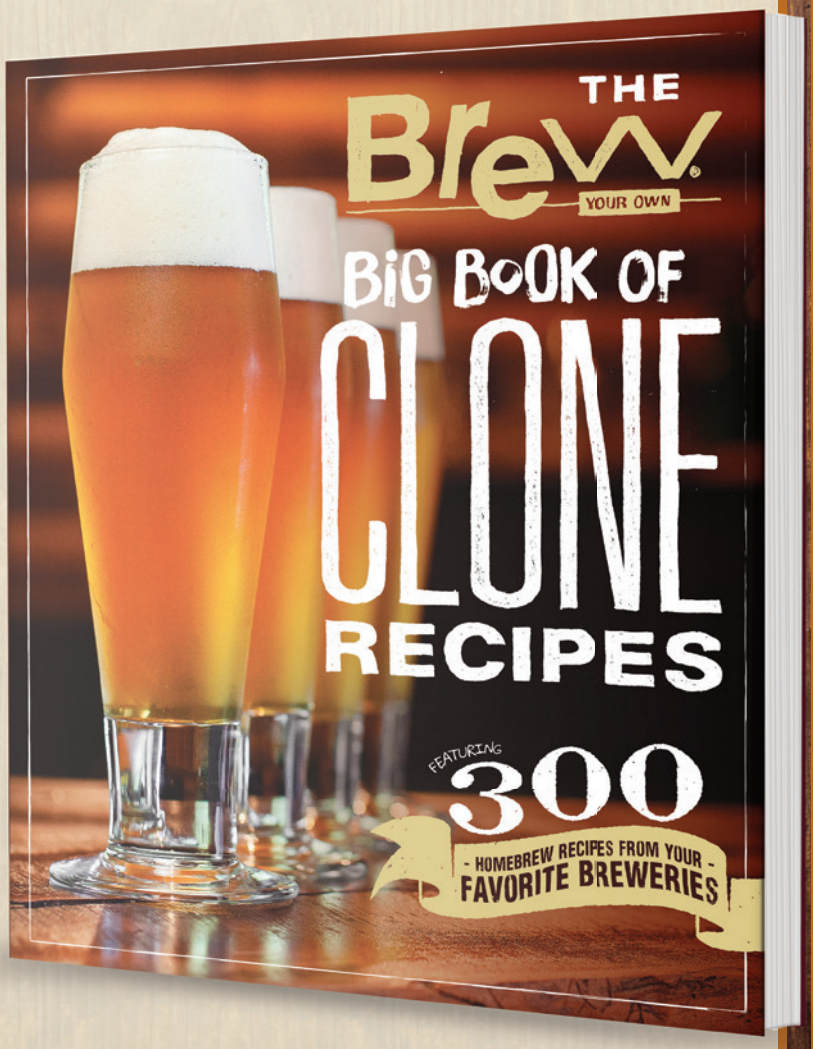

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Founder & CEO, Destihl Brewery

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Hear why Matt at Destihl brews with Briess
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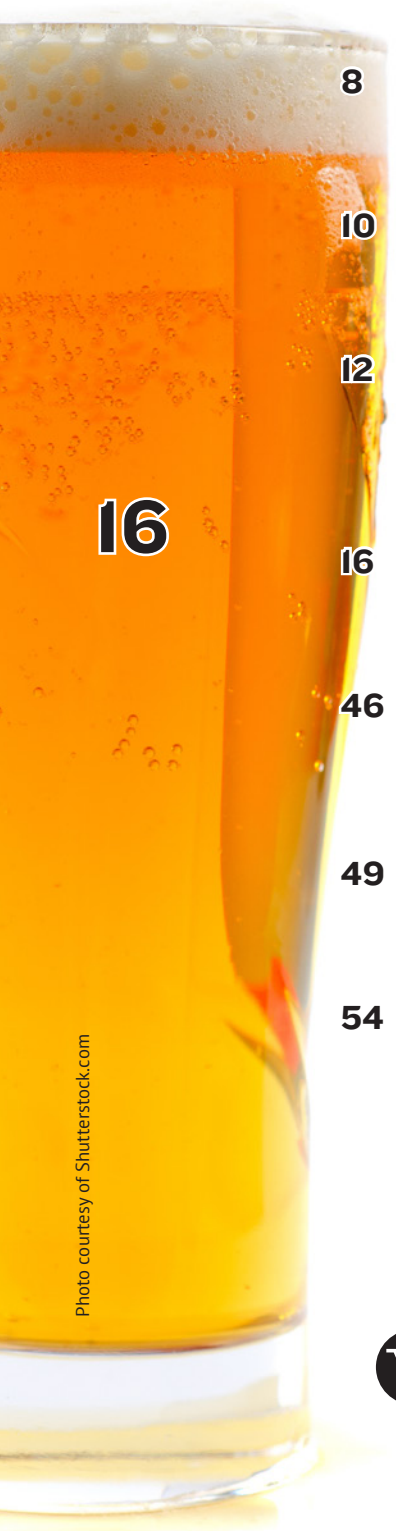

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RECIPE STANDARDIZATION

EXTRACT EFFICIENCY: 65%
(i.e. — 1 pound of 2-row malt, which has a potential extract value of 1.037 in one U.S. gallon of water, would yield a wort of 1.024.)

EXTRACT VALUES FOR MALT EXTRACT:
liquid malt extract (LME) = 1.033–1.037
dried malt extract (DME) = 1.045

POTENTIAL EXTRACT FOR GRAINS:
2-row base malts = 1.037–1.038
wheat malt = 1.037
6-row base malts = 1.035
Munich malt = 1.035
Vienna malt = 1.035
crystal malts = 1.033–1.035
chocolate malts = 1.034
dark roasted grains = 1.024–1.026
flaked maize and rice = 1.037–1.038

HOPS:
We calculate IBUs based on 25% hop utilization for a one-hour boil of hop pellets at specific gravities less than 1.050. For post-boil hop stands, we calculate IBUs based on 10% hop utilization for 30-minute hop stands at specific gravities less than 1.050. Increase hop dosage 10% if using whole leaf hops.

Gallons:
We use U.S. gallons whenever gallons are mentioned.

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Q What is a favorite or unique flavor combination you've found works well in beer?

Wide open question! A couple are fonio in tripel (I can't bring myself to make one without it) and chanterelle mushrooms in wee heavy.

One of my favorite malt combinations is dark Munich malt (like Weyermann Munich II) along with a Belgian aromatic malt. This is something I use to get a super deep malty richness in beer without caramel sweetness or a bready toastiness. I use it in almost all of my malty German lager recipes, along with several Belgian ales.

As a beer judge, I am constantly amazed at the skillful integration of flavors. A couple notable ones I wasn't expecting: 1. Pineapple and jalapeño — I can still remember the sweetness of the pineapple and the heat of the peppers. 2. Thai basil and maibock — I can remember how pure the maibock base beer was and how well the vegetal basil notes worked. 3. Jalapeño and helles — I'm sure this violates so many German Purity Laws, but damn was it a great-drinking beer.

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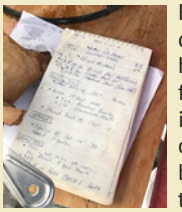
suggested pairings at BYO.COM

Recipe Design Ethos



Homebrewers and craft brewers often have slightly different goals when it comes to recipe design. But craft brewers have been taking cues from homebrewers on ways to improve, so too should homebrewers take cues from craft brewers. www.byo.com/articles/recipe-design-ethos

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If you have drooled over a glycol chilling system wishing you could afford one; drool no longer. Here is a build that is drool-worthy — at an affordable price. www.byo.com/projects/homemade-glycol-chiller

Brewing With Nuts: Tips From the Pros



They don't get the attention that some non-traditional ingredients may receive (like fruit beers), but nuts of all kind make for fun brewing ingredients. Get tips on the types of nuts (and their various forms from chopped to extracts) to use, as well as when and how to use them from three pros who aren't afraid to go a little nuts. www.byo.com/articles/tips-from-the-pros-brewing-with-nuts

Clear Steps for Filtering Homebrew



Filtering may not be a common technique among homebrewers, but it is one every homebrewer should consider. Learn the ins and outs of filtering your homebrew, and why it is a technique with merit. www.byo.com/articles/clear-steps-filtering-homebrew

MAIL



DUMPING YEAST FROM THE FERMZILLA

I have a FermZilla Tri-Conical fermenter. I recently added the stainless steel elbow/reducer and a butterfly valve so that I can dump yeast and trub. I'm having a very difficult time doing it though. It always seems to either clog up and stop or the beer channels through and gushes. I've tried straight off the 1.5-inch opening, using a ½-inch reducer, and a ½-inch hose. I've tried under pressure and not. I've read that the key is opening the valve very slowly and progressively. Nothing seems to work for me. I know others do it. Do you have any tips before I abandon it and go back to using the collection jar?

Kevin Marchese • *via email*

We passed this question to Chris Graham, BYO *Review Board member and President of MoreFlavor! — the North American distributors of FermZilla and other KegLand products — as he's very familiar with the FermZilla. Here is his response: "The yeast variety probably makes the biggest difference here as the higher flocculation ones are going to compact quickly and be hard to fully dump as one plug. I think when people can see the yeast cake they think they're seeing it the whole way as well. For me, that was a struggle the first times I used clear plastic instead of stainless conicals as I didn't realize how much the yeast coats everything and looks like it's super thick, even though it may not be. I'm not always sure why people replace the bottom with elbows, as again this can occasionally make it a little harder to get the yeast out, but I guess that emulates a bigger brewhouse setup. I have occasionally pumped the valve in order to break up clogs, but you end up losing a lot of liquid when doing this. If you don't have anything on the other end, I'm not sure what I would recommend beyond trying it with a different yeast strain or trying to understand what you're trying to gain by changing the setup."*

WRITE TO *BYO*

Have a question about something you've seen in *BYO*? Write to us at: edit@byo.com, find us on Facebook: www.facebook.com/BrewYourOwn, Instagram: @brewyourownmag, or reach out to us on X (formerly Twitter): @BrewYourOwn. You can also email us requests for a clone recipe from your favorite local brewery: replicator@byo.com or ask your homebrewing questions of Mr. Wizard: wiz@byo.com



Joel Takeuchi (right) was born in Hawaii, but due to a military error, his dad was transferred to a base near Fairfield, California. Along with seeking mountainous adventures, he enjoys playing softball, coaching baseball, and annoying his teenage son. His homebrewing adventure began in 2018. **Paul Wade** also lives in Fairfield, California, and drank 17 Coors Lights to celebrate graduating high school before Army boot camp. Newcastle Brown, Bass, Leffe, and Killian's Irish Red, were his introductions to flavorful beer. He's had a love/hate relationship with homebrewing since 2017. They are both members of the Solano Garage Brewers.

Beginning on page 22, Joel shares the story of their latest adventure hiking Mt. Kilimanjaro and bonding with the only craft brewer in the area.



Steve Parsons lives happily with his wife and plane in an aviation community and has recently retired from the IT industry. He has dabbled with many brewing methods from extract, BIAB (Brew-In-A-Bag), BIAC (Brew-In-A-Conical), to 3-vessel RIMS (Recirculating Infusion Mash System), and is now happy with an all-in-one electric system. His garage contains an upright fridge/freezer, now converted to a 4-tap kegerator, and he always has a few good homebrews on draft. Originally from the U.K., Steve has a taste for British-style ales as well as American IPAs.

Living in Florida, he had the challenge of cooling and maintaining a stable fermentation temperature. He solved the problem with his design of a Peltier-powered conical fermenter, which he details on page 28.



Antal Németh started homebrewing in his kitchen before most people in Hungary had ever heard the phrase "craft beer." That curiosity eventually led him to co-found MONYO Brewing in 2014, and over the past 12 years MONYO has grown into one of Hungary's most recognized craft breweries, distributed across nearly 20 European countries, and with beers on shelves in the U.S., Canada, and Mexico. He has also spent more than a decade teaching homebrewing workshops and writing about beer science. Antal's background is in adult education and prior to a career in brewing he worked as a university researcher and lecturer.

Beginning on page 34, Antal explains the science behind why certain flavor combinations work better than others and how understanding flavor networks can lead to better beer recipe design.

STORY BEHIND THE LABEL

OMAR LAZARO
CHICAGO, ILLINOIS



Sometimes labels are created for beers. Other times, beers are created for labels. This is a case of the latter.

I loved the *Spider-Man* cartoons as a boy. I always felt that Spider-Man had the best villains. Anyhow, I recently started homebrewing, and I've been getting a lot of help from AI. Recently, the idea of Hop Goblin (inspired by Spider-Man's villain, the Hobgoblin) as a beer name came to me. I thought it was such a cool name and that it would make a killer beer label, so I got right to work on designing the label even though I didn't yet have a beer to put it on. I figured, what better beer style to match the name than an imperial IPA? So I enlisted the help of ChatGPT to draw it for me, but all the details were mine. He is hovering (like the Hobgoblin) over a field of hops, with Lazaro Brewing Company in the background.

I haven't yet brewed this beer. I'm still fairly new at homebrewing, and I feel that I need to become a better brewer to be able to make a beer worthy of this cool label. When I do, the label will be ready for its bottles.

UPCOMING EVENTS

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PROX Chit from Proximity Malt is a functional malt designed to strengthen the structure beneath every pint. By preserving the natural proteins formed during the earliest stage of germination, PROX Chit enhances foam stability, mouthfeel, body, and haze while contributing virtually no color, sweetness, or flavor. PROX Chit is made from 100% U.S.-grown barley through Proximity's ReGenMalt program, an initiative that supports regenerative farming and reduces transportation impacts. Learn more here.

SAFBREW LA-02



SafBrew LA-02 is the first Fermentis-selected non-*Saccharomyces* yeast (*Torulaspora delbrueckii*) for the production of no- and/or low-alcohol beer (<0.5% ABV). This maltose-negative yeast strain primarily assimilates simple sugars (glucose and fructose) and gradually assimilates saccharose. It does not assimilate maltose, maltotriose, or dextrins. SafBrew LA-02 exhibits mild, neutral fermentation characteristics with no phenolic notes. SafBrew LA-02 is available in 500-g and 10-kg formats. Please consult the product TDS and technical guidelines for brewing recommendations and points of attention. Learn more here.

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BYO REPLICATOR

BY DEREK DELLINGER

DEAR REPLICATOR, I've been on a quest to learn more about brewing with kveik yeast and recently got the opportunity to try Stormcloud Brewing's Sunrunnr. What an interesting beer! I would love to be able to brew something that'll have my friends as curious as this one had me. Any tips?

Geoff Crowell,
Miami, Florida

For Brian Confer, Co-Owner and Head Brewer of Stormcloud Brewing Company, the path to professional brewing didn't start at a commercial brewhouse, or even a garage-based one. It began in a photography darkroom.

Before opening Stormcloud in 2013 with his business partner Rick Schmitt, Confer was a freelance photographer in northern Michigan. As the photography industry made the transition from film to digital, however, his basement darkroom began to sit unused. Soon, Confer realized that an underutilized darkroom was not a loss, but an opportunity for a budding homebrewer. Equipped with a large sink, proper ventilation, commercial refrigeration, and ample storage, it was an environment practically tailor-made for the brewing process.

Confer converted the space into a homebrew lab and approached brewing with the same methodical eye he used behind the camera. "In some ways, it wasn't that different from becoming a photographer," he says. "Study the process, repeat it, evaluate the results honestly, make adjustments, and keep going." That rigorous approach laid the foundation for Stormcloud, a brewery situated in the picturesque, seasonal town of Frankfort, Michigan.

Stormcloud is known for its Belgian-inspired portfolio, a strategic choice made early on to set themselves apart in a region already dominated by IPAs and pale ales. But as the brewery has evolved, so too have its techniques. Confer himself is particular to saisons, but after dealing with a *Saccharomyces cerevisiae var. diastaticus* infection in their production facility, the team had a tough call to make. To mitigate risk, they decided to move away from *diastaticus*-positive strains entirely. Searching for a way to maintain a dry, expressive, fermentation-driven character without the risk, Confer and his team began experimenting with kveik yeast coupled with amylase enzymes. At the same time, the team had also begun to play around with thiolized yeast strains. This exploration eventually birthed the beer known today as Sunrunnr.

"Eventually it occurred to me that we might be able to combine those two ideas: Use a thiolized yeast strain and kveik together to create a beer that had some witbier-like qualities and a big fruity summer character, but without using any actual fruit," Confer says.

Stormcloud categorizes Sunrunnr as a witbier. Philosophically and conceptually, Confer says, the base recipe is built like one. But instead of a classic Belgian witbier strain, the brewery relies on a very specific blend of yeast to create this unique beer. Confer says the goal, was to create a bright, refreshing, fruity summer beer that could be turned around quickly to meet the demands of the brewery's peak tourist season.

After experimenting with a blend of Voss kveik and Omega Lab's Helio Gazer, the brewery faced consistency issues, as the two strains grew at different rates, causing the blend to drift from batch to batch. The solution arrived when Omega released Vossa Nova, a thiolized version of their standard Voss Kveik. By blending 80% traditional Voss with 20% Vossa Nova, Confer found he was able to achieve a stable, homogeneous pitch. The result is a beer bursting with tropical, citrusy brightness and witbier-like qualities, achieved entirely through fermentation rather than fruit additions.

Inevitably, the beer's complicated background has resulted in a few marketing conundrums. Sunrunnr was originally listed as "Farmhouse - Other" on Untappd because the site lacked a "kveik" category. "I actually reached out to Untappd about adding one, and their response was that so many breweries use kveik to make other styles that a broad 'kveik beer' category might confuse consumers," Confer says. Instead, the brewery has simply leaned into marketing Sunrunnr as a witbier, allowing their singular creation to stand out for its uniqueness.

"For most consumers, 'kveik beer' doesn't communicate much and may make a refreshing, approachable summer beer sound more intimidating than it is," Confer says.

The largely unmapped territory explored by Sunrunnr provides plenty of space for at-home experimentation. While the brewing world often focuses on hops for thiol precursors, base malt can play a significant role in thiol expression as well. During trials with zero hops, four different malts yielded four completely different levels of thiols, Confer said. For Sunrunnr, Stormcloud opts for 100% pale malt over their usual Pilsner malt base in order to hit the perfect flavor profile.

"Kveik yeast is fascinating because it can be treated so differently than traditional ale yeast," Confer says. "I've heard of people using it in almost every way imaginable — fermenting at 100 °F (38 °C), pitching at extremely low rates, and generally pushing it much harder than a conventional yeast. We did a fair amount of trialing, especially around pitch rate, and fermented it at temperatures all over the map. Where we eventually settled was not as extreme as some of what you hear."

For Sunrunnr, Confer favors a more measured approach. He lowers the pitch rate slightly (0.6 million cells per milliliter per degree Plato) and ferments warm — around 80 °F (27 °C). "We keep the process fairly normal," he says, including oxygenating the wort at a traditional rate.

STORMCLOUD BREWING CO.'S SUNRUNNR CLONE

(5 gallons/19 L, all-grain)
OG = 1.054 FG = 1.014
IBU = 20 SRM = 8 ABV = 5.2%

Marketed as a witbier, Sunrunnr does not include the traditional witbier spices. It instead relies on yeast to contribute wit-like flavors in this unique ale that pairs perfectly with summer sun.

