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THE HOW-TO HOMEBREW BEER MAGAZINE

JULY-AUGUST 2025, VOL. 31, NO. 4

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- Travel with other homebrewers who share your passion for beer and brewing!

FOR MORE DETAILS VISIT: BYO.COM/TRIP

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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.

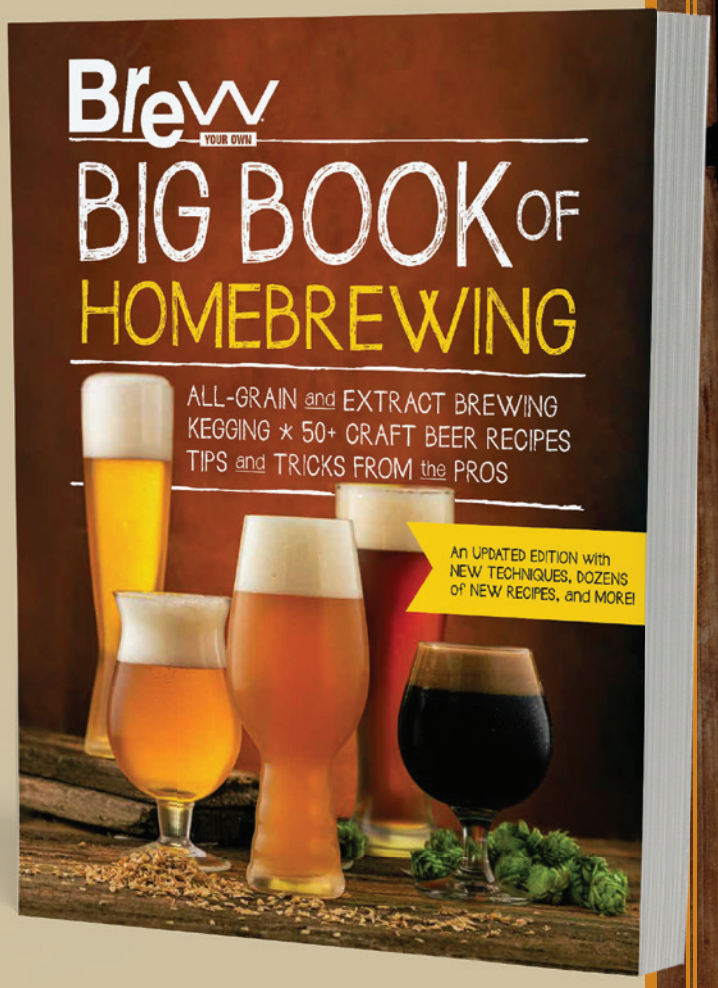
THE BIG BOOK IS BACK

Get Your *BYO Big Book of Homebrewing* Today!

Homebrewers around the world have turned to the experts at *Brew Your Own* magazine for more than two decades. Now, the editors known for publishing the best information on making incredible beer at home have updated their brewing bible. In this edition, you'll find:

- **More to learn: All-new information on creating mouthwatering hazy IPAs, pastry stouts, and kettle sours.**
- **New recipes to brew: Find 25 new clone recipes from popular craft brewers, including Bierstadt, Trillium, Bell's, and Allagash.**
- **Everything you need to up your game: From extended info on brew-in-a-bag to the latest dry-hopping techniques.**

Whether you're looking to get into brewing, become a better brewer, or find inspiration for your next beer, you'll find it in the big book!



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Charles A. Parker/Images Plus

Have you brewed with any ingredients that you've grown?

I've brewed with home-grown (or farm-grown, to be strictly accurate) ingredients a few times, mostly during my time as Head Brewer at Kent Falls, a farm-based brewery in northwestern Connecticut. We cultivated a (relatively limited) annual hop yield that I dedicated to an annual hop-harvest farmhouse ale, as well as easier-to-manage ingredients like herbs and spices. Perhaps the most homegrown brew I've managed was the time I wandered around the farm throwing just about any budding, sprouting, or otherwise lively piece of plant I could find into a jar, and from this, developing a sort of spontaneous yeast culture that would become a house wild culture for the brewery.

I have used home-grown herbs and spices in my beer, mead, and cider. I remember making a great spearmint mead after having judged Byron Burch's National Homebrew Competition (NHC) winner; spearmint is like zucchini — you always have way more than you need. I also got a gold at NHC one year with a beer made with fresh, young blue spruce tips I harvested from trees in my backyard. I sometimes use culinary herbs like thyme, rosemary, and basil in beer, taken from my herb garden.

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The Evolution of IPA

Dramatic shifts in the IPA style are nothing new, even though they are happening more frequently as of late. Review where this style came from, where it is today, and the stops along the way, while also getting advice on brewing a modern IPA. But don't get too comfortable, this style likely won't stop evolving any time soon: www.byo.com/article/the-evolution-of-ipa

Maximizing Tropical Flavors & Aromas: Tips from the Pros

There are many ways to get the most tropical aromas and flavors in your hazy IPAs and other styles. Three pros share their approach to boost tropical characteristics: www.byo.com/article/maximizing-tropical-flavors-aromas-tips-from-the-pros

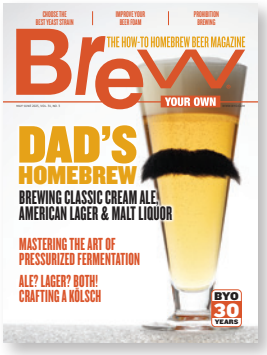
Backsweetening Hard Cider

Not everyone likes a bone-dry cider. Apples are sweet, so why not add a little sweetness back into your cider? Use these techniques to dial in the sweetness to exactly where you like it: www.byo.com/article/back-sweetening-hard-cider

Plant a Backyard Beer Garden

This beer garden doesn't have guys in lederhosen, but it may have the ingredients for your next herb or spiced beer. Learn what plants are easy to grow to bring your witbiers to life, add a fruity punch to your wheat ale, or spice up your holiday ale. You can't get fresher ingredients than those you yank out of your beer garden on brew day: www.byo.com/article/plant-a-backyard-beer-garden/

MAIL



THANKS FOR THE HOMEBREWING VIDEOS!

The videos on your site are great! Keep up the good work!

Greg Johnson • *Jacksonville Beach, Florida*

Thanks Greg! We're glad you are enjoying the videos as part of your BYO+ membership. BYO*'s Technical Editor and "Mr. Wizard" columnist Ashton Lewis will regularly add new video content for members online so you can keep learning. So check back often at our video library page to see the Wiz's latest upload: www.byo.com/byo-videos*

Plus, make sure you also check out the workshop video replays now also available to members. These video replays are in-depth, three-to-four-hour deep dives into different brewing subjects: www.byo.com/byo-workshops

WILD HOPS QUESTION SOLVED

I live in Arizona and have been foraging for medicinal plants and have come across wild hop plants on two different streams. I don't think too many people know about these plants or are harvesting them. Thank you for your article on *neomexicanus* hops. Otherwise I don't think I would know what variety they are.