INGREDIENTS

6.1 lbs. (2.8 kg) 2-row pale malt
4.5 lbs. (2 kg) white wheat malt
3.3 oz. (94 g) Gambrinus honey malt
2.5 oz. (71 g) acidulated malt
0.8 oz. (23 g) Briess Midnight Wheat malt
2.4 AAU Magnum hops (60 min.) (0.2 oz./6 g at 12% alpha acids)
2.1 AAU Czech Saaz hops (60 min.) (0.7 oz./20 g at 3% alpha acids)
2 AAU Mandarina Bavaria hops (15 min.) (0.25 oz./7 g at 8% alpha acids)
Lactic or phosphoric acid (for post-boil pH adjustment, if needed)
Omega Yeast OYL-061 (Voss Kveik) (80% of yeast pitch) or similar
Omega Yeast OYL-407 (Vossa Nova) (20% of yeast pitch)*
¾ cup corn sugar (if priming)

STEP BY STEP

With the goal of creating a moderately dextrinous wort, mash in with 2.75 gallons (10.5 L) of strike water to achieve a single-infusion rest temperature of 156 °F (69 °C). Hold at this temperature for 60 minutes.

Sparge with enough water at 170 °F (77 °C) to collect about 6 gallons (23 L) of wort. Boil wort for 60 minutes, adding hops at times indicated. At the end of the boil, if needed, adjust the kettle pH down to 5.1.

Chill wort to 72 °F (22 °C). Oxygenate normally and pitch the kveik yeast blend at a slightly reduced rate. Cap fermentation temperature at 80 °F (27 °C).

When fermentation is over, add priming sugar and bottle or keg and force carbonate, targeting a carbonation of 2.6 volumes.

STORMCLOUD BREWING CO.'S SUNRUNNR CLONE

(5 gallons/19 L, extract with grains)
OG = 1.054 FG = 1.014
IBU = 20 SRM = 8 ABV = 5.2%

INGREDIENTS

3.5 lbs. (1.6 kg) wheat liquid malt extract
3 lbs. (1.4 kg) light dried malt extract
3.3 oz. (94 g) Gambrinus honey malt
0.8 oz. (23 g) Briess Midnight Wheat malt
2.4 AAU Magnum hops (60 min.) (0.2 oz./6 g at 12% alpha acids)
2.1 AAU Czech Saaz hops (60 min.) (0.7 oz./20 g at 3% alpha acids)
2 AAU Mandarina Bavaria hops (15 min.) (0.25 oz./7 g at 8% alpha acids)
Lactic or phosphoric acid (for post-boil pH adjustment, if needed)
Omega Yeast OYL-061 (Voss Kveik) (80% of yeast pitch) or similar
Omega Yeast OYL-407 (Vossa Nova) (20% of yeast pitch)*
¾ cup corn sugar (if priming)

STEP BY STEP

Place the honey malt and Midnight Wheat in a muslin bag. Steep in 2 gallons (7.6 L) of water as it comes up to 170 °F (68–77 °C). Remove the grain bag, placing it in a colander over the kettle, and gently rinse with 1 gallon (3.8 L) of warm water.

Add water to the kettle to reach a pre-boil volume of approximately 6 gallons (23 L). Bring to a boil, then turn off the heat and carefully stir in the malt extracts until fully dissolved.

Return to heat and boil 60 minutes, adding hops as indicated.

Follow the remainder of the all-grain recipe.

* TIPS FOR SUCCESS:

Omega Yeast no longer sells its thiolized strains — including Vossa Nova — in homebrew-size quantities. If you cannot harvest yeast from a can of Sunrunnr or get a small quantity of Vossa Nova from your local brewery, the best bet for replicating the yeast in this recipe would be to substitute it with White Lab's thiolized yeast strain WLP077 (Tropicale). BYO





Photos courtesy of Stormcloud Brewing Co.

HELP ME, MR. WIZARD

BY ASHTON LEWIS

DRY VS. FRESH FRUIT

Plus: Making makgeolli and conditioning time prior to cold crashing

Q MY WIFE GAVE ME A DEHYDRATOR THAT I HAVE BEEN DRYING ALL SORTS OF FRUITS WITH. I HAVE DEVELOPED A BEER RECIPE USING DRIED CITRUS THAT HAS BEEN A BIG HIT. NOW I WANT TO KNOW MORE ABOUT USING DRIED STONE FRUITS IN BEER AND THE PROS AND CONS OF DRY VS. FRESH.

FRANK KORN
CONNECTICUT

A I love the idea of using your new food dehydrator to preserve fruit for brewing. There is nothing wrong with using dehydrated fruit in beer; however, its flavor and color contributions will differ from those of fresh fruit. To answer your question, I'll begin with fresh fruit and then discuss various preserved fruit products, highlighting how they compare with their fresh counterparts.

Brewers have many options when it comes to selecting fruit for brewing. Common choices include blackberries, raspberries, strawberries, grapes, papayas, oranges, lemons, apples, pears, apricots, peaches, cherries, mangoes, pineapples, and figs. These fruits can be grouped into several general categories, as shown in the table below.

Aggregate fruits are among the easiest to use in brewing because they can be added directly to beer with little or no processing. Their colors, sugars, and acids readily diffuse into beer as the soft cellular structure breaks down due to naturally occurring fruit enzymes. The same process occurs when these fruits are stored for extended periods.

Stone fruits also break down readily in beer, but because of their larger size they are often cut into smaller pieces after removing the pit.

Apples and pears are almost always juiced because their juice is trapped within a pectin-rich cellular structure that requires grinding or milling for efficient extraction. Pineapples and figs present a different challenge because their proteolytic enzymes can negatively affect beer foam stability if the fruit has not been pasteurized.

Fresh fruit can also be troublesome because it commonly carries a diverse population of microorganisms ranging from useful and interesting yeasts to spoilage yeasts and bacteria. Despite these risks, fresh fruit contributes vibrant aromas, fermentable sugars, bright colors, and crisp acidity. For many brewers, the benefits outweigh the drawbacks, and fresh fruit is used before, during, or after fermentation.

In commercial brewing, the risk posed by wild yeast and bacteria is a major concern for most beer styles outside of intentionally mixed-culture or wild-fermented beers. Aseptic

There is nothing wrong with using dehydrated fruit in beer; however, its flavor and color contributions will differ from those of fresh fruit.



Photo courtesy of Shutterstock.com

Drying changes the flavors that fruit contributes. That is not to say that using dried fruit in brewing is a bad thing; it is simply different from using fresh fruit.

FRUIT	BOTANICAL TYPE
Blackberry, Raspberry, Strawberry	Aggregate
Grape, Papaya	Berry
Citrus (Orange, Lemon, etc.)	Hesperidium (a specialized berry)
Apple, Pear	Pome
Apricot, Peach, Cherry, Mango	Drupe (stone fruit)
Pineapple	Syncarp (multiple fruit)
Figs	Syconium (specialized multi-fruit)

processing is widely used in the juice industry because it preserves much of the fresh character of juice while eliminating spoilage organisms. Process details aside, aseptic juices are typically single-strength, pasteurized, shelf-stable versions of their fresh counterparts and can be difficult to distinguish from freshly prepared juice.

Although aseptic processing sounds simple — juice, heat, cool, and package — the details are critical. For readers interested in learning more, this Oregon State University Extension article provides an excellent overview. The advantages of aseptic juices are that they are widely available, easy to use, microbiologically stable, and often reasonably priced.

No discussion of fruit products would be complete without briefly mentioning canned fruit preparations. These products are an option, but canning is more commonly used for concentrated juices, pie fillings, jams, and preserves. Because of the relatively intense heat treatment used during production, cooked or jam-like flavors are common. Although not widely used, these products occasionally appear in homebrewing recipes.

And then there are dried fruits.

When I think of dried fruit in brewing, the first example that comes to mind is dried orange peel in witbier. Dried herbs and spices, while not fruits, fit into a similar category of flavoring ingredients. Witbier typically contains dried coriander seed and may also include dried orange or lemon peel, chamomile, grains of paradise, pepper, ginger, lemongrass, or cardamom. Dried citrus peel contributes a rounded, full, and slightly candied flavor profile that differs markedly from the bright, zesty, and explosive character of fresh citrus peel.

Why the difference?

When fruit is dehydrated, sugars, proteins, acids, and other flavor-active compounds become concentrated. The application of heat promotes a variety of chemical reactions that alter flavor and color. Oxidation reactions change pigment composition, promote polyphenol polymerization, and transform fresh, bright flavors into richer, more rounded flavors. These changes should not be viewed as inherently good or bad; they are simply natural consequences of the drying process.

The type of fruit also matters. Pome fruits, such as apples and pears, become leathery when dried, making them ideal hiking snacks but less ideal brewing ingredients because they do not readily rehydrate. Nevertheless, all fruit types can be dried and successfully used in brewing.

In the brewer's toolbox, dried fruits offer a unique range of flavors that bridge the gap between fruit and malt. Their concentrated, oxidative character can echo the flavors found in specialty malts while complementing malt richness, alcohol warmth, and fermentation-derived esters in many beer styles.

In short, I see many advantages to using your new gadget for brewing. As someone who enjoys malt-forward beers, I find it easy to imagine dried stone-fruit flavors pairing beautifully with caramel malts, Vienna and Munich malts, honey malt, and worts produced using extended boil times.

Before concluding, I want to revisit fruit processing and discuss one thing dehydration does not necessarily accomplish: Microbial kill.

Although dehydration is extremely effective at preventing microbial growth by reducing water activity, it does not reliably kill microorganisms. While microbial populations generally decline during drying, especially when heat is involved, the surfaces of dried fruits often remain populated with viable yeast and bacteria.

Two common methods used to reduce these microbial populations are sulfur treatment and pasteurization. Sulfur dioxide, produced by burning elemental sulfur, can be applied during drying as an antimicrobial treatment. This same approach has long been used to sanitize wooden barrels before being stored dry. A related method involves dipping fruit in a potassium metabisulfite solution before dehydration. Both treatments suppress yeast and spoilage bacteria while helping preserve fruit color.

Steam pasteurization is another effective option. At first glance, using steam on dried fruit may seem counterintuitive because the goal of drying is to remove water. However, steam is a highly effective sanitizing medium because moist heat transfers energy more efficiently than dry heat, and condensing steam delivers substantial thermal energy to microbial cells. In practice, dried fruit can be steam pasteurized near the end of the drying process, and the residual heat in the fruit helps remove surface moisture so that the treatment causes only a minimal increase in overall moisture content.

These treatments significantly reduce microbial populations, but they do not guarantee sterility. Fortunately, spoilage bacteria are generally easier to kill than yeast, and the relatively low populations of surviving wild yeast usually have little impact when fruit is added to finished beer. When fruit is added during active fermentation, the brewing yeast will generally out-compete any remaining wild microorganisms.

Q I RECENTLY SAW A FACEBOOK POST BY YOU TALKING ABOUT ATTENDING A MAKGEOLLI CLASS IN KOREA. WHAT EXACTLY IS MAKGEOLLI AND WHY WERE YOU SO EXCITED ABOUT YOUR EXPERIENCE?

TOM SMITH
TRENTON, NEW JERSEY

A Yes, I recently spent a week in Korea with my wife and posted some pictures of the cool stuff we saw during our vacation. On the last day of our visit, I participated in a short class about makgeolli taught by Joe Kim at Baekusaeng Makgeolli, his makgeolli brewery in Seoul.

For starters, what is makgeolli? In Korean, the word *makgeolli* loosely translates to "roughly filtered" and describes a fermented beverage made from rice, water, and nuruk. There are different styles of makgeolli, but the simplest way to describe the trunk of this branched beverage tree begins with

wonju — the porridge-like, milky, delicious, fermented mixture of rice, water, and nuruk after about a week of fermentation. When *wonju* is roughly strained through cheesecloth, the result is makgeolli. To draw a parallel, makgeolli is similar to nigori sake, the unfiltered sake often found in Japanese sushi restaurants. But makgeolli is not sake!

As a modern brewer educated in the methods of beer brewing, it's a given that malting is required to make what is known around the world as beer. And when beer brewers wax poetic about malted barley, we can all recite the story about why it's the perfect ingredient: It provides starch-degrading enzymes, an abundant source of starch, a wide range of color and flavor depending on how the malt is produced, and a durable husk that serves as the perfect filter material when separating wort after mashing.

But makgeolli is not made from rice malt — it's made from rice. There is no yeast pitching involved, nor is there any special preparation of koji — steamed rice inoculated with *Aspergillus oryzae* that serves as the conversion engine in sake brewing. Instead, makgeolli uses another ingredient called nuruk, a dried grain cake resembling Cracklin' Oat Bran cereal. It turns out that nuruk is to makgeolli brewers what malt and yeast are to beer brewers. Cool stuff!

Unlike beer brewing, makgeolli has a long history of being made at home alongside other cooking tasks, including the preparation of fermented staples like kimchi made from cabbage, radish, and countless seasonal greens, as well as soy pastes, soy sauces, and fermented seafoods.

Nuruk preparation begins with making an uncooked grain "biscuit dough" of sorts that is protected from rainfall but exposed to the local environment for several weeks before being air-dried for prolonged storage. The moist grain biscuit acts like a petri dish, providing a medium for wild fungi, yeast, and bacteria to grow. Because cereal grains naturally carry a heavy load of microorganisms — especially lactic acid bacteria — the grains themselves become a key source of microbes in freshly prepared nuruk.

Homebrewers interested in wild beers or culturing yeast from their local environment can see how nuruk is both an ingredient and a differentiator, contributing to unique makgeollis brewed in different regions with distinct microclimates and airborne microbial populations. As it turns out, preparing nuruk is a major chore, so many makgeolli breweries — even small artisanal ones — purchase it. However, commercially available nuruk is still a "wild product" because it is made using traditional methods rather than lab-purified cultures of molds, yeast, and bacteria.

You asked why makgeolli got me excited, Tom, and those are some of the reasons. I'll finish with a quick overview of how it's made and what it tastes like.

Makgeolli brewing was traditionally an extension of cooking because the first steps really are food preparation. Nuruk preparation is like making dough, except the dough is never baked. The next step involves washing, soaking, and steaming rice. This crucial process removes unbound starch from the surface, hydrates the grain, and gelatinizes the starches. Once cooked, the rice is cooled and loosely broken up to minimize clumping. The next step literally involves manual labor when makgeolli is made in small batches: Water is mixed by hand into the cooled rice along with nuruk until all the water is absorbed. And that's pretty much it for brew day.

The mixture is then transferred to a crock or similar vessel for fermentation. At this point, there are very few, if any, fermentable sugars present. What happens next is known as a parallel fermentation. Fungi, primarily *Aspergillus* and *Rhizopus* species from the nuruk, produce enzymes that hydrolyze rice starch. Some enzymes are already present from nuruk production, and more are produced as the fungi grow. At the same time, yeast convert sugars into alcohol, carbon dioxide, and flavor compounds, while bacteria produce organic acids, some alcohol, and additional flavor compounds.

During the first couple of days, the rice solids begin to liquefy and typical signs of fermentation appear. Unlike beer fermentation, where oxidation is a concern, it is normal to stir makgeolli during the first few days. Fermentations are covered to keep debris out, but the process is essentially open.

Some types of makgeolli include multiple cooked rice additions to boost strength and complexity. The version we made in Joe Kim's class was a simple style with no additional rice added during fermentation. After about a week, the *wonju* was strained and squeezed through cheesecloth to separate the solids. Makgeolli is typically stored in plastic bottles in the refrigerator as a safety measure since continued fermentation can lead to bottle bombs. Unlike beer, original gravity is not measured, and hydrometers are rarely used. What I ended up with tasted pretty darn good!

Makgeolli settles quickly in the bottle, so it's gently shaken before serving to rouse the rice solids. Depending on its age, it can range from lightly sparkling to still, and the drinking experience combines silky mouthfeel, aromatic esters, organic acids, umami richness, and sometimes a subtle funk.

This barely scratches the surface of this traditional and intriguing beverage. What really piques my interest is how different makgeolli brewing is from beer brewing, along with the wide range of variations produced at home and by artisanal breweries throughout Korea. Some versions incorporate fruit and spices, opening the door to all sorts of experimentation.

A key part of Joe Kim's introduction included a tasting.



Photo courtesy of Wikipedia

Nuruk is an uncooked grain disk that provides a medium for wild fungi, yeast, and bacteria that is then used to ferment makgeolli.

Interestingly, commercially produced makgeolli in Korea often differs from traditional versions. Alternate starch sources are sometimes used, and modern mash processes resembling adjunct brewing may be employed. Commercial examples are also commonly sweetened, often with zero-calorie sweeteners. These versions are quite different from traditional makgeolli and, unfortunately, misrepresent the real thing. While traditional makgeolli is easy to find in specialty shops, bars, and restaurants throughout Korea, it's much harder to find outside Korean communities in cities like Los Angeles and New York. The good news is that it's not all that difficult to produce a simple introductory version at home.

Q SHOULD I PUT MY BEER IN THE KEGERATOR RIGHT AFTER IT REACHES TERMINAL GRAVITY OR LET IT SIT AT ROOM TEMPERATURE FOR A WHILE? IF THE LATTER, HOW LONG SHOULD I CONDITION IT FOR BEFORE COLD CRASHING?

HANK DREW
MANCHESTER, NEW HAMPSHIRE

A I spend a fair amount of time browsing homebrewing communities on social media. If you asked this question in one of those groups, a common response would be, "Yeah, dude, cold crash the keg, carb it, and drink it!" I can live with that answer, but a more accurate, even if less satisfying, answer is: It depends. Let's peel back a few layers of this onion and see what factors matter.

Whether a beer benefits from additional time after reaching terminal gravity depends on several things. In my view, the most important are yeast strain, beer style, and the presence or absence of acetaldehyde and diacetyl. If you're brewing a standard-gravity ale with a clean-fermenting yeast, such as one of the many Chico strains, and the beer is not dry hopped, anything beyond a short rest — about two days — is probably a waste of time.

That answer comes with two important caveats. First, if the beer had an original gravity above about 1.060 (15 °Plato), I want to know exactly what is meant by *terminal gravity*. Does it mean the gravity matches the recipe? Or does it mean you've measured the same gravity twice over a three- to four-day period? And if the gravity is stable, is it where you expected it to finish? Bigger beers often need a few extra days because fermentation and maturation simply take longer as original gravity increases.

The second caveat concerns dry hopping. When hops are added late in fermentation, hop amylases can break down dextrins into fermentable sugars. This so-called *hop creep* extends fermentation while increasing the likelihood of a diacetyl spike. The best way to avoid problems is to delay cooling until fermentation is truly complete and diacetyl has been reduced below its flavor threshold. I'll point readers to the link at the end of this article to read more about hop creep and resist diving down that rabbit hole here.

Lagers deserve special mention. If you're using a strain known for leaving buttery fingerprints, extra conditioning time is usually worthwhile because diacetyl reduction often lags behind the point where gravity stabilizes. The same is true for acetaldehyde. Near the end of fermentation, yeast reduce diacetyl and acetaldehyde using NADH as the reducing agent, regenerating NAD^+ in the process.

In practice, you want to verify two things before cooling: That the beer has truly reached terminal gravity and that it is free of detectable diacetyl and acetaldehyde. Diacetyl is easily checked using a forcing test. Heat a sealed beer sample in a 140 °F (60 °C) water bath for 15–20 minutes, cool it to the same temperature as an unheated control sample, and compare the aromas. If the heated sample develops a buttery aroma, the beer needs more time before cooling. Stable gravity and a negative diacetyl forcing test are the two most useful process checks for deciding when to crash cool.