Ginny Baker • *via email*

You're welcome! Humulus lupulus var. neomexicanus *hops — which are a genetically distinct sub-species of hop that has been growing wild in the dry mountain regions of New Mexico and surrounding states for the last million years — offers brewers the first opportunity to brew with what meets the definition of pure American hops, as* neomexicanus *does not trace its heritage back to the European hop lineage. For anyone who wants to learn more about these unique flavored hops, check out this story we did on them a few years back at: www.byo.com/article/neomexicanus-hops. And if you want to try brewing with* neomexicanus *hops, get your hands on some Medusa™ or Zappa hops!*

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. BYO

Adam Wells is an award-winning cider and perry writer, author, and presenter. He is the Founder and Editor of cider-review.com, the world's leading source of aspirational cider content, co-host of the *Cider Voice Podcast*, and has bylines with *Malus*, jancisrobinson.com, *Pellicle*, and many more. His debut book, *Perry: A Drinker's Guide*, won Cider Communicator of the Year from the British Guild of Beer Writers, Special Commendation from the André Simon Awards, and was shortlisted for the Fortnum & Mason Debut Drinks Book of the Year.

Adam shares his knowledge on perry with a synopsis on this ancient fermented beverage and how to make it at home, beginning on page 24.

Michael Tonsmeire is the Co-Founder of Sapwood Cellars (Columbia, Maryland) where he brews IPAs, blends sours, manages the barrel-aged stouts, and writes the email newsletter. He blogs as The Mad Fermentationist (www.themadfermentationist.com), authored *American Sour Beers* (Brewers Publications, 2014), and occasionally writes for *Brew Your Own*. He resides in Washington, D.C. You can follow him on X @MadFermentation.

Beginning on page 38, Michael shares how to get the most from dry hopping and the decisions that influence it.

Jason Simmons has been in the brewing industry since 2003, having worked at several production breweries, brewpubs, and as a brewery consultant. He is currently the Head Brewer at Lindgren Craft Brewery in Duncannon, Pennsylvania. He is a retired firefighter and EMT with 11 years of service, much of which came while also working as a brewer during the day. Jason loves brewing with new ingredients and is an enthusiast of Pennsylvania-grown hops. Even while brewing professionally, Jason has never given up his homebrewing hobby, which he often does to explore unique water sources, ingredients, and recipes.

Last year, Jason took on the challenge of helping to grow and brew with mushrooms. He shares what he learned from that passion project on page 44.

NEWS

2024 HOP INDUSTRY ANNUAL REPORT

Due largely to a surplus of hops, 2024 showed the lowest hop harvest in the United States over the past decade according to the 2024 Hop Industry Annual Report from the Hop Growers of America. The report shows just under 45,000 acres of hops were planted in 2024, amounting in 87 million pounds (39 million kg) of hops harvested (down from high marks in 2021 of more than 60,000 acres and 116 million pounds/53 kg in 2021). 2024 saw the elimination of 9,500 acres of hops planted in the U.S., resulting in a decrease of 17 million pounds (~8 million kg) of hops harvested.

The United States accounted for the second largest portion of the world's hop supply at 35 percent. The world leader is Germany (41%). Far behind the two leading nations is Czech Republic (5.8%), China (5.7%), and Poland (2.6%). All other nations combine for 10.4% of the world's hop supply.

The Pacific Northwest accounts for 98% of the United States' hop supply, with Washington leading the way with 74%, followed by Idaho (15%) and Oregon (11%).

Find the full Hop Industry Annual Report, released at the end of April 2025, at: www.usahops.org/img/blog_pdf/497.pdf

WHAT'S NEW

MJF HOP BLEND

A new hop blend created by the Michael James Jackson Foundation (MJF) board is available exclusively from Yakima Valley Hops. To create the blend, 16 hop varieties were evaluated, blended, and narrowed down to the winning blend of select lots at an event hosted by Brooklyn Brewery. The chosen blend includes equal parts Citra®, Citra LUPOMAX®, Elani™, and El Dorado®. The blend is described as being "fruit-forward and perfect for hop-centric styles like pale ales, IPAs, and hazies." For every pound (0.45 kg) sold, John I. Haas makes a $5 donation to the MJF to go towards scholarships for people of color continuing their education in the brewing industry. Learn more and order yours here.

LIGHTHOUSE™ MUNICH MALT

Briess Malt & Ingredients Co. has released a new Munich malt advertised to deliver all the classic, rich flavors of Munich malt but with a lower color impact and unique flavor profile. With a name inspired by the Manitowoc Breakwater Lighthouse, Lighthouse™ Munich Malt has a bold, bready character, complemented by notes of pretzel, nutty, and honey and is just 6 SRM. Kilning, combined with a unique malting recipe allows for preservation of the natural malt enzymes at a level that allows rapid conversion and typical levels of attenuation. Ask for it at your homebrew retailer.

UPCOMING EVENT

AUGUST 2, 2025

NATIONAL MEAD DAY

The 23rd annual National Mead Day takes place in the U.S. to celebrate and increase awareness of this ancient, fermented honey beverage and foster camaraderie among meadmakers both pro and amateur alike. Never brewed a batch of mead before? Now's the time! Raise a glass and cheers with us on August 2. Find techniques, tips, and recipes for making mead in the *BYO* archives here.

BYO STORY BEHIND THE LABEL

KADEN BRIGANCE • OGDEN, UTAH

I created this label for my dad. Homebrewing is a passion of his, and trying out his new recipes has become one of our favorite activities together. Besides brewing, my dad is an avid river rafter. Growing up, he was known as the "River Donkey," a nickname that became his personal brand. Over the years, he's made stickers, t-shirts, and other items with his nickname, so I naturally named his homebrewery after that.

My dad and I both love the outdoors, so I incorporated that into the design with all original artwork that includes a scenic backdrop of mountains and a river. Of course, I had to include a donkey floating down the river in a tube, enjoying a beer. The pirate theme for the donkey came from my dad's pirate flag that he always attached to his raft whenever we went out on the river. It represents his bold, rebellious, and risk-taking nature — qualities that have always stood out to me.