Too many brewers — including pro brewers — become frustrated because of a common logical fallacy. They insist that two batches were brewed the same way with the same ingredients, yet one batch developed a problem. The difficult part is usually identifying what actually changed so the problem can be prevented next time. In the case of post-fermentation conditioning, there are simply too many variables to control perfectly. The practical solution is to rely on objective process checks rather than the calendar.

I'm an old-school homebrewer and still prefer fermenting in a glass carboy because I can see what's happening inside the fermenter. Before anyone asks, I ferment in a dark basement illuminated by LED lighting, so I'm not worried about light-struck beer.

I like carboys because I can watch yeast movement during and after fermentation, and that visual feedback is surprisingly useful. Since I'm rarely in a hurry, I follow what's happening, pull samples to smell, taste, and measure, and then rack to a keg. Before transferring, I fill the keg with Star San and push it out with carbon dioxide, so I have no concerns about oxidation during racking. Depending on the beer style, I'll often transfer the beer from one keg to a second before serving to leave the settled yeast behind. I'm not worried about yeast autolysis in the types of beers I brew, but I do like minimizing the amount of yeast that ends up in the glass. BYO

Related Link:

- *Large dry-hop additions that have become more prevalent over the past decade have led to surprises among commercial brewers and homebrewers alike. The phenomenon — leading to a lower final gravity, increased ethanol, and increased carbonation — is called hop creep and is due to diastase activity of hops. Learn more about hop creep and how to combat it:* **www.byo.com/articles/hop-creep**

BY GORDON STRONG

DOUBLE IPA

Twice the fun

Double IPA is a bit of a misnomer since it isn't really twice as much as a standard American IPA in terms of style parameters like starting gravity, alcohol level, or bitterness level, but it drinks differently enough that it deserves its own space in the style universe. From the brewer's perspective, it is made a bit differently too since just making an IPA bigger often simply results in an American barleywine. The more modern West Coast IPA is probably closer to a double IPA than other styles since it tends to come in at the upper limit of American IPA.

If you think of the difference between a Belgian blond and a Belgian tripel, you are probably more in the right ballpark of the difference between an American IPA and a double IPA. There is more alcohol and bitterness, but the finishing gravity and dryness remain fairly consistent. That is the one area that I point to when people suggest double IPA is just another name for a barleywine – the final gravity and dryness (thus drinkability) are different.

Double IPA is in Category 22 Strong American Ale in the Beer Judge Certification Program (BJCP) Style Guidelines, along with American Strong Ale and American Barleywine. Standard-strength American IPAs and its variants are grouped together in Category 21 IPA. Double IPA is separated from the standard-strength IPAs for competition purposes, primarily because these styles each tend to draw a significant number of entries. The original English IPA is style 12C within the Pale Commonwealth Beer category. Hazy double IPAs (as well as hazy pale ales) are entered as Style 21C Hazy IPA specifying the session, standard, or double strength indicator as in Specialty IPA.

HISTORY

To talk about double IPA, we first have to summarize the foundational IPAs: English IPA and American IPA. Entire books have been written about IPA (not all accurate . . .), but suffice it to say that they originated in England for export to India. Originally created in London, they were later recreated (and perfected, some might say) in Burton-on-Trent where the sulfate-rich water profile was more suited to the pale, bitter style. It was very popular for well over 100 years, but wars and taxes drove the gravity lower until it became indistinguishable from pale ale and bitter.

The United States had some IPAs before the craft beer era, but none survive. Anchor Liberty Ale is considered the first modern American IPA when it was made in 1975. Early craft beer pioneers began producing IPAs in the 1980s and 1990s, before the style exploded in popularity in the 2000s and sparked many variations. Vinnie Cilurzo at Russian River made what is considered by most to be the prototypical example of double IPA, Pliny the Elder, in the late 1990s. This inspired other brewers to produce similar products in the 2000s, and the style continued to grow in popularity for at least the next decade and a half.

In the late 1990s and early 2000s, there really wasn't a good style description for double IPA (or even agreement that it should be called this name, as Rogue had their I2PA (or Imperial India Pale Ale). Style guidelines of the era had a single IPA description that basically described the historical English IPA, with an implied, "wink wink, nudge nudge, you know there are differences" but that didn't really help judges or people learning about the style. It certainly led to extended debates about which beers should win, but it seemed like it was a matter of personal preference.

When the BJCP introduced the 2004 edition of its style guidelines, the IPA style became a category with three

There is more alcohol and bitterness, but the finishing gravity and dryness remain fairly consistent.

DOUBLE IPA
BY THE NUMBERS

OG:	1.065–1.085
FG:	1.008–1.018
SRM:	6–14
IBU:	60–100
ABV:	7.5–10%



Photo courtesy of Shutterstock.com

new styles: English IPA, American IPA, and Imperial IPA. Imperial IPA was renamed Double IPA in a later edition as it became apparent the market had chosen that as the preferred name.

I recall having a conversation with Vinnie Cilurzo in 2004 at the Las Vegas homebrewers conference where I was trying to tell people how double IPAs were different than barleywines. He agreed that they were different, and pinpointed the greater body, more malt-forward profile and balance, and fuller, often sweeter finish as being the primary differences with barleywine. He thought double IPAs had greater drinkability and were his preferred beer to make. Honestly, his early sharing of the recipe and techniques for Pliny the Elder helped popularize the style with brewers more than anything, in my estimation.

Double IPAs are still being made in quantity, but they don't seem as buzz-worthy as they once were. Perhaps they are being crowded out on the low end with West Coast IPAs and West Coast Pilsners, as there is a seeming generational shift in preference for lower-alcohol products. The advent of other IPA types, most notably the hazy IPAs, has also had an influence. Barleywines are somewhat difficult to find, although in many places on the West Coast, triple IPA has taken over that place in the market.

SENSORY PROFILE

A double IPA is best thought of as a stronger and (perhaps) more bitter American IPA, while retaining a lean body and a dry finish. I think of IPA as being around 6.5–7% ABV while a double IPA is 8–8.5%. The style guidelines have broader ranges, but those are where many examples fall. For strict style purposes, the double IPA is 7.5–10% in strength. West Coast IPAs can nudge up against that bottom end of the alcohol range, so they are often fairly similar.

The color of a double IPA is typically pale, with a gold to light copper-orange color, but most recent examples are fairly pale as crystal malt usage has become increasingly rare in this style. The beers are generally clear, although

DOUBLE IPA



(5 gallons/19 L, all-grain)
OG = 1.072 FG = 1.010
IBU = 74 SRM = 5 ABV = 8.3%

INGREDIENTS

8 lbs. (3.6 kg) pale 2-row malt
4 lbs. (1.8 kg) Pilsner malt
1 lb. (0.45 kg) Munich malt
1 lb. (0.45 kg) white table sugar
12.5 AAU Mosaic® hops (FWH)
(1 oz./28 g at 12.5% alpha acids)
1 oz. (28 g) Mosaic® hops (10 min.)
1 oz. (28 g) Mosaic® hops (5 min.)
1 oz. (28 g) Mosaic® hops (whirlpool, after 10 min. of cooling)
1 oz. (28 g) Mosaic® hops (whirlpool, after 20 min. of cooling)
2 oz (57 g) Mosaic® hops (dry hop)
Wyeast 1272 (American Ale II), White Labs WLP051 (California V Ale), SafAle US-05, or Mangrove Jack's M36 (Liberty Bell Ale) yeast
¾ cup corn sugar (for priming)

STEP BY STEP

This recipe uses reverse osmosis (RO) water. Adjust all brewing water to a pH of 5.5 using phosphoric acid. Add 0.5 tsp. of calcium chloride and 0.5 tsp. of calcium sulfate to the mash.

This recipe uses a step-infusion mash. Use enough water to have a moderately thick mash (1.5 qts./lb.). Mash the grain at 131 °F (55 °C) for 15 minutes. Raise the temperature to 147 °F (64 °C) for 45 minutes. Raise the temperature to 158 °F (70 °C) for 15 minutes. Raise the temperature to 168 °F (76 °C) and recirculate for 15 minutes.

Sparge slowly and collect 6.5 gallons (24.5 L) of wort in the kettle with the first wort hops already placed in the kettle prior to sparging. Boil the wort for 75 minutes, adding hops at the times indicated in the recipe. Stir in the sugar in the last 15 minutes of the boil. For the whirlpool hops, allow the wort to cool below 194 °F (90 °C), stir, then add the first addition of whirlpool hops, and continue to cool until below 180 °F (82 °C) before adding the second addition of hops. Stir, and let rest for 5 more minutes before proceeding.

Chill the wort to 68 °F (20 °C), pitch the yeast, and ferment until complete.

Rack to secondary and dry hop for three days.

Rack the beer, prime and bottle condition, or keg and force carbonate as usual.

DOUBLE IPA



(5 gallons/19 L, extract)
OG = 1.072 FG = 1.010
IBU = 74 SRM = 5 ABV = 8.3%

INGREDIENTS

8.5 lbs. (3.9 kg) pale liquid malt extract
1 lb. (0.45 kg) white table sugar
12.5 AAU Mosaic® hops (FWH)
(1 oz./28 g at 12.5% alpha acids)
1 oz. (28 g) Mosaic® hops (10 min.)
1 oz. (28 g) Mosaic® hops (5 min.)
1 oz. (28 g) Mosaic® hops (whirlpool, after 10 min. of cooling)
1 oz. (28 g) Mosaic® hops (whirlpool, after 20 min. of cooling)
2 oz (57 g) Mosaic® hops (dry hop)
Wyeast 1272 (American Ale II), White Labs WLP051 (California V Ale), SafAle US-05, or Mangrove Jack's M36 (Liberty Bell Ale) yeast
¾ cup corn sugar (for priming)

STEP BY STEP

Use 6.5 gallons (24.5 L) of water in the brew kettle; heat to 158 °F (70 °C). Turn off the heat.

Add the malt extract and sugar and stir thoroughly to dissolve completely. Add the first wort hops. Turn the heat back on and bring to a boil.

Boil the wort for 60 minutes, adding hops at the times indicated in the recipe.

Follow the remainder of the all-grain recipe instructions.

heavily hopped versions can carry some haze. The beer should have a well-formed, persistent head of white to off-white color that is produced by the medium to medium-high carbonation level.

The emphasis of the beer is hops, so the malt profile is fairly neutral and unobtrusive. Clean, grainy, neutral flavors are common, while caramel or toast accents are rare. The malt creates a medium-light to medium body and a dry-to-medium-dry finish. The malt provides a canvas for the hop expression and generally stays in the background. Likewise, the yeast profile is clean and neutral to lightly fruity, again staying out of the way of the hops.

The hop expression can be fairly strong, prominent-to-intense, in both the aroma and flavor dimensions. Modern American or New World hop characteristics are featured, with descriptors continuing to grow as new hop varieties are introduced. Citrus, pine, tropical fruit, stone fruit, resin, spice, berry, or melon are some descriptors. Generally anything that doesn't seem too European (English or German, mostly) is fair game. Hopping techniques vary, but having a strong fresh hop character from heavy dry hopping is common.

The stronger character of the beer should be evident in the taste and warmth of alcohol, but as with most beers, anything that is hot, harsh, solventy, or astringent is undesirable. Modern problems to look for are hop burn, where the quantity of hops creates its own scratchy, harsh feeling, and hop creep, where the hops create an overly attenuated and carbonated beer due to their added enzymatic activity. Neither of these is desirable, but both can be seen in many competitions.

BREWING INGREDIENTS AND METHODS

The selection of ingredients is very similar to what would be followed for an American IPA or a West Coast IPA — a large percentage of pale malts with a fairly neutral flavor profile, little to no crystal malt, American or New World hops, neutral-to-slightly fruity yeast. What often separates a double IPA from the other beers is the use of adjuncts. Simple sugar is most common, often around 10% of the grist, but I have used honey and I know others who have used rice or corn (rice has a more neutral profile).

Common base malts to use are a neutral 2-row North American pale malt, but Pilsner malt could also be used. I would steer clear of anything with too much flavor. I would skip crystal malt, but I don't mind adding a little Munich or Vienna malt as a way to add a little more maltiness with less sugary sweetness.

The mash program can be a simple single-infusion mash, but mashed for attenuation at the lower end of the conversion range (149–151 °F/65–66 °C). Step mashing can also be used to increase attenuation. Note that mash control and adjunct use are both working to reduce body and increase fermentability, so consider these two factors together when making decisions.

Hops are a personal choice for the brewer, and it seems like new versions are being released every season. Double IPA is a good style for hop experimentation, and can be made as a single-hop style. Many brewers choose the opposite approach, with multiple hop varieties selected. My only advice is to consider the interaction between the hop aromatics and avoid clashing choices.

Hops are often added in multiple additions to layer the impact. Additions can be added as traditional boil hops, first wort hops, late hops, hop bursting, whirlpool hopping, dry hopping, and other methods. Many commercial examples are double dry-hopped (DDH), which is an undefined marketing term that can mean two stages of dry hopping, double the dry hops, or both. My personal usage is to use it in the first meaning, since there isn't a standard amount of dry hops used in beer.

Neutral yeast is common in this beer, so the Chico/California Ale strain is perfect. I often switch it up and use the Anchor strain, Wyeast 1272 (American Ale II), in my American IPAs for its light fruitiness. Either is a solid choice, but the Chico yeast is probably most authentic for this style.

HOMEBREW EXAMPLE

My example is a simplified version of a collaboration beer I did in Brazil when I was first trying to demonstrate to them what modern IPAs taste like, as they often only had oxidized imported examples. My original version was a little more complex in the grist and included honey, while this version uses pale, Pilsner, and Munich malts along with white sugar. I think trying rice syrup solids instead of sugar would be an interesting take, more like a cold IPA.

I use a step mash in this recipe for attenuation, but if you prefer to make it as a single infusion, I would target 149 °F (65 °C) as the conversion temperature. Note that I'm not going too high on the starting gravity since I want the finishing gravity to stay on the low side, which is similar to how I make Belgian tripel. The ABV for the beer is around 8.3%, which is good since I try to keep it below 8.5%. Pliny the Elder is around 8%, so I don't think it's necessary to go overboard.

I'm using all Mosaic® hops, but if you have a personal favorite or a new hop you want to try, go for it. I am using multiple additions including first wort hopping for the bulk of the bitterness, as well as late additions and a sizable amount in the whirlpool. I do let the wort cool in the whirlpool before adding some of the hop additions to limit the isomerization of alpha acids, which has the effect of limiting IBUs while increasing the hop oil content. I'm dry hopping my beer in one addition, but you can split it in two additions or double it up if you want to call it double dry hopped.

The water profile is a balanced sulfate-to-chloride addition with enough calcium to support good mash conversion. I'm not looking for any water-specific effects, but I do worry about sulfates making the hops seem too sharp and flinty. At this level, the effect should be minimal. It's basically the same water profile I'd use when making a Kölsch.

IPAs are a very personal choice for people since they have different flavor preferences, bitterness tolerances, and personal biases. My version captures the drinkability of the style while showcasing the hops. I try to avoid extreme experiences but still deliver the bitterness and alcohol that the style demands. Hopefully, you will agree. BYO

PRESERVING THIOLS IN HOMEBREWING:



Thiol-driven beers can be some of the most expressive and rewarding styles to brew at home. Notes of grapefruit, passion fruit, white grape, or blackcurrant can leap from the glass even at extremely low concentrations. The challenge is that thiols are highly reactive, and oxidation after fermentation can very quickly strip these aromas from finished beer. In practice, many homebrewers successfully generate thiols during fermentation, only to lose a large part of that character during packaging and cold-side handling.

Discover two distinct, practical strategies for preserving thiols in homebrewing. The first works within a traditional bottle-conditioning setup. The second takes a bigger step and uses Cornelius kegs for fermentation and packaging, offering much tighter oxygen control. The starting point for either strategy is to design the recipe and fermentation to build and promote thiol expression, while planning the packaging process and equipment setup to help retain many of these thiols in the finished beer.

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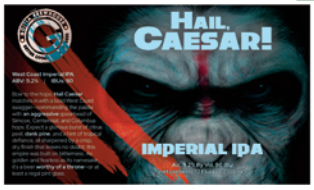



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BYO NANO CON ONLINE

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Seminar Descriptions

Friday, October 23, 2026

11:00 a.m. – 12:00 p.m. (Eastern)

LOW-ABV & NA BREWING STRATEGIES FOR NANOS

▶ *BREWERY OPERATIONS*

Don't miss out on the rising popularity of lower-alcohol or no-alcohol options at your taproom. *BYO*'s Technical Editor Ashton Lewis will walk you through the keys to successfully brewing and serving these low-to-no ABV beers on small-scale craft brewing systems. And just as importantly, what common pitfalls to avoid when tackling making these beverages in-house for your taproom.

ASHTON LEWIS, *INTERNATIONAL TECHNICAL ACCOUNT MANAGER, RAHR BSG*
TECHNICAL EDITOR, BREW YOUR OWN MAGAZINE

YOUR BREWERY START-UP LEGAL CHECKLIST

▶ *START-UPS*

Your to-do list when starting up a new nano brewery and taproom will always be a long one. However one mistake that many new brewery start-ups make is putting all their focus on the brewing and serving side and not enough on the legal aspects when getting ready to open a brewery. But don't worry – we have Matthew McLaughlin, an attorney specializing in alcohol beverage law who has helped dozens of new breweries through the start-up legal hoops (including his own craft brewery!) He will give you a checklist covering the legal needs to take care of and consider before you ever pour your first pint.

MATTHEW MCLAUGHLIN, *FOUNDER, MCLAUGHLIN, PC*

FORECASTING BREWERY CASH FLOW IN A CHALLENGING MARKET

▶ *BUSINESS OPERATIONS & SALES*

Over the last few years the craft brewing market has changed dramatically. All that change and churn has resulted in additional challenges for small breweries trying to get an accurate handle of their all-important cash flow projections. Understand the best strategies you can use to map out your brewery's cash flow in these ever-changing times with brewery financial expert Kary Shumway.

KARY SHUMWAY, *PUBLISHER, CRAFT BREWERY FINANCE*

12:15 – 12:45 p.m. (Eastern)

Q&A WITH NANO VENDORS

You can check in live with your choice of top craft brewing vendors to get your questions answered about nano-sized equipment, gear, ingredients, and supplies.

1 – 2 p.m. (Eastern)

NANO PANEL: PRIVATE TAPROOM EVENTS FOR PROFITS

▶ *BUSINESS OPERATIONS & SALES*

Your taproom spaces can pull double duty to boost your profitability especially during slower times. Many nano breweries are regularly renting out taproom areas to private groups for parties and functions creating a new revenue source. But there are plenty of common mistakes to avoid when getting into private rentals. Our panel of small craft brewery owners will discuss the pros and cons of adding or boosting private rentals to your overall business strategy.

ANDREW COPLON, *FOUNDER, SECRET HOPPER*
FOUNDER, CRAFT BEER PROFESSIONALS

NEW POURING TECHNIQUES FOR NEW CUSTOMER BEER EXPERIENCES

▶ *BREWERY OPERATIONS*

Think that your beer's final flavor is set once it is kegged? Think again, as Master Cicerone® and commercial draft beer expert Neil Witte explains how the pour can influence flavor in many directions. From adding a variety of faucet styles to your taproom to different pouring techniques, customers will get excited learning more about how flavors can change with each pour. And an excited customer is a good customer!