This design is dedicated to my dad, who has been a role model throughout my life, teaching me invaluable skills along the way. BYO

BYO REPLICATOR

BY DEREK DELLINGER

DEAR REPLICATOR,

Fontana Farms' Blood Orange Pale Ale managed way more fruit flavor than any citrus beer I've had in a long time. I'm curious how they did it and I would love some pointers on replicating this beer that is perfect for the summer months.

Kevin Brunswick
Louisville, Kentucky

For Michael Meeks and Richard Carl, friends since high school and founders of Delphi, Indiana's, Fontana Farms Brewery, their vision for breaking into the beer industry has always been rooted in a desire to create something that felt grounded. Inspired by small European breweries — which are often located on small personal properties — as well as innovative American operations like Illinois' Scratch Brewing, they envisioned a farm brewery where a significant portion of the beer was intrinsically linked to the land itself.

"We love outdoor venues, beer gardens, and rustic businesses," Meeks says. Their goal was to create a space reminiscent of both Indiana wineries as well as the various breweries that inspired them along the way — small-scale production, a welcoming tasting room, and the unique charm of being deeply intertwined with the community around them.

Like many who have turned pro over the years, Meeks and Carl started as avid homebrewers. A pivotal moment came when friends of theirs opened Teays River Brewing in Lafayette, Indiana. Meeks seized an opportunity to work part-time in the cellar.

"Working one day a week for about a year, the passion became a bit of an obsession," Meeks recalls. "We decided there was no turning back."

Fontana Farms opened its doors in the autumn of 2023, and has already set itself apart with a brewing philosophy centered on a sense of place. "We like to be known for our unique beer that comes from here," Meeks says. "The stuff that we grow and forage, the yeast that we collect."

While these hyper-local brews are currently a smaller part of their output, it's an area they're passionate about expanding, according to Meeks.

Fontana Farms maintains a diverse beer lineup appealing to broad tastes — always featuring IPAs, a porter, a kettle sour, and a cream ale — but their seasonal and specialty beers best showcase their brewing philosophy.

"We double down on the fact that we are both a farm and have a small woods," Meeks says. The bounty of the land dictates their brewing calendar, and thus far, they've incorporated a variety of foraged ingredients in their brews, including mulberries, elderberries, and dandelions.

"We are currently in the process of collecting sap from maple, black walnut, and Sycamore trees. We grow tomatoes, grapes, jalapeños, pumpkins, watermelon, horseradish, and spices that we use in our beers. We've also collected wild yeast to ferment. These things make us stand out and encourages people that it's worth the drive to come find out what we are all about."

All the extra effort required to obtain local, foraged ingredients is worth it, Meeks believes, as it serves a secondary function beyond just creating memorable beer. According to Meeks, it also helps educate their customers as to the variety of beer that can be produced even with the limited range of local ingredients, and highlights the notion that beer doesn't have to fall within one of the select beer style categories that shoppers commonly find at the grocery store.

Though it doesn't rely on foraged ingredients (for obvious reasons), Orange Mountain Pale Ale is a perfect example of Fontana Farms' creative output. The beer has had a place on the brewery's tap list from day one. Originally conceived during their homebrewing days, it has transformed significantly over the years.

"It started as a pale ale, but it has evolved tremendously," Meeks says. Early versions included crystal 60 malt, which was eventually cut from the grain bill. The team also experimented with Munich malt to enhance the orange hue, only to discover that the blood orange addition provided ample color on its own, so Munich was then scrubbed from the recipe also. The current recipe uses aromatic malt for a touch of color — although now, they've realized, the beer no longer fits within the traditional pale ale profile.

"Once we run out of labels, we will likely rebrand it as another category," Meeks says.

The goal for Orange Mountain deviates from their often subtle approach to fruited beers. "This is not one of those beers," Meeks says. "We want the orange to be in your face."

To achieve this assertive character, Fontana Farms employs sweet orange peel alongside the blood orange addition, and the flavor is further bolstered by a late addition of Amarillo® hops. A final touch of blood orange puree added to the brite tank provides a rounding complexity.

Balancing the prominent fruit and hop character requires careful consideration, Meeks says, noting that the blood orange itself contributes some bitterness. The result is a beer that "drinks balanced without being bitter," successfully delivering the unambiguous punch of orange that the team aimed for.

FONTANA FARMS' ORANGE MOUNTAIN PALE ALE CLONE

(5 gallons/19 L, all-grain)
OG = 1.058 FG = 1.010
IBU = 35 SRM = 6 ABV = 6.3%

INGREDIENTS

9.8 lbs. (4.4 kg) Pilsner malt
14 oz. (400 g) malted oats
7 oz. (200 g) aromatic malt
7 oz. (200 g) corn sugar (dextrose)
4 AAU Magnum hops (60 min.) (0.3 oz./9 g at 12% alpha acids)
11 AAU Amarillo® hops (10 min.) (1.5 oz./43 g at 7% alpha acids)
0.5 oz. (14 g) sweet orange peel (0 min.)
2.7 lbs. (1.2 kg) blood orange puree
SafAle US-05, Wyeast 1056 (American Ale), or White Labs WLP001 (California Ale) yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Mash in with 2.75 gallons (10.4 L) of 166 °F (74 °C) strike water to achieve a single-infusion rest temperature of 153 °F (67 °C). Hold at this temperature for 60 minutes. With sparge water at 170 °F (77 °C), collect about 6 gallons (23 L) of wort.

Bring wort to a boil. Add Magnum hops and set timer to boil for 60 minutes. With 10 minutes remaining in the boil, add the Amarillo® hops and corn sugar (dextrose), stirring gently to dissolve the sugar. During the boil, or before, peel a couple sweet oranges using a carrot peeler to collect 0.5 oz. (14 g) orange peel. Collect only the orange peel, not the layer of white pith below it that is very bitter. At flameout, add the sweet orange peel.

Chill the wort rapidly to your target fermentation temperature, around 68 °F (20 °C). Pitch the yeast, aerating the wort first if using liquid yeast.

Ferment at approximately 68 °F (20 °C). When fermentation is nearing completion, carefully rack the beer onto the 2.7 lbs. (1.2 kg) of blood orange puree in a sanitized secondary fermenter or add the puree directly to the primary. Allow at least five days before packaging to allow the secondary fermentation to subside.

FONTANA FARMS' ORANGE MOUNTAIN PALE ALE CLONE

(5 gallons/19 L, extract with grains)
OG = 1.058 FG = 1.010
IBU = 35 SRM = 6 ABV = 6.3%

INGREDIENTS

5.4 lbs. (2.4 kg) Pilsner dried malt extract
7 oz. (200 g) wheat dried malt extract
7 oz. (200 g) crystal malt (20 °L)
7 oz. (200 g) corn sugar (dextrose)
4 AAU Magnum hops (60 min.) (0.3 oz./9 g at 12% alpha acids)
11 AAU Amarillo® hops (10 min.) (1.5 oz./43 g at 7% alpha acids)
0.5 oz. (14 g) sweet orange peel (0 min.)
2.7 lbs. (1.2 kg) blood orange puree
SafAle US-05, Wyeast 1056 (American Ale), or White Labs WLP001 (California Ale) yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Place the crushed crystal malt in a muslin bag. Steep the grains in 5.5 gallons (21 L) of water as it heats up to 165 °F (74 °C) for up to 30 minutes. Remove the grain bag, allowing it to drain into the kettle.

Bring wort to a boil and then turn off the heat and carefully stir in the dry malt extracts until fully dissolved. Return to heat and boil for 60 minutes, adding the Magnum hops at the start of the boil. With 10 minutes remaining in the boil, add the Amarillo® hops and corn sugar (dextrose), stirring gently to dissolve the sugar. During the boil, or before, peel a couple sweet oranges using a carrot peeler to collect 0.5 oz. (14 g) orange peel. Collect only the orange peel, not the layer of white pith that is very bitter. At flameout, add the sweet orange peel.

Chill the wort rapidly to your target fermentation temperature, around 68 °F (20 °C). Pitch the yeast, aerating the wort first if using liquid yeast.

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BY DAWSON RASPUZZI

TWO APPROACHES TO PERRY

Two pros share how they make perry — one primarily with culinary pears and the other with perry pears. This decision results in drastically different perry, but both approaches are great options for homebrewers.

Dessert pears lend themselves to easy-drinking perries, contributing a creamy mouthfeel that complements co-ferments with bold fruits like sour cherries and passion fruit.

Jeremy Hall and his wife, Erin Chaparro, founded Blossom Barn Cidery on his parents' farm in southern Oregon's Rogue Valley in 2018. The farm has four acres dedicated to 480 perry trees and they also incorporate Rogue Valley agricultural products in all the perries, with fruit and botanicals coming from neighboring farms and orchards.

Our flagship perries that go into cans and kegs are primarily made with Rogue Valley-grown dessert Bosc and Comice pears. These are the pears that have dominated Oregon's Rogue Valley pear industry going back to the 1880s and the locals love them. It's the reason we decided to make perry instead of apple cider. These perries range from 100% culinary pears to 90% culinary pears co-fermented with fruit like cider apples, passion fruit, sour cherries, and strawberries. These are crowd-pleasing perries that generally appeal to people that are used to modern, semi-dry ciders.

Dessert pears lend themselves to easy-drinking perries, contributing a creamy mouthfeel that complements co-ferments with bold fruits like sour cherries and passion fruit. These perries can be drunk after just a couple months of aging in a reductive environment. We have made small batches from young perry trees we have on our orchard. These perries really showcase the depth and astringency of the perry pear and benefit from longer aging on fine lees with an occasional pump over to get some oxygen in the cider. This helps resolve all the short tannins into longer tannins that deliver a smooth yet complex perry.

We ferment all of our perries to dry, though we do backsweeten our seasonal perries with juice from local seasonal fruit like raspberries.

The juice undergoes treatment with pectinase to get the pectin out. We also add malic acid to our dessert fruit to get the pre-fermentation pH down to 3.8. After the acid and pectinase treatments, we add 25 ppm SO_2, mostly to control bacteria that convert the high citric acid content of the pears to acetic acid.

We use white wine yeast to ferment our perry. We're currently using ES181 from EnartisFerm, and have used DV10 also, but switched as we found the fermentation to be cleaner with no hydrogen sulfide (H_2S) production with a longer, colder ferment. I would recommend a first timer use a commercial yeast — mostly to avoid H_2S and volatile acidity (VA) that can dominate perry ferments. Or at least split the juice and use a commercial yeast on one and a wild ferment on the other.

If you have made hard apple cider but are new to perry, here are a few things to look out for:

1. Most pears benefit from cold storage to ripen. Even wild pears will ripen more consistently with a couple weeks or even a full month of cold storage. Juicing fully ripe fruit that hasn't been cold stored can be like trying to get juice out of apple sauce. Pick the pears a little early, cold store them for at least a week, and pull them out for a day or two and then juice them.

2. Unless you're going to keeve (a process of nutrient deprivation for a naturally sweet cider or perry), the high pectin content can create a lot of issues for fermentation, aging, and packaging. Treating the juice for pectin pre-fermentation is recommended. The citric acid content of pears is a big issue for VA, so controlling the populations of bacteria that cause VA is more important in perry than it is for apple-based cider or wine.

3. You can make a good perry out of any pears that are somewhat firm when ripe. Avoid varieties like Bartlett that are soft and creamy when ripe — they will be tough to juice.

Chris Weir leads the cidermaking team at Finnriver Farm & Cidery in Chimacum, Washington. After honing his craft in winemaking, brewing, and cidermaking across the West Coast, Chris returned to Finnriver in 2021, where he balances tradition with innovation and enjoys experimenting with barrel aging, wild fermentations, and creative blends to craft ciders that tell a story of place.

We grow three main varieties of perry pears in our orchard: Yellow Huffcap, Hendre Huffcap, and Romanian. We also have some amazing community members that will often bring us several thousand pounds of wild harvested seedling pears that are generally exceptionally high in acid and tannin content. Typically we produce our estate perry each year for our Orchard Series lineup. If we have an abundant perry pear year we may do an additional one or two specialty releases, such as our Keeved Single Malt Barrel Aged Perry.

Perry pears allow us to produce an assertive and bold perry without the need for fermentation adjuncts, acid additions, or added sugars. While I can certainly understand the appeal of blending in some culinary variety pears to increase volume and mellow out some of the aggressive tannins, I often find that the utilization of these varieties can result in a perry that is a bit more mellow and tame than I generally prefer. But that is just a personal preference.

We use an extended maceration process for our perry during the pressing stage. We will grind the pears into macro bins and allow it to sit for 24 hours prior to pressing. This extended maceration of the pulp allows for some controlled oxidation to occur, which helps to soften the aggressive tannins. Numbers depend on the harvest, but our juice is usually coming off the press around 3.4 pH and about 0.65 TA (titratable acidity). We sulfite between 15–30 ppm prior to primary fermentation and that is often the only addition made to the juice.