NEIL WITTE, *MASTER CICERONE® & OWNER/FOUNDER, CRAFT QUALITY SOLUTIONS*

PRACTICAL AI TOOLS FOR NANO FINANCIAL REPORTS

▶ *BUSINESS OPERATIONS & SALES*

Setting up the right financial reports for your nano brewery is important, but it can be time consuming taking away from the thousands of other tasks on your list. Brewery Finance expert Audra Gaiziunas is here to help you save time and still get the reports you need to make better business decisions for your brewery. She has done all the research for you on how to put AI to work creating reports and financial tools to make sense of your numbers without you having to spend hours creating your own spreadsheets. With Audra's help, let AI help you work smarter and not harder on the financial side of your business.

AUDRA GAIZIUNAS, *OWNER, BREWED FOR HER LEDGER, LLC*

2:15 – 2:45 p.m. (Eastern)

Q&A WITH NANO VENDORS

You can check in live with your choice of top craft brewing vendors to get your questions answered about nano-sized equipment, gear, ingredients, and supplies.

3 – 4 p.m. (Eastern)

FEATURED PANEL: NANO LESSONS LEARNED I WISH I KNEW WHEN I STARTED MY BREWERY

▶ *BUSINESS OPERATIONS & SALES/BREWERY OPERATIONS/START-UPS*

Hear stories from fellow nano brewers on important lessons they learned (and wish they knew earlier) after starting their breweries. Chances are their hard-won advice covering both the business and brewing sides can be put to use to help your own brewery.

JOHN HOLL, *HOST, BYO NANO PODCAST*
EDITOR, ALL ABOUT BEER

4:15 – 4:45 p.m. (Eastern)

Q&A WITH NANO VENDORS

You can check in live with your choice of top craft brewing vendors to get your questions answered about nano-sized equipment, gear, ingredients, and supplies.

5 – 6 p.m. (Eastern)

TRACKING MARKETING ROI AS A SMALL BREWERY

▶ *BUSINESS OPERATIONS & SALES*

As a nano brewery you are always running lots of different marketing campaigns – from beer release events to social media post promos to dozens of other ways to boost beer sales and foot traffic into your taproom. But how do you know if any of these efforts really worked or not? That's where brewery marketing wiz Julie Rhodes comes in to help you understand how to measure your return on investment (even if that investment is just your time). Learn how to track your marketing efforts so you can repeat those marketing campaigns that worked and leave behind those that failed according to the numbers.

JULIE RHODES, *OWNER, NOT YOUR HOBBY MARKETING SOLUTIONS*

SMARTER BREWERY INGREDIENT & SUPPLY PURCHASING TO GAIN MARGINS

▶ *BUSINESS OPERATIONS & SALES*

In today's current craft brewery landscape every penny counts. One area many breweries can improve their margins is improving how they plan their beer ingredient and supply purchases. Given your small scale (and usually smaller storage spaces), nanos need to be especially strategic when placing ingredient orders. Let craft beer industry veteran Audra Gaizunas show you how to use your past numbers and other planning strategies to order the right amounts of supplies while cutting down on costs to help your bottom line.

AUDRA GAIZIUNAS, *OWNER, BREWED FOR HER LEDGER, LLC*

TEST YOUR WAY TO BETTER BEER QUALITY

▶ *BREWERY OPERATIONS*

No matter how small your craft brewery might be, you need to run certain quality control tests on your beer. And don't worry, these basic tests don't require too much space, resources or cost. Brewery QC expert Audrey Skinner will walk you through the tests and equipment you need to make sure the beer you are selling to customers is the best quality it can be. And producing better quality beer will result in happier customers ordering more pints helping your business be more successful.

AUDREY SKINNER, *GASTRONOMICAL CHEMIST, IMBIBE SOLUTIONS*

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THE BEST BEER BENEATH KILIMANJARO

Two homebrewers discover craft beer in Tanzania

by Joel Takeuchi

Somewhere around 18,000 feet, I felt the full effect of the altitude. After several long days of hiking, we were finally at the summit approach. Our group was patiently enduring the struggle, each of us looking forward to the victory at the peak. Standing at 19,341 feet (5,895 m), Mt. Kilimanjaro, in Tanzania, Africa, is the tallest freestanding mountain in the world. Paul, on the other hand, was still doing dance moves in the conga line, like we were at sea level.

Paul Wade and I are homebrewers from Northern California. We met a few years ago at a meeting of our local homebrew club, the Solano Garage Brewers. We quickly discovered shared interests beyond brewing; a love for the mountains being one of the biggest. Summiting a mountain is amazing — the views, the relative solitude, the sense of accomplishment. Over the years, we've done a few ascents together, and often talk — over a beer of course — about our individual adventures. We believe in earning our beer, and after a long day of hiking and ascending a few thousand feet, a beer is well-deserved . . . and maybe even tastes better.



Photo by Joel Takeuchi

Sanga Joseph Massawe is the Co-Owner and Head Brewer at Maisha, a small craft brewery at the foot of Mt. Kilimanjaro that brews an IPA and blonde ale.

We had ascended Mt. Kilimanjaro over the course of six days, passing through diverse environments like the rain forest and the Afro-Alpine moorland. Each day seemed like a new adventure, an individual experience full of unique memories. There was a night of howling monkeys, lots of rocks to climb, and always new fauna to photograph. Fortunately, at the end of each day we were exhausted, so sleep came quickly in the tiny tent. We didn't have long to think about the fact we hadn't showered in several days. The only thing that seemed to be missing was a cold beer.

On a side note, one of the most impressive aspects of the trip were the hardworking porters. Every time we made it to camp, they had everything set up — our tents, the dining tent, and most importantly, the bathrooms. They were heroes who graciously listened to our complaints and made the trip bearable.

It took another day and a half to hike down to the exit at Mweka Gate, an access point for several of the routes used to summit Kilimanjaro. After completing the 42-mile (68-km) trek, I walked straight past the congratulatory sign, an obvious photo stop. I saw Paul sitting at a table next to the souvenir shop, where he had probably been for a while before anyone else made it down. "You get a beer yet?" I asked. I couldn't have cared less about the t-shirts and trinkets being hawked to exhausted hikers. My focus was entirely on the refrigerator. The only offerings were lagers from a few of the larger African breweries, but they were a welcome treat. We had definitely earned a beer.

After getting our boots washed, enjoying a lager or three, we got back in the van and went to a wonderful celebration hosted by the tour company. It was great to finally relax and party with our group. It was even more special to give a toast to the porters. The beers were well earned by all.

Our flight the next day didn't leave until the evening. It was just enough time to find another adventure. This one with a strong connection to home.

DISCOVERING MAISHA

After one of the most refreshing showers of my life and a great night of sleep, Paul and I were ready for more exploration. Naturally, we both had the same Google search in mind, "breweries." The big breweries showed up, of course — Serengeti and Tanzania, but they were an hour or more away. But then a phrase popped up next to one of the options that made the decision very easy. Under a brewery named Maisha it said, "Best IPA in Tanzania." No further searching was needed.

It took a little bit of explaining to the front desk for them to understand where we wanted to go. It seemed like they didn't know anything about Maisha. When they called the brewery for us, they were told it was closed until the afternoon. But after mentioning we were tourists flying out later, we were given the green light to visit. A ride was arranged, and we were on the way.

The directions took us through town and eventually down a dirt street with no driveways or house numbers visible along the road. Most of the properties had fences or walls around them and it was hard to know if there was a gate or any access. As we reached the red dot on the map, there was still no indication we were at the right location. We were looking at a metal fence with a small gate, but no signs of a brewery. The only sign on the gate appeared to be related to some kind of medical business. Our driver kept going, looking for something that said Maisha, or looked like a brewery. At the end of the street, he called the brewery again and, speaking in Swahili, was told someone would open the gate.

As we drove back towards the red dot, a gate at the medical business began to open. We drove inside and saw nothing resembling a brewery, or any kind of commercial operation. We appeared to be in the backyard of a residence, a large property with construction taking place on a couple of buildings at opposite ends of an expansive yard. As our driver stopped, a man emerged from around the corner of the building and walked towards

the car. When we got out and looked towards the portion of the building from where the man had come, our eyes got a glimpse of some familiar sights. Behind the man, inside a space roughly the size of a single-vehicle garage, we saw a brew kettle and the unmistakable shine of stainless-steel fermenters. We had arrived at Maisha.

The man who greeted us was Sanga Joseph Massawe, the Co-Owner and Head Brewer for Maisha. Our adventure at Maisha was one of fate. As Paul and I walked into the brewery, we could smell the sweet scent of mashing grains. "I'm brewing my IPA right now," said Sanga.

In discussion with Sanga, we learned after much experimentation he decided to focus on two main beers, a blonde ale and an IPA. He didn't have any of the blonde available, but after being there for just a few minutes, Sanga's assistant, Naso, brought out some bottles of the IPA. "Please tell me what you think," Sanga said with curious eyes.

The beer had a beautiful, white foamy head, and the clarity was stunning. "This is what we've been missing," said Paul. The aroma wasn't very strong compared to the IPAs we were accustomed to, but the taste had the classic tropical, citrus, and piney notes you expect from Mosaic® hops. The clarity and lager-level ABV was strategic, as Sanga is trying to introduce a different style of beer to his community. That first beer turned out to be one of many, as we spent the whole day brewing with Sanga and Naso, and learning about the story of Maisha.

THE STORY OF MAISHA

Sanga and his brother, Sadick, started brewing as a hobby. Like many of us, they started by brewing small batches in their kitchen.

"We have always wanted to start a beverage manufacturing company. While growing up, our mom used to make a local banana beer, which we enjoyed helping with," said Sanga. "Naturally, one day Sadick and I decided to make our own beer."

As they gained knowledge and skills, they moved from 1.5-quart/L batches, fermented in a water bottle, to a 5-gallon (19-L) bucket. Like most homebrewers, they learned by reading, watching videos, and brewing batch after batch.

"For two years we brewed regularly, trying to perfect our art. We read brewing literature, watched YouTube videos, found like-minded brewers, experimented with hundreds of recipes and brewing techniques. We began sharing our brews with friends and relatives, who provided positive feedback," Sanga told us.

Spurred on by the support of their family and friends, they began to look for larger equipment. With no local homebrew shop, nor many brewing suppliers in their part of the world, their search expanded, and yet was paradoxically confined to mostly international vendors for equipment and ingredients. "(Sourcing equipment) has been one of our major challenges considering our capital and size. Our friends and family have helped support our passion with the purchases of bigger equipment."

With much of the equipment coming from China, we observed dents and other imperfections in the fermenters, evidence of the challenges of the long shipping distance. The brewhouse was a basic three-vessel, propane-fired system, with a 26-gallon (100-L) boil capacity. It takes three turns for Sanga to fill the 79-gallon (300-L) fermenters.

"My brew day takes around 18 hours," Sanga said.

And we thought our six-hour brew days were long.

Since much of the capital was consumed with building up cold-side capacity and quality, the hot side and other accessories were in obvious need of improvement. The valves weren't always the right size, so various adapters and mismatched hoses were used. The one small chugger pump was noticeably tired.

With small propane burners, Sanga told us it is difficult to control temperature and achieve an even boil.

"I scorch the bottoms of my pots often," said Sanga. "And the design of the kettles makes it difficult for wort recirculation."

Despite the challenges, the beer kept improving, and after four years they moved from the kitchen to the larger space. Sanga and Sadick registered the brewery in 2021 and now brew and package close to 2,000 bottles per month. The beer is served to visitors at the brewery, usually friends and locals, but they also have a few accounts with restaurants and hotels.

"We distribute around Moshi and our neighboring tourist city, Arusha. We see the potential for selling more craft beers in the country. We just need to find ways to upgrade our equipment, explore more ingredients, improve quality and efficiency, and introduce more styles."

"THE BEST IPA IN TANZANIA"

Sanga's IPA is a SMaSH (Single Malt



Photo by Joel Takeuchi

The Maisha brewing system is a large homebrew-style three-vessel, propane-fired system with a 26-gallon (100-L) boil capacity that requires three brews to fill the 79-gallon (300-L) fermenters.

and Single Hop) beer, with Pilsen malt and Mosaic® hops.

"I use 22 kilograms (48 lbs.) of Pilsen malt in each batch," said Sanga. "We get our grains from the U.S. or Nairobi, Kenya. We have bought local barley and malted it ourselves, but this adds more time and challenges." Sanga mills the grain in a mill similar to what homebrewers use, which is adequate for the amount of grain in each brew day.

Each batch of IPA uses about 130 grams (4.6 oz) of hops on the hot side in addition to a small dry-hop addition. Sanga sources the hops from online distributors, usually from the U.S. It's a small amount of hops compared to IPAs we are used to, but with ingredients being such a commodity and local beer drinkers still being introduced to the style, it works.

"I wanted my beers to mirror what was popular here in Tanzania, but with an exploration of flavor. I like hops and Mosaic® is very popular, but you can't make the beer too bitter here," said Sanga.

When I asked how a hazy IPA might be received by the locals, Sanga didn't hesitate. "People also expect the beer to be clear like a lager," he said.

The longer we chatted, the more curious we became and started peppering him with questions, as homebrewers so often do when discussing brewing with other brewers.

"What about a hoppy Pilsner, international pale lager, or offer an IPA series that explores different hops?" we asked. Sanga looked intrigued.

"What about your water?" asked Paul, inquiring where it comes from and how he treats it.

"I use tap water that I have tested in the laboratory. The profile, measured in mg/L, is pH 7.82, calcium 3.2, sulphate 0, magnesium 0.48, chloride 13, sodium 52.9, and alkalinity ($CaCO_3$) 40. No salt additions," said Sanga.

For fermentation, Sanga uses SafAle US-05. Dry yeast is easier to manage than its liquid counterparts, suitable for longer storage, and is ideal for brewing neutral and well-balanced ales. Given all the supply challenges Sanga has faced, dry yeast seems like the most logical choice.

BEER BRINGS PEOPLE TOGETHER

As most of the readers here know, brew days are often when friends and other brewers love to hang out (and interrupt your brewing). Paul and I got to do exactly that with Sanga. We dove right in helping with his brew day and tried not to get in the way. We were able to stay through two batches, helping to mash in and observing how he transferred to the fermenter.

Maisha's brewhouse is in need of upgrades, but capital is limited. The three-burner deck sits on a slight slope in the front. Since his kettles only have 26-gallon (100-L) capacity, to fill the fermenter with three turns, the boil volume is right to the top. Due to the unlevel deck, there is no margin for error. I tossed in too many hops during one charge and caused a momentary boil over. Sanga fired me and did the rest himself.

Watching Sanga work through the series of valves and assortment of hoses was impressive, but clearly inefficient. Still, he makes a damn good beer. Plus, every time our glass was empty, Naso would appear with another bottle of IPA. It was an awesome brew day.

Throughout the day, we each shared the brewing knowledge we possessed and bounced around all kinds of ideas for how we could help Maisha grow. Before we departed, we exchanged



Photo by Joel Takeuchi

Paul and author Joel Takeuchi (right) pose with Naso, who helps Sanga in the brewery.

contact information with Sanga and Sadick. We promised to bring his story back to the homebrew club and to do whatever we could to help. In that day, we had become not just fellow brewers, but brewing brothers.

Back home, Paul got Sanga connected to the Solano Garage Brewers website and access to all the educational material and brewing stories. At the next meeting, we presented the story of Maisha to the homebrew club. Our fellow brewers were on board with doing what we could to support our international brother. One of the ideas was to start a movement called "Brewers Without Borders," a play on another famous international organization. Knowing what I know about beer lovers and brewers, if we connected homebrew clubs in the U.S. with brewers in parts of the world where there may not be many resources, remote collaborations would begin. After all, beer brings people together, and brewing is the process of making connections. We're still trying to figure out how to get the idea off the ground, if any readers of this article want to help!

Sanga told us Maisha, in Swahili, means "life."

"It is a common saying in Tanzania that if you don't have money, then you don't have life. We noticed," laughed Sanga, "when people were complaining they don't have life because they have nothing in their pockets, we would give them one of our beers, and they would stop complaining. We quickly realized, Maisha beer is about restoring life to people."

The Maisha IPA bottles feature a basic graphic of the iconic shape of Mt. Kilimanjaro as it appears towering over the skyline of Moshi. On the back of the Maisha IPA label it says:

"This brew was initially home crafted and since it tastes so good it was time to share it with everyone in order to strengthen our friendship. Now enjoy a brew that is made from the finest ingredients of the motherland, Tanzania."

Paul and I look forward to brewing up our own version of Maisha IPA here in the U.S., and can't wait to discover all the ways we can strengthen our new friendship.

MAISHA IPA CLONE

(5 gallons/19 L, all-grain)
OG = 1.050 FG = 1.010
IBU = 21.5 SRM = 3 ABV = 5.2%

INGREDIENTS

10.2 lbs. (4.6 kg) Pilsner malt
4.2 AAU Mosaic® hops (75 min.)
(0.35 oz./10 g at 12% alpha acids)
0.5 oz. (14 g) Mosaic® hops (5 min.)
0.7 oz. (20 g) Mosaic® hops (dry hop)
1 Whirlfloc tablet
SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

This recipe uses a step mash. Begin by mashing the grains in 3.5 gallons (13 L) of water for 15 minutes at 122 °F (50 °C). Raise to 154 °F (68 °C) and rest for one hour. Then raise the temperature to 165 °F (74 °C) for 20 minutes before sparging with enough water at 172 °F (78 °C) to collect 6.5 gallons (24.5 L) in your brew kettle.

Boil for 75 minutes, adding the first hop addition at the start of the boil. Add Whirlfloc with 15 minutes remaining, and with five minutes remaining add the second hop charge.

At the completion of the boil, chill the wort to 68 °F (20 °C) and pitch yeast. Ferment at this temperature until fermentation begins to slow, then allow temperature to increase to 73 °F (23 °C) until finished fermenting. Chill beer to 50 °F (10 °C) and add the dry hops for four days.

Add priming sugar and bottle condition or keg and force carbonate as usual to 2.4 volumes.

MAISHA IPA CLONE

(5 gallons/19 L, extract only)
OG = 1.050 FG = 1.010
IBU = 21.5 SRM = 3 ABV = 5.2%

INGREDIENTS

5.5 lbs. (2.5kg) Pilsner dried malt extract
4.2 AAU Mosaic® hops (60 min.)
(0.35 oz./10 g at 12% alpha acids)
0.5 oz. (14 g) Mosaic® hops (5 min.)
0.7 oz. (20 g) Mosaic® hops (dry hop)
1 Whirlfloc tablet
SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Heat 6 gallons (23 L) to a boil. Remove from heat and slowly stir in the dried malt extract until fully dissolved. Return to heat and boil for 60 minutes. Add the first hop addition at the start of the boil. Add Whirlfloc with 15 minutes remaining, and with five minutes remaining add the second hop charge.

At the completion of the boil, chill the wort to 68 °F (20 °C) and pitch yeast. Ferment at this temperature until fermentation begins to slow, then allow temperature to increase to (23 °C) until finished fermenting. Chill beer to 50 °F (10 °C) and add the dry hops for four days.

Add priming sugar and bottle condition or keg and force carbonate as usual to 2.4 volumes. BYO



Photo by Joel Takeuchi



Photos by Steve Parsons

BUILD A BETTER PELTIER-COOLED CONICAL

Quiet and efficient cooling

by Steve Parsons

We all know the importance of keeping our fermentation temperature in the ideal range for the specific yeast being used and avoiding fluctuating temperatures. As homebrewers, there are a number of ways to achieve this, with the best option for each individual depending on their own preferences, price range, and space. For me, I wanted something small, neat, and quiet to help keep my fermentation temperature dialed in. These requirements eventually led me to build, and refine, a Peltier cooling system. Though, that wasn't my first choice.

I started my attempts at temperature control with a water jacket, a pump, and ice bath. It worked OK, but it was messy and required a water reservoir and constant ice replacement. After that, I looked at glycol systems, but they would be overkill for my needs. Fridges were another possibility, but they would need to be large enough to fit the conical, which wasn't a great option for my space.

I read online about Peltier cooling and decided to give it a shot. A Peltier chip is a thermoelectric cooler (TEC) that transfers heat from one side of the chip to the other. By mounting a Peltier chip against an aluminum block machined to the conical's curve, the device pulls heat from the fermenter and a fan dissipates the heat externally. There are several Peltier builds on the internet, but none of them exactly suited my needs, so I decided to build my own solution from scratch. There are two links at the end of this article for other builds, both quite similar to each other. I suggest you read them as well before embarking on this project as there are some good ideas in each, some of which I borrowed or based my own build on. Before we get to my own design, let's discuss Peltier-chilling systems in a little more detail first.

WHO NEEDS A PELTIER-COOLED CONICAL?

This project will ideally suit someone who has a conical fermenter and needs to keep their wort at stable fermentation temperatures. It is best suited for fermenting ales, as the cooling needed for ale fermentation is minimal (usually within about 10 °F/5 °C of room temperature). It will also cool to lager temperatures, but that requires a bit more power, so the fans will be louder. This equipment will handle crash cooling, but the power draw is again larger and the fans will be noisier. It will suit any conical from 6–15 gallons (23–57 L). If you require both heating and cooling, that too is possible, but I'll let you work out the wiring for the heating as I don't have that need where I live.

I've tested many things and found better ways to do much of it, so if you already have a Peltier-cooled conical, keep reading as you may find these tips useful to further enhance your system.

THE BUILD

Before you start this DIY, know we are working with electricity, which can be



TEC1 12710 Peltier chip.

dangerous if you are not careful. If you are not comfortable with your abilities, consult an electrician.

My fermenter is a 12.5-gallon (47-L) stainless steel conical that I bought on Ebay, now fitted with four TEC1 12710 Peltier chips that easily satisfy my fermentation needs.

I have brewed 10-gallon (38-L) batches, but my normal batch size is 6 gallons (23 L) (of which, 5 gallons/19 L go into a Corny keg and the rest is bottle-conditioned.

My conical is slightly pressure-capable and I route the blowoff CO_2 through a Corny keg into a bottle of sanitizer. This way I can do an oxygen-free transfer into a pre-purged keg. I also have a port in the lid so I can dry hop without introducing oxygen.

The Peltier systems I originally looked at use two aluminum blocks that require the conical to be fairly full to operate. My preferred batch size only comes to about 3 inches (7.5 cm) above the top of the cone, so my Peltiers had to be mounted very low. Also, the aluminum blocks would have to be purchased or machined by very expensive CNC machines. A further complication was that my conical is not a brand name that the commercially available blocks would be guaranteed to fit.

My solution was to engineer my own much smaller and easier-to-make aluminum blocks, which is the first major deviation from the traditional setup. Cutting a precise curve in aluminum to fit a conical is difficult and expensive, so my solution had to be easy and cheap.

For this, I bought a small 1/16-inch thick sheet of aluminum and cut a 1.5-inch (3.8-cm) strip. Then you can easily bend the strip around something slightly smaller than the conical (I used a 5-gallon/19-L kettle). Put the strip against the side of the conical and find a length that fits best and then cut a 1.5-inch (3.8-cm) length (resulting in a square piece of aluminum exactly the size as the Peltier chips). The curved side will go against the surface of the conical, exactly matching the curvature and the flat side will go against the Peltier chip. As I said, cutting curves is very difficult, but milling a flat surface is pretty easy. Leave one side of the Peltier-sized strip with a curve (the concave side), and mill the other side flat. There are many ways to cut a flat surface such as grinding, sanding, filing, etc. I used a pillar drill with a spiral end milling cutter and a cross-slide vice to mill the flat surface required. If you are not comfortable with home milling, any engineering shop should be able to do this for you. Use fine-grit sandpaper to lap the curved side to the conical, and use a sheet of glass or other perfectly flat surface with fine-grit sandpaper on it to sand the flat side to get a smooth finish. Make four of these.



This was an early attempt at the aluminum plate that requires one side to be straight and the side that will butt up to the fermenter to have a matching curve to the wall of the fermenter.

Use two adjustable hose clamps, one top and bottom of the aluminum plates, short uprights either side of the plates will enable connection to the heatsinks. These have a slight bend in them to allow for the mounting screw heads. The screws face outwards to allow for connection to the heatsinks (which I scavenged from old computers).

The plates are then glued to the conical using a thin layer of thermal glue. I originally used thermal paste but condensation on the sides of the conical eventually washed away the paste. You may want to start with thermal paste and change to glue when you are confident with your build.

You will need to insulate your conical. I used K-Flex rubber sheet insulation, which works well.

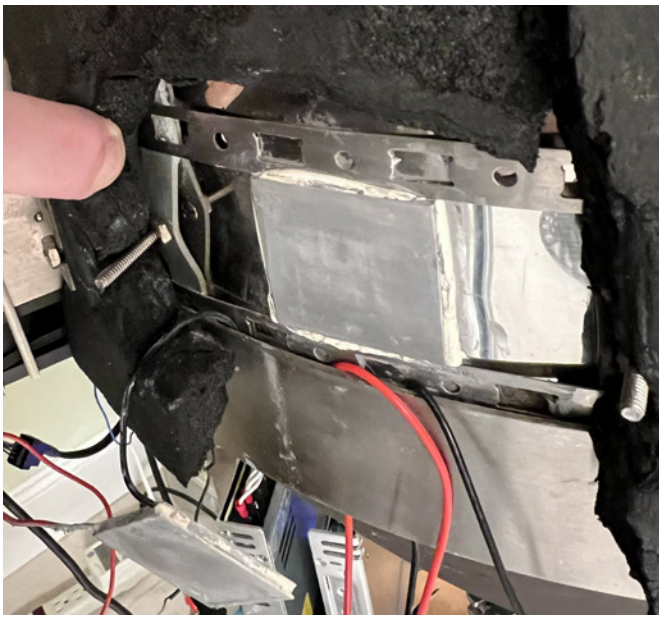
The top half is fairly straightforward, just cut to length of the cylinder and cut out for the chips, heatsinks, and fans. Cutting to insulate the cone is more difficult. Google "How to make a pattern for a cone shape" and you will find several informative videos on how to do this. I have included a link at the end under "Reference Materials."

You will need to apply a very thin layer of thermal paste to both sides of the Peltier chip, I used an old credit card to evenly spread the paste, which is then placed on the aluminum plate with the text / model number (cold side) facing the conical. Black wire will be on the right. Heat sink is then secured to the conical fitting snugly against the TEC1 12710 Peltier chips.

I had to drill small holes in the heatsink to allow the mounting screws to pass through, and then fastened with a nut.

With the heatsinks in place, now is the time to mount the fans. I used elastic cord but there are several ways to accomplish this. I found mounting the fans on the bottom of the heatsinks blowing upwards through the vanes was the most effective method. Your mileage may vary depending on heatsink design and orientation.

I purchased a 5-pack of Arctic P8 fans, which are extremely quiet. This gave me one for each heatsink and one for the power supplies, which I put



The aluminum plate is glued to the side of the conical with large hose clamps on the top and bottom. Also shown is the mounting for the heatsinks.



Heatsink mounted on top of the Peltiers, my heatsinks are narrower than my fans, so I used a cut down credit card to fill the gap.

back-to-back with the fan sandwiched in between. The airflow of the fan is adequate to keep the power supplies cool enough where their internal fans do not need to come on. I reversed the direction of one of the internal fans so when needed, all the fans draw in the same direction.

I then bought a couple of cheap drop-down voltage controllers to reduce the 12V from the power supplies so I could control the fan speed to that required to keep the heatsinks cool without the noise of full speed fans.

TEMPERATURE CONTROL

You will need a 110/120V temperature controller. The probe will be attached to the outside of the fermenter or if you have a thermowell you can insert the probe into that. I started with a thermowell but found the temperature readings on a probe on the outside of the fermenter (under the insulation) to be so close that I now only use that.

You can also use other temperature controlling solutions such as BrewPi/Brewblox, which I now use with a Raspberry Pi-based controller with two Arduinos that in turn control the power supplies. This turned out to be a perfect solution for me — I have one channel controlling each pair of chips, with one channel set half a degree higher than the other so it cuts in if further cooling is needed. Temperature stability is stellar, usually plus or minus less than 0.2 °F (0.1 °C) of the set point. I think it is best to start with a simple controller.

POWER SUPPLY

This is where you have to make some decisions. If you only need a 10 °F (6 °C) drop from the ambient room temperature to your fermentation temperature, then a 100W power supply should be sufficient. If you're brewing lagers or are in a room that gets hot in the summer and need a 20 °F (11 °C) drop, it will require 300–350W. Cold crashing will require even more. The important thing here is to estimate the difference between your maximum room temperature and the minimum fermentation temperature needed.

If you have an old computer power supply laying around, that will be a good start and then you can upgrade from there.

I use two Mean Well LRS-350-12 power supplies. These are well-suited to the task, although slightly noisy when the internal cooling fans kick in. This gives me all the power I need for multiple configurations. The voltage can be adjusted between about 10–13.5 volts, giving more flexibility in powering the system.

VOLTAGE CONTROL

This is where the fun begins — you will need to experiment with various configurations to suit your fermentation needs. This build is extremely flexible: You can use a high-power configuration to quickly cool 80 °F (27 °C) wort to pitching temperature, then rewire to low power for the rest of the fermentation, an almost silent configuration. Here are some suggestions:

Don't run 12V Peltier chips at 12V

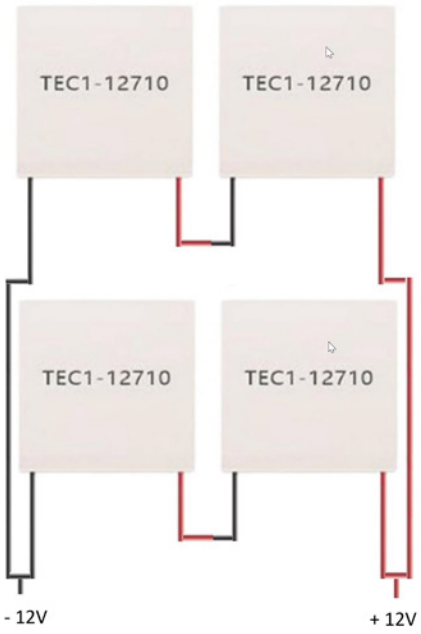
They are very inefficient at or near max voltage. If you reduce the voltage, efficiency improves. The trick is to supply slightly more power to the chips than you need to maintain temperature so the controller can cut in and out to keep the brew at the set temperature and keep running near highest efficiency for your system.

For ales — 10–12 °F (6–7 °C) below ambient room temperature

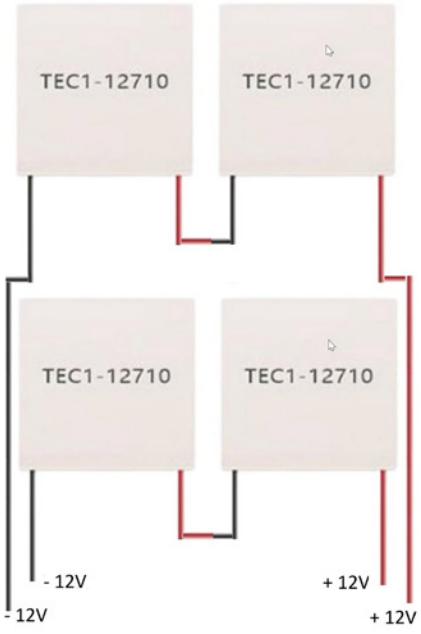
Run four Peltiers in series. With a 12V power supply, each chip gets 3V and the fans can run at 6v. This is my favorite configuration as the unit is virtually silent and draws the least power.

For lagers and cold crashing — 20–30 °F (11–17 °C) below ambient room temperature

With a single power supply you can have the two chips in series, in parallel with the other two chips in series. 6V per Peltier. The wiring required for that is shown on the following page.



Suggested wiring for single power supply.



Suggested wiring for dual power supplies.

If you are building a system with two power supplies then you will use the top configuration with each set of chips having its own power supply. This will allow you to control each set of chips independently.

Extreme cold crashing — 30–40 °F (17–22 °C) below ambient room temperature

All four Peltiers will run in parallel, 12V to each.

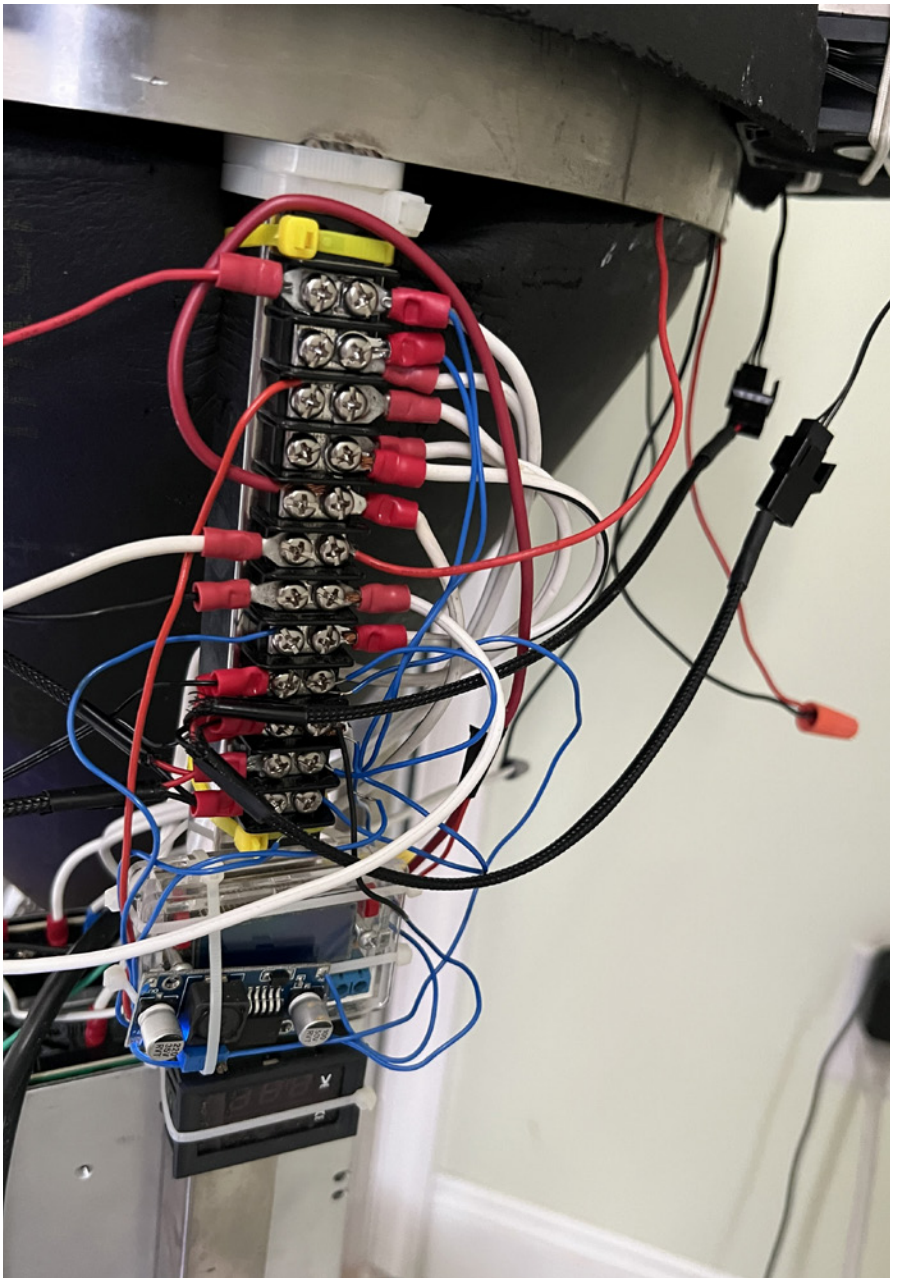
I would suggest two power supplies for this, as you will be drawing about 40 amps total, 20 from each supply. Your wiring and connections will have to handle very high current, you will need more powerful fans than the ones specified, as well as large and efficient heatsinks.

Use fan power adapter cables to connect your fans to the terminal block. This will allow longer lengths of cable and also allow for quick and easy fan connection or swap if needed. The 4-pin cables fit 3- or 4-pin fans, although only two connections are needed. Pin 1 (Gnd) and pin 2 (+12V).

When you have tested everything, run a trial with water in the fermenter to see how it performs. When you are happy with the performance, time to try it out on a brew. Remember, wort will need more cooling power as fermentation produces heat.

RESULTS

I am getting better cooling with two chips in series than one chip at full voltage, using half the power. One chip at 12V draws about 120W, while two chips in series draw about 60W and the cooling is more effective. Another



I still need to tidy up my wiring, but using a terminal block allows for quick wiring changes. I can easily convert from four Peltier chips in series to two sets of two Peltier chips in series. I will be adding a shroud to protect from possible spills when I finalize the wiring.

bonus, the much lower current draw means that the heatsinks now barely get warm, requiring much less airflow from the fans. At chip voltage of 12V each, heatsink exceeds 100 °F (38 °C), at the much lower current the heatsinks are in the 70s °F (low- to mid- 20s °C).

Just for fun I connected all four Peltier chips in series and reduced voltage to 10V. It is currently keeping 6 gallons (19 L) of English ESB (SG 1.061) at a constant 66 °F (19 °C) during the height of fermentation and drawing 21 Watts, at a duty cycle of about 2/3 (cooling for ~30 minutes, idling for ~15 minutes). Room temperature is 75 °F (24 °C), yet the fan noise is just a whisper.

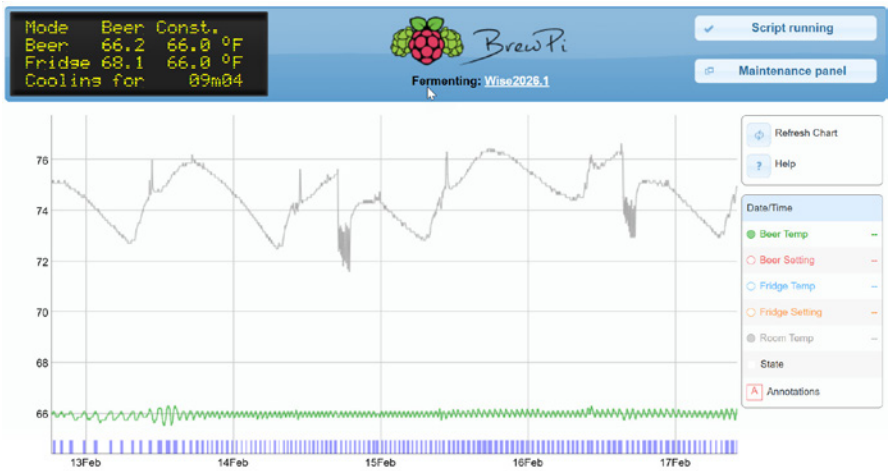
The cost to run is negligible, at about 25 cents per week. Say 25 Watts at average duty cycle (both actively fermenting and just keeping cool) of 50%. 25 x 24 x 7 x 50% = 2.2 kWh at 11 cents per kWh.