If it is an off year with low harvest yields we will typically ferment all of our perry varieties in one batch. If we have an abundant harvest I will ferment the varieties separately. This can allow for more creative freedom down the line in terms of blending for our final product. It opens up the option of utilizing different yeast strains to highlight certain characteristics of different varieties. There are a massive variety of yeasts available on the market and I enjoy experimenting with what they have to offer. Other times I utilize the natural yeast that comes in on the fruit and allow the wild ferment to do its thing. Ultimately it is a matter of creative inspiration in the moment. For a first-time perrymaker I would generally recommend pitching a cultured yeast. Wild ferments come with some risks and can be challenging to keep clean and healthy if you are unfamiliar with the process and don't have a solid nutrient plan or temperature control.

Even if you don't have access to traditional perry pears you can certainly ferment a unique and delicious perry at home. While using juice from entirely dessert variety pears will generally yield a lighter, less complex perry, there are many tools at the cidermaker's disposal to help build some complexity in the final product. Using a small amount of light or untoasted oak in the primary fermentation can add fullness and complexity without coming across as an inherently oaked or aged perry. If you don't mind some woody depth, I have used toasted Douglas fir staves to surprising success as well as toasted acacia wood. Co-ferments with other fruits are also a fantastic way to bring a little extra excitement to the table.

If you are familiar with making hard cider you should be well set to dive into the world of perry, though there are a few differences between them worth noting. Pears contain sorbitol, an unfermentable sugar, which means perry always has some residual sweetness remaining after fermentation. The level of residual sweetness can vary drastically from variety-to-variety and harvest-to-harvest.

Perry is also more challenging to clarify than apple cider and will often remain quite hazy after fermentation and aging. I personally don't mind a hazy perry, but if you prefer a clear and bright beverage, I have had the best luck achieving clarity with repeated cold-crashing and racking.

Lastly, if you usually allow for any malolactic activity in your ciders you should bear in mind that pears generally have high levels of citric acid as opposed to apples, which predominately contain malic acid. The bacteria used for malolactic fermentation to convert malic acid into lactic acid will also convert citric acid into acetic acid, which is generally less desirable.

BY ASHTON LEWIS

MEASURING & HITTING FG

Plus: All-in-one brew system designs and temperature's impact on pH

Q I MONITOR MY FERMENTATION WITH A TILT HYDROMETER, BUT BACK IT UP WITH A STANDARD HYDROMETER. THE TWO ARE ALWAYS A LITTLE OFF BUT ARE GOOD CHECKS. MY FINAL GRAVITY (FG) IS ALWAYS HIGH, NO MATTER WHAT STYLE I AM BREWING. IF THE TARGET IS 1.018, I'M USUALLY FINISHING AT 1.022. ALTHOUGH I CALIBRATED MY TILT, THE HYDROMETER READS 2–4 GRAVITY POINTS HIGHER FOR FINAL GRAVITY EVEN WHEN ADJUSTED FOR TEMPERATURE.

WHAT AM I DOING WRONG TO ALWAYS HAVE HIGHER GRAVITY AT THE END OF FERMENTATION?

BARNEY HELLER
NORTH WALES, PENNSYLVANIA

Hydrometers rely on the proper placement of a slip of paper for proper calibration. Misplacement by a couple of millimeters in a short hydrometer can result in significant errors.

Hydrometers must be properly calibrated to ensure they are accurate.

A Well, Barney, this question touches on two separate pain points in brewing — measurement challenges (calibration) and final gravity issues.

One of my brewing touchstones is to always give instruments a serious side-eye. I don't recall when I began questioning instruments, but know that mistrust is an asset. You have two instruments that are supposed to measure the same thing and have two different results. You have two options: Compare your Tilt and your hydrometer against standards (and when you say you calibrated the TIlt hydrometer, I'm guessing this is what you have already done) or add a third instrument to the party. Although the second option is not a terrible idea, unless the third instrument has been certified all you will do is add more confusion to things. So, what about bumping these up against a standard?

The gold standard for specific gravity is pure water with a density of 1.000 kg/L or a specific gravity of 1.000 (SG is unitless as it compares the density of one liquid to that of water). For many instruments, a single-point calibration is insufficient and a second or third calibration standard is required. Examples of multi-point calibrations include pH, temperature, and mass. This is also true of density, but once a hydrometer of a given length and weight is calibrated over a range using at least two calibration standards, the calibrated scale can be replicated. The takeaway is that you have completed the first step in sleuthing out the measurement by dropping your hydrometer and your Tilt into pure water and measuring the density. They both should read 1.000 at the water temperature your hydrometer is calibrated (your Tilt has a built-in correction).

My distrust of instruments is generally related to devices with "black boxes" that bring in some sort of input and return a value. Measurement errors often result from something awry with the black box input. This could be a dirty sensor, something touching a sensor, or interference with moving parts. The Tilt is a clever device where density is determined by the angle that the Tilt device floats in liquid. As density drops, so does the Tilt device. And as the Tilt hydrometer sinks, it becomes more vertical. Drop the same Tilt hydrometer into a high-gravity wort, and it will lean more horizontal.

Both of your devices have simple measuring principles, although the

> “If you want a drier beer, there are a few easy things to try. The first is extending your mash temperature in the 149 °F (65 °C) range.”

inner workings of the Tilt are nifty. And both devices will be affected by deposits on the surface that change the weight of the device; make sure they are both clean. My money is on the Tilt for being correct and your hydrometer for being off. I guess this is a good time to mention that you are probably not the problem.

Hydrometers rely on the proper placement of a slip of paper for proper calibration. Misplacement by a couple of millimeters in a short hydrometer can result in significant errors. This is why it is critical to always test hydrometers in standard solutions. For those of us using sets of tall hydrometers with relatively narrow ranges, for example 1.000–1.034 SG, 1.032–1.068 SG, and 1.065–1.101 SG (or 0–8.5 °P, 8–16.5 °P, and 16–24 °P), calibration is easier said than done. Suffice to say, don't trust a hydrometer further than you can drop it before first checking it out.

Missing your FG is a deep topic that I will simply dip my toe into. For starters, the FG of a brew has a lot to do with malt, mashing, and yeast. Change any of these things and expect a change in FG. But then there is the published FG. What does this mean? Is it a value plucked from the performance of a single batch of beer or is it the average FG of many, many brews of the same recipe? Here is the thing with FG . . . it usually contributes less to body and flavor than brewers think. The one exception to this is when a beer finishes high because of unfermented sugars that are sweet.

Details aside, if you want a drier beer, there are a few easy things to try. The first is extending your mash temperature in the 149 °F (65 °C) range. Sixty minutes is long enough to produce highly fermentable wort. Another thing to consider is to back off specialty malt additions, like crystal and caramel malts, that boost FG. And then there is yeast strain; yeast strains that are either unable to ferment maltotriose or those that do so poorly will leave higher finish gravities compared to strains that do ferment maltotriose. For the latter, most lager strains and ale strains like Chico gobble up maltotriose like nobody's business.