If I were to build again, I would probably only use one power supply and temperature controller (still BrewPi) as the Peltier chips have been extremely reliable and I haven't needed to replace one for years. I would use a much less powerful power supply, possibly a variable supply, so I could keep all four chips in series and vary the power to just over that needed to cool to the desired temperature. That way the chips are operating at their most efficient.

If you want to heat the beer instead of cooling it, it is fairly straightforward to reverse the voltage to the Peltiers.



Running in "economy mode," all four Peltiers in series, power at 10V (2.5V per Peltier), fans at very low power, drawing only 21 Watts.



My current fermentation. The blue lines at the bottom are where the cooling is active. They get denser when the room is warmer and during active fermentation.

A NOTE ON COMPONENTS

Don't buy cheap Chinese LED power supplies. They almost always overstate the power they can produce by a large margin. Use a well-known and reliable power supply.

Heatsinks are at the heart of the system — use large heatsinks with plenty of vane surface area. Peltier chips produce a lot of heat, especially at higher power settings requiring efficient cooling. BYO

Reference Materials:

Two other Peltier builds, both use the large CNC-engineered aluminum blocks:

Build 1 (from the American Homebrewers Association)
Build 2 (from Cian Clark)
Brewpi documentation
Peltier efficiency reference
Cut pattern for a cone

Parts List:

- Stainless steel conical fermenter
- (4) TEC1 12710 Peltier chips
- Adjustable stainless steel hose clamps
- 1/16-inch thick sheet of aluminum
- K-Flex rubber sheet insulation 1/2- or 3/4-inch
- 5-pack Arctic P8 fans (These are suitable for lower-powered builds as they are extremely quiet. If you need lower temperatures look for more powerful fans.
- 110/120V temperature controller (Many options here, if you are in the U.S. make sure it displays Fahrenheit, many don't.)
- Mean Well LRS-350-12 power supplies (1 or 2 depending on power requirements)
- Fan power adapter cables
- Terminal block
- Drop-down voltage controllers
- Wires and ring connectors to suit.

THE FLAVOR NETWORK BEHIND YOUR *Best Brews*

Using flavor science to design better beer recipes

by Antal Németh

Ever wonder why some ingredient combinations just work while others fall flat? Or why beer seems to play nice with almost any flavor you throw at it?

Researchers led by Albert-László Barabási at Northeastern University mapped the mathematical reason — 56,498 recipes, 381 ingredients, and one surprising discovery: Beer occupies a sweet spot in the global flavor network that makes it uniquely suited for creative brewing. Understanding this network logic can help you design better recipes.

Through this article, I'm going to explain what the scientists found in their research and how to use it in your next brew. But first, a note on the science and the author:

I'm Antal Németh, founder of MONYO Brewing in Budapest, Hungary. I have spent more than a decade as a professional brewer, and just as long teaching homebrewing workshops and writing about beer science. My background is in adult education, working as a university researcher and lecturer, so translating peer-reviewed science into something actually useful, rather than just cited, is what I do.

When I first encountered Barabási's flavor network research, I built a custom analysis tool using the published dataset directly. The network measurements and ingredient connections cited in this article come from that analysis of the publicly available dataset (Ahn, Ahnert, Bagrow & Barabási, Scientific Reports, 2011). The brewing applications and recipe strategies are my own interpretations of how these principles translate to the brewhouse.

THE FLAVOR NETWORK DISCOVERY

Ahn, Ahnert, Bagrow, and Barabási's team at Northeastern University did something fascinating: They mapped how every culinary ingredient connects through shared flavor compounds. Think of it like a molecular compatibility map — ingredients that share flavor molecules tend to pair well together.


CITRUS
WHEAT
PINE
NUTTY
STONE FRUIT
CHEESE
TOAST
SPICE
CHOCOLATE
VANILLA
COFFEE
DARK ROAST

When they analyzed beer specifically, something remarkable emerged. Beer connects to ingredients across more flavor categories than any other alcoholic beverage in the network — bridging grains, fruits, botanicals, dairy, and fermented foods simultaneously. But it wasn't just about quantity. Beer's real advantage was where those connections led.

The network revealed that beer bridges multiple ingredient categories simultaneously — grains, fruits, spices, dairy products, and roasted ingredients. It connects to citrus through hop terpenes, to chocolate through malt pyrazines, to cheese through fermentation compounds. This multidirectional connectivity is what network scientists call a "bridge position," and beer scores 0.634 on a 0-to-1 scale (where 1 would be a perfect universal connector), based analysis of the published dataset.

What caught my attention: When looking at these network properties together — connections, bridge positioning, and category flexibility — beer consistently scored higher than other fermentable bases. Not because we wanted it to, but because the math kept saying so.

Let's make this practical.

WHY YOUR BEST EXPERIMENTAL BREWS ACTUALLY WORKED

Example 1: That Surprisingly Good Strawberry Wheat

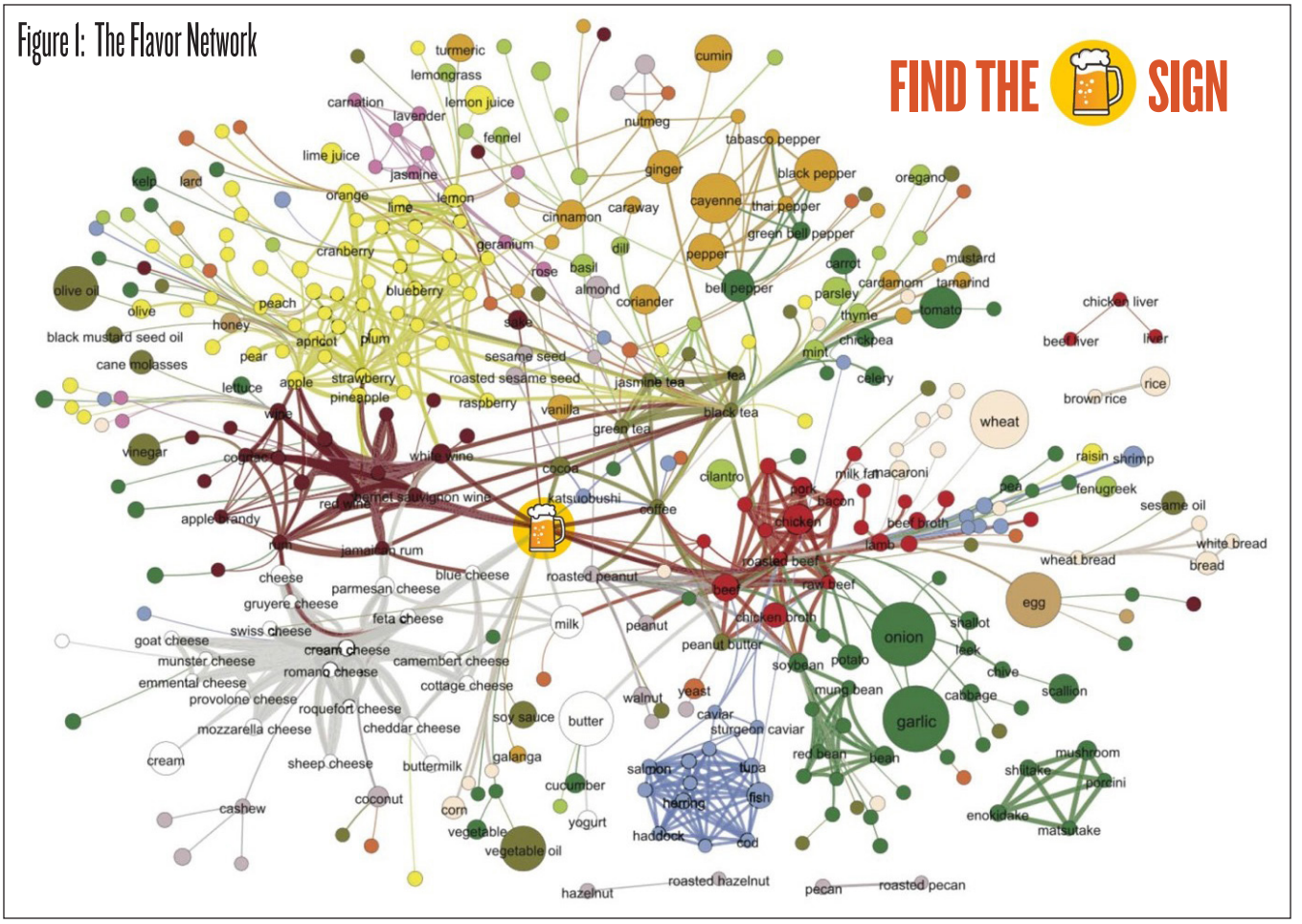
If you've ever brewed a strawberry wheat and been surprised at how naturally it worked, network science has an explanation. (And if you have not, listen up because you may want to give it a try!)

Wheat is a common base for fruit beers, in part because it ferments dry, leaving little residual sweetness to compete with fruit aromatics. But here's the network part: Wheat shares 44 flavor compounds with strawberry — the highest overlap of any common fruit, based on my analysis of the published dataset.

Try this: Next time you brew a fruited wheat beer, consider the fruit's network compatibility:

- **Strong overlap (25+ compounds):** Strawberry, raspberry, mango, blackberry → fruit amplifies the base
- **Medium overlap (15–24 compounds):** Blueberry, apricot, peach, orange → fruit adds dimension
- **Lower overlap (under 15 compounds):** Cherry, lime → deliberate contrast, use intentionally

Figure 1: The Flavor Network



Each circle in the flavor network represents a culinary ingredient; circle size reflects how frequently it appears in recipes. Two ingredients are connected by a line if they share a statistically significant number of flavor compounds — the thicker the line, the more compounds they share. Colors indicate food category. Alcoholic beverages (dark red cluster, center-left) sit at a crossroads between fruits, dairy, meats, and botanicals — visually reflecting their role as flavor bridges. Beer is highlighted within the alcoholic beverages cluster. Figure courtesy of Scientific Reports.

Example 2: The New England IPA Fruit Addition Secret

Ever wonder why so many New England IPAs include fruit additions? It's not just trend-hopping (pun intended) — it's network logic.

Modern American hops like Citra® and Mosaic® share 15+ flavor compounds with tropical fruits. When you add mango to a Citra®-hopped NEIPA, you're not introducing foreign flavors — you're amplifying what's already there. The specific bridge comes from thiols — aromatic compounds that Citra® and Mosaic® produce in unusual abundance, and that are found in the same tropical fruits.

Recipe idea: Network-Amplified NEIPA

Grain Bill:

- 85% 2-row pale malt
- 10% flaked oats (texture bridge)
- 5% white wheat malt (haze stability)

Hops:

- Citra®: 2 oz. (56 g) whirlpool (170°F), 2 oz. (56 g) dry hop day 3
- Mosaic®: 1 oz. (28 g) whirlpool (170°F), 1 oz. (28 g) dry hop day 3

Fruit Addition:

- 2 lbs. (0.9 kg) mango purée, added on day 5 of fermentation.

Yeast:

- Wyeast 1318 (London Ale III)

Fermentation temperature:

- 68 °F (20 °C) (fruit flavor complements the NEIPA character and promotes haze)

The network logic: Upon closer review of the dataset, mangos share 36 flavor compounds with hops (and passion fruit shares the same number). You're not adding complexity with the mango addition, you're adding clarity to the tropical character already found in the beer.



Photo courtesy of Shutterstock.com

Mango is often found in hazy IPAs because it complements the hops often used in this style, sharing 36 flavor compounds with hops!

Pro tip: This is why passion fruit works brilliantly in IPAs — it mirrors mango's overlap almost exactly. Coconut behaves differently: Its flavor profile is dominated by lactones, a compound family that sits outside the terpene-driven hop-fruit continuum. The network confirms the intuition: Coconut feels like a different conversation.

Example 3: The Brown Ale That Became Something Special

Brown ales are classic, but let's be honest, they can be boring (this isn't just my opinion — how many trendy breweries do you know with a brown ale in regular rotation?). Here is a network-approved upgrade that will transform a standard brown into a dessert-worthy experience.

The Traditional Problem: Brown ales have lovely biscuit-toffee malt character to them, but they often lack a "wow" factor.

The Network Solution: Look at what brown ale malts naturally connect to — caramel, nuts, vanilla. These aren't random; they share Maillard reaction products from the kilning process.

QUICK NETWORK HACKS

High-Connection Ingredients (use as versatile bases)

- Beer (187 connections)
- Wheat (89 connections)
- Vanilla (76 connections)
- Honey (51 connections)

Bridge Ingredients (connect distant flavors)

- Vanilla (dessert ↔ spice ↔ fruit)
- Honey (sweet ↔ floral ↔ fermented)
- Coriander (citrus ↔ spice ↔ grain)

Amplifiers (boost existing character)

- Mango + Citra® hops (18 shared)
- Chocolate + roasted malt (18 shared)
- Orange + hefeweizen or witbier yeast (25 shared)

Contrast Creators (deliberate tension)

- Salt + anything (0–2 shared, use for enhancement)
- Hot peppers + malt (3–4 shared, use sparingly)
- Smoke + fruit (2–5 shared, creates complexity)

Recipe idea: Hazelnut Vanilla Brown Ale
Grain Bill:
- 75% Maris Otter malt
- 10% Munich malt (amplifies maltiness)
- 8% crystal malt (60 °L) (caramel bridge)
- 5% Victory® malt (biscuit, toasted)
- 2% chocolate malt (color, subtle roast)

Hops (low-key, supporting):
- 1 oz. (28 g) Fuggle 60 min. (18 IBU)

Additions:
- 4 oz. (120 mL) hazelnut extract at flameout (or 1 lb./0.45 kg toasted hazelnuts in secondary, 5 days)
- 2 vanilla beans split, added post-fermentation

Yeast:
- LalBrew Nottingham

Fermentation temperature:
- 65 °F (18 °C) (clean, allows malt/adjuncts to shine)

The network logic: Victory® malt shares Maillard-derived compounds with toasted hazelnuts — both develop their character through the same roasting chemistry. Vanilla shares vanillin with oak-aged character in crystal malts. The combination creates a "dessert bridge" without a sweetness overload.

Serving suggestion: Pair with hazelnut biscotti — the network math predicts the pairing will be exceptional.

THE BRIDGE INGREDIENT STRATEGY

Here's where it gets powerful: Some ingredients act as bridges between distant flavor territories. Understanding these allows you to create combinations that seem weird on paper but work brilliantly in practice.

Case Study:
Coffee Vanilla Orange Stout
Coffee and orange sounds like a bizarre pairing. But watch this:

Without a bridge:
- Coffee ↔ Orange: Only 3 shared compounds
- Result: Muddy, confused

With a bridge:
- Coffee ↔ Vanilla ↔ Orange
- Vanilla shares 18 compounds with coffee (both roasted/fermented)
- Vanilla shares 12 compounds with orange (floral/sweet esters)
- Result: Harmonious complexity

Mini-recipe for 5 gallons (19 L):
Base:
- Your favorite imperial stout.

Additions:
- 8 oz. (235 mL) cold-brew coffee concentrate (at packaging)
- Zest of 2 oranges (10 min., boil)
- 3 vanilla beans split (secondary, 5 days)

The vanilla acts as a translator between coffee's roasted character and orange's bright citrus. Without it, they fight. With it, they dance.

NETWORK HACKS FOR RECIPE DESIGN

Amplify, Don't Invent
When adding adjuncts, choose ingredients sharing compounds with your base. Chocolate in stout (18 shared compounds) amplifies roast character. Coconut (4 shared) creates contrast — use sparingly unless contrast is your goal.

Check Your Hop-Fruit Math
Before buying expensive fruit purée, check if your hops already have those aromatics:
- Citra® + mango = redundant (18 overlap) → use mango to amplify
- Hallertau + mango = complementary (3 overlap) → use mango to add dimension

Use Fermentation as a Bridge
Farmhouse yeast creates phenolic and ester compounds that connect distant flavors:
- Saison yeast + black pepper + lemon: The yeast bridges the spice (phenols) and citrus (esters)
- Result: Natural integration

Low-Overlap Can Be Beautiful
Sometimes you want contrast. Gose (salt + coriander + citrus) works because salt has minimal flavor overlap — it enhances rather than blends. Know when you're seeking harmony vs. contrast.

Try These Network-Approved Harmonious Combinations (10+ shared compounds):
- *Hefeweizen + apricot + coriander*

Wheat beer's ester profile shares

TROUBLESHOOTING WITH NETWORK LOGIC

Problem: "My fruit beer tastes muddy/confused"
Network diagnosis: You likely chose low-overlap fruit (3–5 shared compounds) without a bridge ingredient.
Fix: Add vanilla or honey as a mediator, or reduce fruit quantity and treat it as accent.

Problem: "The adjuncts disappeared in fermentation"
Network diagnosis: You added them too early; volatile aromatics were scrubbed by CO_2.
Fix: Add high-overlap adjuncts (amplifiers) late in fermentation or at packaging; add low-overlap adjuncts (contrast) even later.

Problem: "My spiced beer is overwhelming"
Network diagnosis: Spices are low-connection ingredients — a little goes a long way.
Fix: Use spices at 20–30% of what recipes suggest, especially if they're low-overlap with your base.

Problem: "Everything tastes the same/boring"
Network diagnosis: You're only using high-overlap combinations (harmony without tension).
Fix: Intentionally add one low-overlap ingredient (3–5 shared) for complexity.

compounds with stone fruits. Coriander bridges the citrus notes from hefeweizen yeast. Classic German pairing, validated by network math.

• *Belgian blond + honey + orange peel*
Honey shares fermentation-derived compounds with Belgian yeast. Orange peel connects through citrus esters. The result is easy-drinking with a complex aroma.

Creative Contrast (3–6 shared compounds):

• *Smoked porter + chipotle + chocolate*
Chipotle brings two powerful dimensions at once: Smoke and heat. Chocolate bridges both — it shares Maillard-derived compounds with the roasted malt base, and capsaicin-adjacent character with the pepper. The danger isn't the network compatibility; it's intensity. Start with one dried chipotle in 5 gallons (19 L), taste, add more if needed.

• *Pilsner + chamomile + honey*
This low-overlap combination creates delicate layering. Chamomile: 1 oz. (28 g) steeped at flameout, 5 min. Honey: 8 oz. (230 g) at high kräusen (fermentable character, not sweetness).

THE CULTURAL BRIDGE DISCOVERY

Here's something fascinating from the research: Western cuisines average 11.7 shared flavor compounds in their recipes. Eastern cuisines average 6.2. While Western cuisines emphasize complementary flavors, Eastern dishes emphasize contrast (based on my analysis of the published dataset).

Beer averages 9.4 shared compounds with typical ingredient pairings — right in the middle. This "bridge position" between Eastern and Western flavor philosophies helps explain beer's global appeal and adaptability.

Practical application: When designing fusion-style beers (Asian-inspired, Latin American, etc.), beer's middle position makes it naturally suited to bridge those traditions.

Example: Sake-yeast saison with yuzu and jasmine.

Western structure (saison), Eastern ingredients. Beer's network flexibility accommodates both philosophies. Use sake yeast (Wyeast 4134) at 68 °F (20 °C), add yuzu zest at flameout, jasmine tea in secondary.