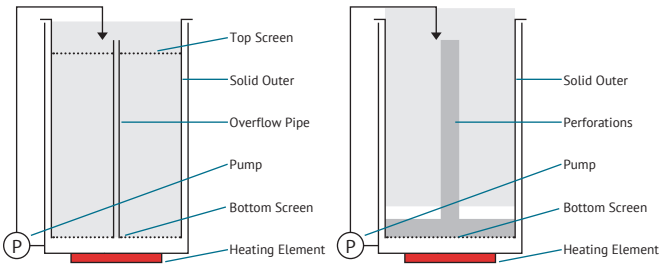
Q BY READING ONE OF YOUR EXPLANATIONS ON "SIMPLIFYING BREWING" I UNDERSTAND THAT YOU USE A GRAINFATHER ALL-IN-ONE BREWING SYSTEM. I HAVE USED THE GRAINFATHER G30 FOR ABOUT EIGHT YEARS. FROM THE VERY BEGINNING I WAS UPSET WITH THE NON-HOMOGENEITY OF TEMPERATURE DURING MASHING. BECAUSE THE TEMPERATURE MEASUREMENT POSITION IS LOCATED UNDER THE FALSE BOTTOM, I HAVE CONCLUDED THAT THE WORT ATOP OF THE GRAINS IS MUCH COOLER (CONFIRMED BY MEASUREMENTS WITH AN EXTERNAL THERMOMETER).

I SAW THAT THE GRAIN TUBE IN THE NEW GRAINFATHER MODEL HAS PERFORATIONS ON ITS CYLINDRICAL SURFACE, SO I AM UPDATING MY SYSTEM WITH A NEW BASKET. THOUGH I QUESTION WHETHER PART OF THE WORT WILL NOT BE FLOWING THROUGH THE GRAIN WITH THIS DESIGN AND THE EFFICIENCY WILL BE SEVERELY REDUCED. WHAT IS YOUR OPINION ON THIS?

LUIZ REBOUÇAS
VIA EMAIL

A Luiz, thank you for the great question. I do brew using a Grainfather G30 and am familiar with how the original system is designed, as well as the new basket. For those of you who are not familiar with these systems, there are two main parts of the Grainfather and other systems based on the same basic all-in-one design (see diagrams shown in Figure 1).

Figure 1: Original Grainfather design shown on left and new design shown on right.



The brew kettle is heated from the bottom using an electric heating element positioned on the bottom of the kettle from the exterior. When looking down into the kettle, the heater is not visible. When used for mashing, a smaller mash basket is inserted into the kettle to hold the mash. In the original basket shown on the left in Figure 1, wort flows down through the bottom screen, into the pump and is returned to the mash basket onto the top screen. Wort pooling above the top screen flows directly to the bottom of the vessel through an overflow pipe to prevent the pump from exerting too much pull on the mash and from starving after all wort outside of the basket has been pumped to the top.

In my experience, the original design works best when using coarsely milled malt or more finely milled malt in conjunction with rice hulls because the mash bed is more

permeable. The issues I have experienced with the original design are variable yields, occasional long wort collection times, and difficulty with uniform mash temperature. This sounds like your experience.

One thing that works for me is to start my mash at about 140 °F (60 °C), periodically stir for about 15 minutes, then install the top screen, and start the recirculation pump and the mash profile. If I am using a single mash temperature, I start my mash at about 149 °F (65 °C), periodically stir for 15 minutes, install the top screen, and start the pump and simply set my mash temperature at 149 °F (65 °C) to maintain temperature. Mash stirring during the beginning of the mash really helps with thorough hydration of the malt while also moving things around to improve extraction. I spent my commercial brewing days using stirred mashes and really like the yield improvement and increased consistency between batches that stirring provides.

To answer your questions, I contacted Aaron Hyde with RahrBSG to get some information about the new basket design used in all new Grainfather systems. Aaron is currently RahrBSG's Director of Product and Portfolio and the former General Manager of Portfolio and Strategy for Bevie, the New Zealand-based company that produces the Grainfather. The basket redesign was Aaron's brainchild.

"I suspected side perforations would improve temperature control because the perforations improve wort flow through the mash, even when thick and sticky, which is why the overflow pipework on the old system was needed." Aaron also felt that adding side perforations would not decrease efficiency because liquid tends to flow down through the grain bed during draining. In practice, users of the new design report higher yields in comparison to the old design and find the new design to perform more consistently from brew-to-brew.

One thing to consider is sparging technique. Some brewers like to keep a small volume of water above the mash bed during sparging and time additions or the flow rate of continuous sparge additions to maintain a consistent level of water. With the new design, that method would indeed result in water flowing out of the side perforations. The best approach to sparging is to add sparge water in batches until it just begins to pool. After a couple of minutes of draining, add more sparge water.

The larger models are equipped with a sight tube showing wort volume in the kettle, while the G30 does not have this feature. I use a calibrated wooden stick (flat yard stick purchased at the hardware store) with my G30 to monitor how much wort I have collected and use this information to gauge when more sparge water is needed (to use this stick, I slip it between the kettle and grain basket wall and look for the top of the wetted portion). For example, if adding sparge water in 2-quart (2-L) increments, waiting for the kettle volume to increase by 2-quarts (2-L) indicates when the next addition can be made.

I do think that the questions posed make sense, but at the end of the day, the improved liquid flow through the bed during wort recirculation outweigh the small volume of wort flowing outward from the perforations.

Q I AM WATCHING JOHN PALMER'S WATER PRESENTATION ON THE *BYO* WEBSITE AND HE GOT INTO pH A LITTLE BIT. I HAVE ALWAYS BEEN CONFUSED ABOUT THE CHANGE IN pH WHEN TAKING A SAMPLE. IF I AM UNDERSTANDING WHAT JOHN IS SAYING, MASH pH IS 0.3 LOWER THAN THE pH METER READING AT ROOM TEMPERATURE OR BELOW? IF THAT IS THE CASE, TO ENSURE MY MASH pH IS 5.2, THE READING ON MY pH METER SHOULD BE 5.5, CORRECT?

SOMETIMES WHEN I TAKE A SAMPLE, I PUT IT INTO AN ICE BATH TO QUICKLY COOL IT DOWN. IF I AM NOT CAREFUL, SOMETIMES THE TEMPERATURE DROPS DOWN TO ~63 °F (17 °C) OR SO. WHAT IMPACT DOES MEASURING AT THIS TEMPERATURE HAVE ON CALCULATING THE MASH PH?