WHAT THIS MEANS FOR YOUR BREWING

The craft brewing revolution wasn't an accident. Beer's network position — 187 connections, strong bridge score, balanced between culinary traditions — created what we might call an "optimal innovation zone." Knowing that, how should you go forward using this to your advantage? Here are three things to try in your next brew:

1. Map Before You Brew
Before adding that exotic ingredient, ask: "Does this share compounds with my base, or am I creating deliberate contrast?" Both are valid, just know which you're doing and do it with purpose.

2. Use Bridges for Weird Ideas
Got a wild flavor combination in mind? Find a bridge ingredient. Vanilla, honey, and certain spices (coriander, cardamom) are high-bridge ingredients that can make unlikely pairs work.

3. Trust the Network
When a combination seems like it should work but you're not sure, look for shared compounds. If they share 8+ compounds, give it a shot. If they share just one or two, find a bridge or approach carefully (or embrace the contrast intentionally).

THE MATH THAT MADE SENSE OF EVERYTHING

Looking back at decades of brewing innovation — fruit IPAs, pastry stouts, dessert sours — the network data explains patterns we've seen but couldn't articulate. Beer doesn't just allow creativity; its molecular structure actively supports it. That's not marketing speak. That's mathematics.

The next time someone asks why you're adding something unusual to a beer, you can tell them: "It's not crazy — it's network science." Then hand them a glass and let the shared compounds speak for themselves.

Want to go deeper? The original research (Ahn et al., *Scientific Reports* 1:196, 2011) can be viewed online here. For an interactive ingredient lookup tool, visit the online public flavor compound database here.

But more importantly: Get brewing. The best way to understand network logic is to test it. Try the combinations suggested in this story or find your own, track what works, and develop your own network intuition.

The math says beer is the ultimate recipe playground. As a homebrewer, your job is to play. BYO



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The same reason beer pairs so well with food is the reason so many ingredient combinations work well in brewing, which begins with the diverse flavor networks of grains, hops, yeast, and other adjuncts.



Photo courtesy of wikipedia.com



BEYOND BARLEY: BREWING 100% CHESTNUT BEER

The challenges of brewing without grain

by Dylan McDonnell

Since I began homebrewing, I've always tried to test the boundaries of beer — seeing what can, and cannot, be done. When I brewed my 3,000-year-old beer (that I wrote about in the January-February 2026 issue), one question kept coming up: What makes beer . . . well . . . beer?

Is it the hops? The barley? The yeast? What separates beer from wine, cider, mead, and every other fermented drink? The more I thought about it, the more I came back to the process. At its core, it is defined by two steps: Converting starches into sugars, and then fermenting those sugars into alcohol.

Most of the time, those starches come from grains and cereals. Barley malt is the classic example because it brings both starch and the enzymes needed to convert that starch into fermentable sugar. But cereal grains are not the only foods that contain starch. A few nuts do too, especially once dehydrated. The problem is that nuts generally do not come with the same enzymatic machinery as malted grain. They may contribute flavor, body, or complexity, but without outside help, they usually remain adjuncts rather than the foundation of the beer.

Chestnuts are one of those nuts. When dehydrated, chestnuts contain more starch than most other nuts, which makes them a fascinating candidate for brewing. But without the fundamental enzymes that break down starches, there could never be a 100% chestnut beer.

At least that used to be true. Modern brewing science changed that, and a new idea for my next brew was born.

After some research, I found Gluten Free Home Brewing website (www.glutenfreehomebrewing.com), which offers a range of enzymes for non-traditional mashes. I ordered lactic acid, Termamyl, and SEBAmyl L Endo-Alpha Amylase. Termamyl SC DS Thermo-Stable Amylase is a heat-resistant alpha amylase designed to help break down starches at higher temperatures. SEBAmyl L Endo-Alpha Amylase is also used in gluten-free mashes to aid starch conversion into fermentable sugars. Between the two, I had a plausible path to full starch conversion.

Next, I had to order chestnuts.

I did not want to dehydrate them myself, since crushing them into a usable powder was already going to be a chore, so I ordered 25 pounds (11.3 kg) of dehydrated chestnuts from a bulk-food supplier — enough for a 10-gallon (38-L) batch of beer. I considered buying chestnut flour, but was unsure of the process the chestnuts would have gone through, or that it was indeed 100% chestnut flour, so I opted for the much more time-consuming method of grinding the chestnuts myself. Because they are nuts, there was a real risk of the grinder heating them up and turning them into paste, so I kept the chestnuts frozen and iced the grinder. Three full grinds (and grinders) later, and I had chestnut flour that would be capable of saccharification. To build some malt-like character, I roasted 1 lb. (0.45 kg) of chestnut flour for about half an hour. I smoked another half pound (230 g) for about the same amount of time, hoping to add a subtle "open fire" note; I wanted warmth and depth to come through in the final glass without turning the beer into a smoke bomb.

With the chestnuts prepared, I turned to hops and yeast. Originally, I wanted to wrangle my own yeast to give the beer a unique signature. But I eventually reminded myself that the point was to make chestnut beer, not a wild fermentation experiment. A yeast that introduced too many unpredictable flavors might bury the very thing I was trying to showcase. With that in mind, I chose Wyeast 1762 (Belgian Abbey Style Ale II) for its relatively clean profile and its ability to contribute character without taking over. For hops, I paired East Kent Golding with Strisselspalt, aiming for something that evoked "chestnuts roasting

Photos by Dylan McDonnell



I used 25 lbs. (11.3 kg) of dehydrated chestnuts for a 10-gallon (38-L) batch of chestnut beer, roasting and smoking a small percent of the ground nuts to add some malt-like character and depth to the final beer.



The chestnuts were ground into a flour capable of saccharification needed to brew. To ensure the nuts and grinder would not get too hot, the nuts were first frozen and bags of ice were kept on the grinder motor.

over an open fire" without becoming a novelty beer.

On brew day, I set the strike water to 175 °F (79 °C) and added 2 lbs. (0.9 kg) of rice hulls along with the 25 lbs. (11.3 kg) of chestnut flour. The rice hulls were essential. Chestnut flour does not behave like crushed barley, and I wanted every possible advantage when it came time to lauter. Because chestnuts do not lower mash pH the way barley or other grains often do, I adjusted the mash before adding enzymes. I diluted 88% lactic acid with water at a 1:4 ratio, added two tablespoons of the solution, and waited ten minutes. That brought the pH down to 5.75, which was where I wanted it before adding the Termamyl.

At this stage, the mash looked less like a mash and more like very thick oatmeal. The total volume was about 15 gallons (57 L), and I had not even added enzymes yet. I was only supposed to add around 2 fl oz. (60 mL) of Termamyl, but this is not really an ingredient you "overdo" in the usual sense. The enzyme breaks long starch chains into shorter dextrins. You either add enough to do the job, or you do not. Since the Termamyl came in a 4-fl oz. (120-mL) bottle and I had no use for the remaining half-bottle, I added all 4 fl oz. (120 mL). As soon as I stirred, the mash de-clumped and thinned out into something much closer to a traditional mash. After about 15 minutes, the chestnuts had absorbed roughly 1.5 gallons (6 L) of water during the enzyme breakdown process. Five minutes later, the mash smelled like nutty bread. That was the first moment I really believed this might end in drinkable success. After a 30-minute rest, I let the mash temperature drop to 145 °F (63 °C). I then used the remaining lactic acid solution to bring the pH down into the 5.2–5.4 range. Once the mash reached that target, I added 2 fl oz. (60 mL) of SEBAmyl and held the temperature for a 75-minute saccharification rest.

I sparged until I had 12.5 gallons (47 L) of pre-boil wort and decided on a 90-minute boil. After 30 minutes, the wort smelled amazing, unlike any I had brewed before. At the 60-minute mark I added 2.5 oz. (71 g) of East Kent Golding hops; with 15 minutes left, I added 2 oz. (57 g) of Strisselspalt hops and suddenly it had the aroma of a proper wort. At flameout, I added the final 2 oz. (57 g) of Strisselspalt. I transferred the wort to the fermenter while chilling it to 64 °F (18 °C). Because chestnut wort does not contain the same nutrients as barley wort, I added Fermaid O and diammonium phosphate (DAP) before pitching yeast; both nutrients that would provide a better environment for fermentation. Being my first time working with chestnuts, I had no idea how well they would ferment, so it was important to provide the optimal environment, especially immediately after the pitch since I wasn't making a starter.

The original gravity came in at 1.067. I pitched six smack packs of Belgian Abbey Ale II and oxygenated the wort. Fermentation had visibly begun 12 hours later. After 24 hours, I added a little more Fermaid O to help the process along, then sealed the fermenter and let the yeast do its work. My final gravity target was somewhere between 1.010 and 1.020 (again, I wasn't sure how well they would ferment). It landed at 1.012. Success!

The beer fermented for four weeks before I moved it into a 10-gallon (38-L) rye whiskey barrel for six more weeks. The goal was to give this gluten-free chestnut beer a more familiar beer-adjacent structure: A little oak, a little whiskey, and enough depth to support the nutty base. After barrel-aging the beer, I bottled it with one Coopers carbonation drop per 12-oz. (335-mL) bottle.

Two weeks later, the first bottle was ready.

I chilled it for a couple of days before opening it. A 100% chestnut beer was not something that I could find any examples of so I had no idea what to expect. Twenty percent chestnut? Sure. Maybe even 50%. But a beer built entirely on chestnut starch required enzymes, and using isolated enzymes this way has only recently become practical for a homebrewer.

The first thing I noticed was the carbonation. There was plenty of it, but there was almost no head. That made sense. Chestnuts do not bring the same proteins that barley does, and those proteins play a major role



Photo by Dylan McDonnell

The addition of Termamyl enzyme to break down long starch chains into shorter dextrins was essential. Shortly after adding it, the chestnut mash was transformed from an oatmeal consistency to one more closely resembling a traditional all-grain homebrew mash.

in head formation and retention. The second thing I noticed was the haze. It was not just hazy — it was almost concerningly hazy. At first, that threw me off, but it was not thick, it did not smell bad, and nothing about it suggested a problem. So, I took a swig.

The first flavor came from the rye whiskey barrel. It was a little hot at first, but after a few more weeks of bottle conditioning, that initial bite softened. Underneath it was a nutty, fruity body followed by a bitter finish.



Photo by Dylan McDonnell

The resulting chestnut beer was hazy and had a lot of carbonation but almost no head due to the lack of proteins chestnuts contain.

After finishing the bottle, I deemed this batch a success. I set out to see if I could brew 100% chestnut beer, and I did. The starch converted. The yeast fermented. It tasted like beer. If I did not have to grind the frozen dehydrated chestnuts again, I would absolutely brew this beer again.

Once I decided it deserved a label, I named this 100% chestnut beer Corsican Reserve, a nod to the island and the people so intimately tied to the chestnut for hundreds of years.

Related Link:

- *For a long time, the only enzyme most brewers would ever think about adding during the brewing process was some amylase enzymes . . . boy have times changed. Learn about the rapidly expanding world of exogenous enzymes:* **www.byo.com/articles/explore-the-world-of-exogenous-enzymes**

RECIPE

CHESTNUT BEER

(10 gallons/38 L, all-nut)
OG = 1.067 FG = 1.012
IBU = 30 SRM = 7 ABV = 7.2%

INGREDIENTS

25 lbs. (11.3 kg) dehydrated chestnuts (crushed)
2 lbs. (0.9 kg) rice hulls
4 fl oz. (120 mL) 88% lactic acid
4 fl oz. (120 mL) Termamyl
2 fl oz. (60 mL) SEBAmyl
12.5 AAU East Kent Golding hops (60 min.) (2.5 oz./71 g at 5% alpha acids)
8 AAU Strisselspalt hops (15 min.) (2 oz./57 g at 4% alpha acids)
2 oz. (57 g) Strisselspalt hops (0 min.)
2 oz. (57 g) Fermaid O
0.25 oz. (7 g) diammonium phosphate (DAP)
6 packs Wyeast 1762 (Belgian Abbey Style Ale II) (or build up an equivalent size yeast starter)
Coopers Carbonation Drops

STEP BY STEP

Crush the dehydrated chestnuts into a fine powder and then add chestnut flour and rice hulls directly to the mash tun (I chose to smoke and roast a small percent of the flour for added dimension, which is optional). Alternatively, you can buy chestnut flour if you trust the source. Add 10 gallons (38 L) of strike water at 175 °F (79 °C) to get mash to ~165 °F (74 °C). Dilute 88% lactic acid to three times as much water and add 2 Tbsp. every 10 minutes until the mash reaches 5.5–5.75 pH when measured at room temperature.

Add Termamyl at the start of the mash and hold for 30 minutes. Reduce temperature to 145 °F (63 °C) and continue to add 2 Tbsp. of the lactic acid solution every 10 minutes until the mash reaches 5.2–5.4 pH. Then add SEBAmyl and hold for 75 minutes for the saccharification rest. Both of these enzymes can be purchased in homebrew-size quantities from glutenfreehomebrewing.com.

Lauter and sparge at 168 °F (76 °C) until there's 12.5 gallons (47 L) of wort in the kettle.

Boil wort for 90 minutes, adding hops as indicated. At the end of the boil, chill to 64 °F (18 °C) and transfer to the fermenter. Add 1 oz. (28 g) Fermaid O, 0.25 oz. (7 g) DAP, and the yeast. I used six individual packs of liquid yeast instead of building up a starter because I wasn't sure how a starter made with chestnut flour would react and I did not want any fermentable beyond chestnut in the beer . . . though if you are OK using malt extract it would be a big money saver. After 24 hours, add another ounce (28 g) of Fermaid O to the fermenter. Fermentation will take 3–4 weeks to complete.

Once done, transfer to a rye whiskey barrel for 6 weeks, if possible, or add oak cubes previously soaked in rye whiskey. Transfer to bottles, adding one Coopers Carbonation Drop to each bottle or keg and force carbonate as usual. BYO



Photo by Dylan McDonnell

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BY DREW BEECHUM & DENNY CONN

BEER CLARITY

From recipe design and technique to finings and filtering options

You'll hear again and again the old adage "we first drink with our eyes." Legend links the rise of Pilsner to the increasing availability of affordable clear glassware because it allowed drinkers to appreciate the beer's clarity.

The rise of hazy IPAs was a potent battleground of generational differences in visual preferences. Older drinkers were completely turned off — "Gravy! Thick! Soupy!" Younger drinkers were excited — "Juicy! Smooth! All the hops!"

Hidden in the fog of hop soup is that unrelenting truth: For most beer styles, clarity is a mark of excellence. Would a pale lager be as highly praised without that bright diamond gleam? Would your palate fizz with excitement if there was a haze-roughened mouthfeel? Fortunately, clarity isn't magic — it's mostly a matter of time, cold, stillness, and finings to make a beverage "clear, bright, and pure" (for those judging by their puritanical beer bibles).

Nota Bene: Hazy IPA (or any heavily dry-hopped beer), wheat beers (hefeweizen, witbier, etc.), and farmhouse ales are all signs that brilliant sparkling clarity is not necessary for a great beer experience. Haze is perfectly fine when it fits the style and taste goals.

Remember the near universal cure for haze problems — time, cold, and stillness (finings come later). Most haze causes will clear up with a judicious application of that trio.



Photo courtesy of Shutterstock.com

There are many factors that cause haze, but most can be remedied by keeping the beer cold and still for a period of time.

THE STUFF THAT HAZE IS MADE OF

Beer haze is largely driven by three causes: Yeast, protein, and polyphenols.

Yeast is every brewer's best friend, but we also know the horror of a shaken carboy turning transparent liquid into a murky mess. Enough yeast in suspension yields cloudy ugliness and a sharp, meaty "yeast bite." If you start with a healthy yeast pitch and a proper fermentation environment, they will almost always behave as polite little gremlins should. Strain selection also plays a role (read more about this in the "Mr. Wizard" column on page 12).

Protein is not just the latest fad in "healthy diets," but a large component of brewing. We need enough protein and amino acids for fermentation and head formation. But we want to avoid the extra haze and mouthfeel that comes from too much protein. Modern maltsters have largely rendered this worry moot; as long as you're smart with your recipe structure, you'll be fine.

Polyphenols are the most mysterious of the three haze-inducers we're talking about. You can deduct from the name that they are complex snarls of multiple phenol compounds. These could be tannins from grain husks and plant materials or complex compounds leached from hops.

With our big haze hurdles identified, let's talk about making our clarity lives easier from the jump. By starting with a proper foundation that leans towards clarity, we'll make later polishing steps more effective. Also, remember that every time you "touch" the beer — transfer it, dose it with a compound, etc. — you run the risk of damaging the beer via oxidation or contamination. As a homebrewer, you get to decide if the juice is worth the squeeze. Does your beer need to be perfectly polished to be enjoyed by your audience? Is it OK to have a slight haze instead of risking an oxidized mess because you employed aggressive clarifying measures?

UN-HAZE THE EASY WAY

Remember the near universal cure for haze problems — time, cold, and stillness (finings come later). Most haze causes will clear up with a judicious application of that trio. Think of the clarity that comes after a meditative stillness and apply it to beer.

When saying "cold," what we mean

is ***cold.*** We routinely bring finished beer down to 40 °F (5 °C) or lower. When beer gets that cold, proteins coagulate, yeast goes dormant, carbon dioxide stops evolving, and the churning excitement of fermentation fades. With the lack of a buoying current, the heavier clumps of material succumb to gravity and drift to the bottom of the fermenter.

And the fun part — the cold crash doesn't take long. Even as little as 24 hours will show remarkable improvement in clarity. Try this with a starter in a glass jar and you can watch it in real time! When Drew really wants the beer to be clear (and he remembers to time it correctly), he'll schedule a two-week cold crash at 40 °F (5 °C). Hard for a beer with appropriate recipe choices to be murky after that! The colder the temperature, the quicker the beer will clear up. If you can get down to freezing temperatures, try that for a day and watch your beer clarity shine!

Getting to a crash state is as simple as setting a thermostat if you have a glycol system. If you have a fridge or chest freezer, you're pretty set as well. But if you don't have either of those, you can do what we used to do and use large water baths with plenty of ice to get the beer cold for a brief crash.

But that's only the first part of the equation. The next part is stillness. Once you've let the beer settle, any motion will stir things up and ruin weeks of quietude. That goes for even the most well-settled yeast cake. Now, this isn't "don't open the oven while baking a soufflé" levels of caution, but if you have to move the beer to rack it, be as gentle as possible and then let the beer settle for a few hours before racking.

If you're feeling particularly old school, you could be the brewer to bring back racking to a secondary fermenter (aka moving the beer to a new clean fermenter for further settling away from the bulk of the yeasty morass). We still don't recommend secondaries for most projects due to the risk of transfer-related damage.

SETTING IT UP

Of course, the best cure is prevention. You don't have to remove haze if you never generate it. So, where is haze bred? The mash tun or the boil? The answer is both, and to make the easy way work, you'll need to start at recipe design.

Most modern malts have been engineered for ease of use and that includes clarity. Having said that, you still need to make smart choices about avoiding haze. While some old-school malts will have high enough protein levels to worry over, the big culprit is anything you'd throw in a hazy IPA to generate clouds — think wheat, oats, chit malt, etc. (Grains that break down to simple sugars and are low protein like rice and corn are usually problem-free.)

With hops, our primary concern is about amounts and application. The more plant material you throw in the kettle (or the dry-hop), the more haze you'll have to fight. On the dry-hop side, we know that dry hopping during active fermentation creates perfect conditions for haze formation. If clarity is your goal, skip the biotransformation step. Active fermentation dry hopping doesn't guarantee a hazy pint, but it's far more likely than traditional dry hopping. I always expect a light haze in a dry-hopped beer, but you can still achieve brilliant clarity with appropriate dosing and treatment.