RICK BRAY
VIA EMAIL

A I think the best way to explain this is to start with a brief discussion about pH and why temperature affects it. pH is a measure of hydrogen ion concentration using a logarithmic scale, where pH = -log [H^+]. The pH of pure water is 7.0 at 77 °F (25 °C) because the concentration of hydrogen ions is 10-7 moles per liter — noted as [10^{-7}] using standard chemistry shorthand — because of the equilibrium of water with its dissociated ions as shown below:

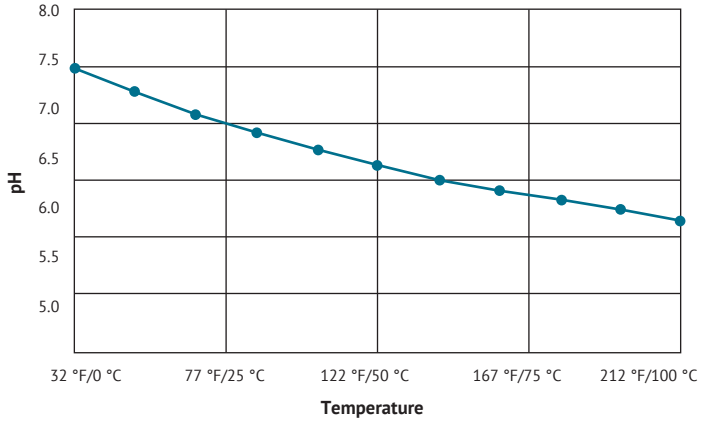
$$H_2O \leftrightarrow H^+ + OH^-$$

The equilibrium of molecules is governed by an equilibrium constant at a specific temperature. The equilibrium constant of water (written as K_w) is 10^{-14} at 77 °F (25 °C). As temperature increases above 77 °F (25 °C), or standard temperature used in chemistry, dissociation increases as does the concentration of hydrogen ions. Because pH is defined as the -log [H^+], an increase in [H^+] corresponds to a lower pH. Acidic solutions have a higher concentration of hydrogen ions than pure water and bases have lower hydrogen ion concentrations compared to pure water.

The graph shown in Figure 2 illustrates that water pH ranges from 7.5 to 6.1 over the temperature range from 32–212 °F (0–100 °C).

Using water as the topic of discussion, Figure 2 shows that water with pH 6.5 measured at 140 °F (60 °C) will increase to pH 7.0 when cooled to 77 °F (25 °C). However, this assumption becomes invalid if there is anything in the water that acts as a pH buffer. Buffers are systems of organic acids that can bind hydrogen ions through their own equilibria. For example, carbon dioxide readily dissolves in water and

Figure 2: pH of Pure Water



exists in three forms — carbon dioxide, bicarbonate, and carbonate, as shown in the following equation:

$$H_2O + CO_2 \leftrightarrow HCO_3^- + H^+ \leftrightarrow CO_3^{-2} + 2H^+$$

Back to the assumption that water at 140 °F (60 °C) with pH 6.5 has a pH of 7.0 at 77 °F (25 °C). This is a poor assumption because the atmosphere contains about 0.04% carbon dioxide. Mashes contain much more buffering compounds compared to the small amount of carbon dioxide contributed by the atmosphere. These buffers include proteins, amino acids, phosphates, and nucleic acids from malt, plus carbonate from brewing water. To further complicate things, calcium and magnesium from brewing water both cause a reduction in mash pH because they react with malt compounds. In practical terms, this means that the mash system is heavily buffered and that changes in mash pH as a function of temperature are not as big as changes in pure water pH.

Life is full of approximations. The typical thumb is about an inch (2.5 cm) wide. A stone fetched from a pile of standard stones weighs 14 pounds (6.4 kg). A hand is 4 inches (10 cm) measured from thumb to opposite side of palm. And mash pH drops by about 0.30 pH units when cooled from mash to room temperature. One thing we know about these approximations is that they are indeed approximate!

The best way to consistently monitor mash pH is to either cool it to 68 °F (20 °C) — not 77 °F (25 °C) because biochemists use a different set of rules than physical chemists — or measure mash pH hot. If you prefer measuring mash pH at 68 °F (20 °C), you should use published pH ranges that are associated with cooled samples for your target range. Although the ranges vary by source, 5.45–5.65 at 68 °F (20 °C) agrees with textbook information. Some references, most notably *Malting & Brewing Science* by Hough, Briggs, Stevens, and Young, provide mash pH at mash temperature and at room temperature. The true confusion with this subject comes from the lack of temperature reference in nearly all published data about mash pH. Given the well-known effect that temperature has on pH, it's appalling that brewing scientists and academics have omitted this important detail.

Hopefully the background about pH and temperature is useful. Now let's apply this information to your specific

Photo courtesy of Shutterstock.com

Understanding the impact of temperature is key to hitting your mash pH.

questions. You correctly understand what John is saying. The mash pH is lower than the pH measured in a cooled sample. Is it 0.3 pH units lower? The only way to know is to measure the pH at two temperatures because the mash buffering systems are too numerous and variable to predict the temperature effect.

Yes, if you are targeting pH 5.2 for your mash pH, then you want your reading to be higher when measuring a cooled sample. I will come back to this in a moment.

If you cool your sample to 63 °F (17 °C) instead of 68 °F (20 °C), you cannot use the same approximation for the offset. Instead of the difference being ~0.3 pH units, it may be closer to 0.32 pH units. Is this difference going to change your beer? Probably not, unless you are brewing the same beer many times a year on a commercial scale.

Now that I have answered your questions, let's muddy things up a bit! pH 5.2 likely became a target for mash pH because of the following excerpt from *Malting & Brewing Science*: "An infusion mash is best carried out at pH 5.2–5.4. Consequently, the pH in the cooled wort will be 5.5–5.8." I think the first sentence became part of the homebrewing zeitgeist while the values in the second sentence were forgotten! I suggest changing your target pH at 68 °F (20 °C) to be in the 5.5–5.8 range. BYO

Related Link:

• *Take a deeper dive into the impact pH has on your beer at* **www.byo.com/article/sorting-the-facts-a-deep-dive-into-mash-ph/**

BY GORDON STRONG

COLD IPA

New style or the future of American IPA?

While it's tempting to present it as a distinct style — especially given its clean, dry finish and crisp hop profile — I suspect it may actually represent what IPAs are becoming.