Lastly, the yeast. Given how much Wyeast 1318 (London Ale III), Imperial Juice, and more became the rage during hazy IPA's rise, yeast strain matters! For clarity's sake, you'll want to look for strains that are both good flocculators and don't have a rep for throwing haze when exposed to dry hops. (See Omega Yeast's work on the HZY-1 gene). Look again at Wyeast 1056 (American Ale) or a similar strain from another supplier as a classic clear-dropping strain, or SafLager W-34/70, the world's most used lager strain that produces incredibly bright beer.

Finally, the biggest non-recipe cause of haze in homebrew is contamination by wild yeast and microbes. Unless you're making a wild ale, you don't want those in your beer! So, be a good brewer and keep the gate crashers from the party.

SETTING IT UP PART 2 – BREW DAY BOOGALOO

Clarity on the brew day comes down to good brewing basics — reduce haze materials and exercise a sure hand on temperatures. For the mash, this means good water stripped of sanitizing compounds and overloads of minerality but still having the minimum calcium levels needed for conversion and yeast (~50 ppm). You hit proper mash pH (5.2–5.5, typically) and spend enough time in the tun to convert starches into sugars (with modern malts, 20–30 minutes suffices). When it comes time to separate the grain and liquid, keep the grain mostly out of the boil kettle. You don't have to be obsessive about it but it's good practice to prevent any potential starch contamination.

Once you're in the boil kettle, our goal becomes encouraging two separate protein coagulating events — the hot and cold breaks. For the first, we make sure we have a strong boil. The old rule of thumb was a boil vigorous enough to lose ~10% of your kettle volume (e.g., 2 quarts/L per 5 gallons/19 L of wort). Assuming your mash pH was correct and the boil is vigorous, you'll notice long sheets of egg-like protein form during the boil — that's the hot break.

As we move down the boil clock, we add our first fining agent – Irish moss, either granule or in the form of Whirlfloc tablets. Many brewers view these finings as helpers with hot break, but they actually have their most profound effect on cold break. The negatively charged seaweed pulls proteins and polyphenols into heavy clumps that will settle out. A gallotannin kettle addition (see OxBlox or BrewTan-B) can also help, but that's not the primary purpose of those compounds.

To get our cold break, this is when we have to slam on the brakes and do the exact opposite of what we just did and chill the wort rapidly to pitching temperature. Again, the idea is to clump proteins and drag other undesirables into their web as they drop out of solution. As we've pointed out in the past, one can make great clear beer with no-chill or slow-chill, but if clarity is the goal you want to chill quickly.

And then we get to the last stage of the brew day — transfer and yeast pitching. You don't have to pull ultra clear wort into the fermenter (some trub can aid fermentation), but it's still best to avoid slopping all the gunk into your bucket. For yeast, you're intentionally murking up the wort. Ensuring that your yeast are vital and ready means they'll be more well behaved and go to bed when the feast is over.

There is one last addition you can make to help clarity. At

pitching, add a clarifying enzyme like DSM Brewer's Clarex/White Labs Clarity Ferm. It attacks specific protein structures to prevent the formation of haze in the finished beer without filtering or fining. Bonus — the proteins it attacks include gluten — yielding "gluten-reduced" beer. (Please do more research on "gluten reduced" before handing off a beer brewed this way to someone with gluten issues.)

At this point, we're back to the start of the "easy" way — time, cold, stillness. If this was an old Choose Your Own Adventure book, we'd tell you "Turn back to Chapter 1."

FINE, WE'LL FIX IT IN POST (FERMENTATION)

Even the best of us could use an occasional boost, and so it is with the "easy" way. Whether you're looking to speed things up, the beer is stubbornly refusing to clear, or you really want that "I can read the newspaper through the glass" effect, there are biochemical tools to aid your quest for clarity.

The additives we'll explore do the same general thing — introduce an electrostatic charge to attract haze-causing particles into clumps that fall out of solution. We mentioned Irish moss is negatively charged when used in the kettle, but most of our post-fermentation finings are positively charged to pull in the majority of our haze-inducers at this late stage.

Vegetarians Beware: If you are on (or are serving to those on) the plant-based dietary spectrum, be aware some of these additives are decidedly not lifestyle compatible. You probably won't run into isinglass, but gelatin is very popular with homebrewers. This is one reason Biofine Clear and other silica-based finings are popular at the professional level.

Usage instructions for these additives are pretty consistent. Take cold beer that's finished fermenting and settled. Prepare the solution according to package instructions. Then add to the beer and mix it in thoroughly. Drew prefers to add the solution to a sanitized, oxygen-purged keg and then transfer the beer into the keg to blend into solution. Others will pop open the fermenter, pour in the additive, close the works up, and give it a good swirl.

THE BIG ADDITIVES

Gelatin: It's cheap and available at the grocery store. To use, dissolve 1 gram of unflavored gelatin per gallon (3.8 L) in just enough water to dissolve. (Drew uses ~5 grams in a cup of water for a 5-gallon/19-L batch.) Sprinkle the gelatin over the cold water and hydrate for 10–20 minutes. Heat the mixture to above 160 °F (71 °C), microwaving in 30-second intervals. Add the gelatin soup to the keg/fermenter. Wait a couple of days below 50 °F (10 °C) before carefully racking into your clear beer receptacle.

Silica Finings (e.g., Biofine Clear): Widely available to homebrewers now, these vegan-friendly silicic acid-based fining agents also have the benefit of avoiding mixing, blooming, and heating steps. Just add and go! Dosing depends on the formulation, but Biofine Clear is commonly 5–10 mL per 5-gallon (19-L) batch of finished beer. Wait a couple of days at cool temperatures and rack.

Kieselsol/Chitosan: This is a two-stage application (sometimes sold together as Super-Kleer) that is the nuclear solution for a haze that won't quit. Kieselsol is a silica-based fining that you add first. Wait a day, and then dose chitosan (usually a shellfish/crustacean-derived clarity agent) to sweep behind it. Drew's broken this out before to kill a haze that would not die. It's comparatively expensive, but effective.

Two other special mentions, though our experience with them is largely with mead, cider, and wine. First, **Polyclar**, a PVPP polymer that swells in the presence of water and acts like a sponge. It's easy to use, but when professional brewers use it, they tend to filter it out as it can remain suspended for a while. The other is **bentonite**, a natural clay that sweeps through liquid quickly. Bentonite should be added into the top of the vessel to settle through the beer. When Drew was learning meadmaking, it was a common technique to use Polyclar to grab a bunch of material and then bentonite to sweep it out of solution. Bentonite forms a hard-set cake at the bottom of the tank as well.

One last note — if your fining didn't work, you can try running another cycle with a larger dose. Or try a different fining agent. The effectiveness of a fining can vary widely with the cause of the haze, the pH of the beer, age of the fining, and the sheer load of material in solution. A beer that you didn't allow to settle first or a highly, double dry-hopped IPA will require more fining!

WHERE DOES HE GET THOSE WONDERFUL TOYS?

If the thought of time and additives doesn't thrill you and you really want to tackle this problem mechanically, you can go for a filter setup. Truthfully, we don't use filters. Drew used one once just to see what the deal was. The deal? A lot of fiddly fussy risky work for brilliant beer.

You can buy homebrew-sized filters in canister or plate formats. The idea is the same — push finished beer through a set of filter media. The media catches the yeast and protein particles and allows the beer to flow clearer. The media is sized by microns (aka how big a particle it will let through). Generally, they're grouped as "coarse" filters (5–10µ) good for removing the larger cruft (yeast, hop bits) and "fine" filters (1–3µ) that will take out much finer particles. It is imperative that you begin with a coarse filter prior to using a fine filter.

There are also metal screen inline filters like the Bouncer. They have the advantages of reusable screens in a homebrew-friendly size. They're better suited towards catching the big stuff instead of polishing the beer bright. The capacity is smaller, meaning more clogged screens with oxidation still a major risk. But for our money, they're better suited for our general needs as occasional filter practitioners.

WHAT ABOUT CHILL HAZE?

If you've ever poured a pint and been disappointed at its cloudy appearance only to find when you let the beer warm up it's turned clear, you've experienced chill haze! What's happening is proteins and polyphenols in solution will tangle up in the cold like a pile of puppies on a winter's night. In that state, they scatter light and cause a haze. As the beer warms, the strands relax and no longer act like shutters.

The good news is that the primary way to fight chill haze is precisely through all (waves hands frantically at this whole article) the things we've discussed. BYO

BY BILL JABLONSKI

DRAFT UPKEEP

Keeping your beer pouring clean

Brewers already know that cleanliness is next to godliness; sanitation is one of the very first skills we master on the homebrewing journey. If you have never lost a batch to a lapse in cleaning or just plain bad luck, don't get too comfortable — your time will come.

For those of us running a draft system, maintenance requires a few extra considerations beyond standard brewhouse sanitation. There is already no shortage of basic draft cleaning guides available online, so there is no reason to repeat the introductory steps here; if you are new to kegging, start with the article linked at the end of this column. Instead of rehashing the basics, let's dive into the core principles, practical tips, and observations gained from years of maintaining both commercial and home draft systems of every shape and size.

CLEANING CHEMICALS

The easiest way to clean draft systems is with a caustic solution formulated specifically for beer equipment. These solutions are typically powered by chemicals like sodium hydroxide or potassium hydroxide. There are "eco-friendly" hydrogen peroxide alternatives; effective cleaning requires an extreme pH. It's that chemical intensity that does the heavy lifting. The undiluted solution is quite potent. Follow the instructions for mixing the proper solution.

Because these chemicals are so powerful, you need to treat them with respect, especially when they are undiluted. At an absolute minimum, wear safety glasses and a pair of nitrile gloves when handling.

While bleach might be one of history's greatest sanitation tools, keep it far away from your draft system. It rinses poorly, lacks the necessary surfactants, smells terrible, and can actually corrode your stainless steel draft equipment.

When picking a proper beer line cleaner at home, the decision mostly comes down to price and convenience. Commercial users buy the most concentrated formulas available — though you have to do the math, as the cheapest undiluted bottle can sometimes end up costing more per ounce once mixed. For homebrewers, a single bottle lasts so long that price isn't a massive factor. Don't buy into the marketing hype here; this stuff is just heavy-duty soap. I can't spot a performance difference between *Brand A* and *Brand B*, and neither will you.

A common question is whether it is okay to let line cleaner sit in your draft lines for an extended period. Is it okay? Yes and no. Short soaks are not harmful, but they don't add much cleaning when the solution is not flowing. At best, it just gives you a bit of breathing room in a busy schedule. If the soak is too long, damage can occur depending on the materials used in the system. The best practice is to rinse, clean, rinse, and finish the project.

More importantly, leaving cleaner in the lines creates a serious safety hazard: There is always a chance someone might accidentally pour and drink a glass of toxic chemicals. That alone is a reason the risk of leaving cleaning chemicals soaking in your draft lines is a risk you should not take.

The final and most crucial step of the process is a thorough rinse. If you own a pH meter, this is another good time to use it by testing your rinse water to ensure all the caustic cleaner is completely gone. Given that pH meters must be calibrated with standards before use, which can take a little time and effort if all you want to use it for is to check the rinse water, this is a good use of the pH papers that often fall short for most

Because these chemicals are so powerful, you need to treat them with respect, especially when they are undiluted.



Photo by Laura Schott

Cleaning home draft lines should be done every 3–4 weeks. If that is around how long it takes to finish a keg, then between kegs makes sense to do draft line cleanings.

uses in brewing. If you don't have a way to check the pH, the slippery finger test is pretty effective (if what comes out still feels like cleaning solution, keep rinsing). If you aren't checking the pH, always rinse with more water than you think you need, but a shot of beer down the drain will also help neutralize any residual cleaning solution.

CLEANING SCHEDULE

How often you should clean your draft lines depends on several factors. The Brewers Association (BA) Draft Beer Quality Manual recommends cleaning commercial systems every two weeks. In my experience of installing and maintaining commercial draft systems, I've seen that newer tubing materials have improved things, and modern commercial systems with new equipment typically won't show signs of needing a clean for about three weeks, even while moving massive volumes of beer. With the smaller amount of beer flowing through your home draft system, assuming you empty a keg after a few weeks, cleaning between kegs makes sense on the home scale. If you run your own A/B test, you might find you can stretch your schedule further. Try pouring a pint, cleaning the line, and then pouring a second pint to compare them side-by-side. Usually, you won't notice a taste difference until around the four-week mark, but every system is different, as is every beer.

Ultimately, time and volume dictate your cleaning protocol. Because kegged homebrew stays constantly cold, there is little chance for rogue microbes to take over, though hop resins, yeast deposits, and proteins will still accumulate. The longer you wait, the tougher it is to clean — just like neglecting a kitchen or bathroom until it becomes a major project. Furthermore, if warm beer is ever allowed to sit in the system, you are likely looking at a full overhaul. Every brewer intuitively understands why, but we will dive deeper into that later.

Along with caustic, there are acid-based line cleaners. Their necessity for homebrewers is highly debatable. Acid breaks down beer stone — a combination of oxalate, proteins, and other organics.

While the commercial industry recommends an acid wash every three to four months, it is highly unlikely your home system has this buildup. Beer stone is a problem for commercial draft systems moving dozens or hundreds of kegs. Homebrewers simply do not see that kind of volume, and if beer stone ever does become an issue for you, your lines are already well past their useful lifespan. Homebrewers can confidently skip acid-based line cleaners entirely. Speaking of . . .

REPLACING LINES

Eventually, replacing your draft lines becomes cheaper and easier than trying to clean them. When that time comes, opt for a full overhaul. While stainless steel components like the faucet, shank, and coupler can last for decades with proper care — which means disassembling, brushing, and hand-washing them every few months while replacing gaskets as needed — the lines themselves are a different story. Six feet (1.8 m) of modern thermoplastic extrusion (TPE) choker line actually costs less than a single bottle of line cleaner, and swapping it out is quick. Instead of fighting stained lines, just add a 50-foot roll of TPE to your cart the next time you stock up on brewing ingredients. I must confess, because I have an abundance of choker lying around, I find myself snipping and replacing line a bit more frequently than I probably should — but it illustrates the ease of replacing lines compared to doing a thorough cleaning of them.

DETAILING HARDWARE

You are going to need to disassemble and hand clean the hardware occasionally. The faucet, the keg quick disconnects (or Sanke coupler), and the shank will all need a scrub, though not as often as the lines, and the process of cleaning the lines also goes a long way towards keeping these parts sanitary. The faucet, in particular, houses some parts that are always beer-soaked, and because the faucet is in ambient conditions, this component can get really fouled if not looked after. Forward-sealing faucets, such as the Perlick Perl, offer some advantages because they have fewer internals, but nothing is immune to bacterial growth. It is an easy task: Unscrew everything that will unscrew. Pay attention to the disassembly. Wash everything in a soapy hot water mix, rinse thoroughly, and then reassemble in reverse order. With the faucet removed, you can inspect the shank and wipe away any snot. A thin brush specifically designed for the shank is available, but so is a Q-Tip. The same goes for the quick disconnects — disassemble, inspect, and clean thoroughly, then reassemble. Keep track of the little parts as they often disappear under the refrigerator.

IN CONCLUSION

That is the industry scoop regarding line cleaning and draft system maintenance: Follow the instructions, be diligent without being paranoid, and respect the beer. Your specific protocol can be tailored to meet your needs.

Before we move on, here is one final nugget. In addition to caustics and acids, there are enzyme-based cleaners on the market. These are specifically formulated to attack persistent odors and flavors — like that experimental strawberry chocolate stout that somehow still haunts every single beer you pour after it. While these enzyme cleaners can be effective, they are also expensive and unnecessary for a homebrewer. Your stainless steel hardware can be scrubbed clean with standard methods, and the lines themselves are cheap enough that you should just replace them instead. Save your money, skip the enzymes, and swap out the vinyl. BYO

Related Link:

- *Get to know the equipment and techniques required to start kegging your homebrews and keeping your draft beer safe from infection. With some initial investment, you can soon be serving beers on draft in the convenience of your own home.* **www.byo.com/articles/kegging-101**

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BY KEN KEES

DAD'S HOMEBREWS

My dad, Don, started homebrewing in the early 1960s and exemplified the "keep it simple" approach to the craft.

The ingredients of his recipe included Premier Blue Ribbon prehopped pale malt extract (two 3-lb./1.35-kg cans), C&H cane sugar (13 lbs./5.9 kg), and Fleischmann's active bread yeast (two packets). All of the ingredients, including the Blue Ribbon extract, came from the local Independent Grocers Alliance (IGA) store.

The wort and fermentation equipment included a 21-quart (20-L) canning pot, a small saucepan, a 20-gallon (76-L) plastic garbage can with a lid, and a glass hydrometer. Bottling equipment included a 6-inch (15-cm) piece of 2x4 with a hole in the middle, 6 feet (1.8-m) of surgical tubing, 50+ empty 1-quart (1-L) bottles, caps, and a bottle capper.

Wort preparation didn't require boiling. It started with pouring the cans of malt extract into the canning pot and rinsing the cans with hot tap water to get every drop. The sugar was added to the pot with more hot water and stirred until blended. Yeast was added to the saucepan with warm water to condition for starting. The wort was now ready to be taken to the basement and poured into the garbage can on top of a wooden pedestal that stood a couple feet (0.6 m) tall. Cold tap water was added to the wort, eyeballed up to about the 15-gallon (57-L) mark, the activated yeast was pitched, and the lid was seated on the garbage can.

Fermentation was not temperature-controlled, but a light bulb and canvas cover was used in the winter to keep the bubbles coming, monitored by eye, as there was no airlock. Kräusen was skimmed a couple of times during fermentation with a sieve. The hydrometer was then set in the beer to monitor the finish point, which was important to catch before full fermentation. There was no priming, as residual sugar remaining in the beer was used to provide carbonation as each bottle finished fermenting in the capped bottle.

Bottling started by pushing the surgical tubing through the 2x4 with a short protrusion and set on top of the beer to float above the trub. Pulling a vacuum by mouth on the end of the tube started the beer flowing. The float was monitored so it didn't hang above the beer, as restarting a siphon at lower levels could be difficult. Filled bottles were capped and moved to the basement beer shelves to condition. Cleaning of equipment after bottling was done using hot soapy water. There were no sanitation steps.

Chilled bottles from a new batch were usually opened over the kitchen sink to test for over-foaming or geysers. Rarely, a "hot" batch would blow up a bottle during conditioning. The finished beer was typically clear with a steady foam head, estimated around 5–6% ABV based on a "feel" comparison with commercial 3.2% beers of the time. The taste was somewhat sharp and cidery, but popular with visitors. This simple homebrew was a link to good friendships for many years and was said to improve dart and horseshoe throws as well.

Dad and his younger brother, Bob, started brewing at the same time, sharing their knowledge and using similar equipment, recipes, and techniques. Quality assurance was done by sampling each other's brews over the years.

Bob's son, Kraig, and I have used our fathers' experience for our own homebrewing efforts from the 90s on through to the current day. Both my cousin and I have taken a bit more of a scientific and modern approach to homebrewing, but recalling how our fathers made beer reminds us that sometimes simple techniques and equipment are all you need. At the end of the day, it's all about having a homebrew you like! BYO

This simple homebrew was a link to good friendships for many years and was said to improve dart and horseshoe throws as well.



Photo courtesy of Ken Kees

The author's father, Don Kees, is on the right toasting with half-yard glasses of homebrew.



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