COLD IPA
BY THE NUMBERS

OG:	1.055–1.065
FG:	1.006–1.010
SRM:	2.5–5
IBU:	45–70
ABV:	6.4–7.9%

Photo courtesy of Shutterstock.com

I shouldn't be so conflicted writing about a style I really enjoy, but I'm a bit uncertain how to characterize cold IPA. My basic dilemma is whether to talk about it as a new, distinct style, or to think about it more as the natural evolution of American IPA. While it's tempting to present it as a distinct style — especially given its clean, dry finish and crisp hop profile — I suspect it may actually represent what IPAs are becoming. With a flavor profile reminiscent of a West Coast IPA, yet paler, drier, and often smoother, cold IPA typically lands in the mid-6% to nearly 8% ABV range. Whether it's a reinvention or a refinement, its growing popularity suggests it's worth paying attention to.

Cold IPA absolutely has an origin story, but how other brewers are making it can be seen as the complicating factor. One mistake I would rather avoid making is describing the style based on how the original example was made since that ignores the range of the style. When I think about the changes to make to the American IPA style to allow it to encompass cold IPA, the changes are actually fairly minimal. But when I drink the beer, it seems like something a bit different.

OK, I've teased you enough. Cold IPA is not currently recognized as a Beer Judge Certification Program (BJCP) style. It could be entered in the 21B Specialty IPA category, with an explanation that it is a cold IPA. A short explanation of the recipe changes from an American IPA (21A) could be sufficient, or judges may insert their own judgment about what constitutes a cold IPA (admittedly, a risky choice, depending on the competition and the experience of the judges).

HISTORY

I've written extensively in these pages about the history of IPA, the original English IPA, and how IPA evolved into more modern American forms such as the popular West Coast IPA (which covers much of the current American IPA style). I've also written about the other current American IPA, the hazy IPA. Cold IPA is essentially a tweak of West Coast IPA using some process and ingredient changes inspired by lager brewing.

Cold IPA was a project of Kevin Davey while he was Brewmaster at Wayfinder Beer in Portland, Oregon. They first released the beer in October 2018 as Relapse IPA, but it has since been renamed to Wayfinder Original Cold IPA. It became very popular and trendy in the times when we were emerging from the COVID pandemic, especially in 2022 and 2023. While no longer having the newness buzz it once had, it remains a popular style of beer even if it is not consistently named.

After I judged at the Great American Beer Festival in 2022, I sought out Kevin Davey at Wayfinder for his firsthand take on the style and what he thought of other examples. I found it notable that he had high praise for Firestone Walker's Hopnosis IPA, even though Matt Brynildson used another path to get to a similar result. Remember this moment, since it is the basis of my problem with characterizing the style, as I discuss later.

Many articles were written introducing the style, offering recipes, and discussing the origin. Perhaps with the recent memory of brut IPA still fresh, the messaging around the beer and the style was noticeably different. However, the comparison with brut IPA is apt because it shared the same goal of cold IPA — to be a drier, more drinkable, clearer counterpart to the hazy IPA juggernaut.

Wayfinder themselves describes

cold IPA as "Wester than West Coast," implying that the essence of a great West Coast IPA is at the heart of the style. It also introduces lager yeast (potentially) but tries to avoid the issues that surrounded the so-called India pale lager, or IPL — most notably how the sulfur from lager yeast and fermentation would often clash with the sulfur in many modern hops. Stan Hieronymus had previously described to me that beers had a kind of sulfur limit or budget that couldn't be exceeded without having detrimental sensory effects (meaning, that it becomes unpleasant to drink). It's a concept that I think has merit and I hope to explore more in the future.

The original cold IPA at Wayfinder was distinguished from a West Coast IPA by using rice or corn adjuncts like an American lager or cream ale, using a clean, low-sulfur lager yeast fermented warmer than is typical, fermenting totally dry with a lower final gravity, and using some biotransformation methods with hopping during fermentation. The lower final gravity means that overall bitterness should be reduced (as in brut IPA) to achieve a more drinkable balance.

SENSORY PROFILE

A cold IPA has a similar profile to a West Coast IPA, but is often paler, drier, and smoother. The alcohol strength is similar, from mid-6% to nearly 8%, but the starting and finishing gravities are often lower to gain the additional dryness. The apparent bitterness level is similar, but measured IBUs could be a little lower (45–70) due to the dry finish.

The beer can be quite pale, especially in variations using rice. The color can be as low as 2.5 SRM, but shouldn't get into the gold colors. Clarity can be excellent, although a light haze is possible in unfiltered versions.

The malt profile is relatively neutral, and caramel flavors should be absent. Bitterness is significant, in the medium-high to high range, but a clean bitterness profile without harshness is most desirable. The hop flavor and aroma should be substantial, and can take many directions. Many versions feature biotransformation effects

COLD IPA

(5 gallons/19 L, all-grain)
OG = 1.062 FG = 1.009
IBU = 55 SRM = 3 ABV = 6.9%

INGREDIENTS

9 lbs. (4 kg) North American Pilsner malt
3.5 lbs. (1.6 kg) flaked rice
12 AAU Mosaic® hops (first wort hops) (1 oz./28 g at 12% alpha acids)
1 oz. (28 g) Mosaic® hops (5 min.)
2 oz. (56 g) Mosaic® hops (whirlpool)
1 oz. (28 g) Mosaic® Cryo™ hops (dry hop during fermentation)
1 oz. (28 g) Mosaic® Cryo™ hops (dry hop post fermentation)
SafLager W-34/70, Wyeast 2124 (Bohemian Lager), or White Labs WLP830 (German Lager) yeast
¾ cup corn sugar (if 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 1 tsp. of calcium chloride to the mash.

This recipe uses a step infusion mash. Use enough water to have a moderately thick mash (1.5 qts./lb.). Mash in the grains at 131 °F (55 °C) for 10 minutes. Raise the temperature to 145 °F (63 °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. The first wort hops go in the kettle prior to lautering.

Boil the wort for 75 minutes, adding hops at the times indicated. When the boil is complete, cool the wort to 160 °F (71 °C) before adding the whirlpool hops. Stir, and let rest for 20 minutes before proceeding.

Chill the wort to 59 °F (15 °C), pitch the yeast, and ferment until complete, allowing the temperature to rise to 64 °F (18 °C). The first dry hops go in the fermenter after two days of high active fermentation. Allow fermentation to completely finish and then rack to secondary and add the post-fermentation dry hops for three days.

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

COLD IPA

(5 gallons/19 L, extract only)
OG = 1.062 FG = 1.009
IBU = 55 SRM = 3 ABV = 6.9%

INGREDIENTS

6.5 lbs. (3 kg) extra pale liquid malt extract
2.1 lbs. (0.95 kg) corn sugar (dextrose)
12 AAU Mosaic® hops (first wort hops) (1 oz./28 g at 12% alpha acids)
1 oz. (28 g) Mosaic® hops (5 min.)
2 oz. (56 g) Mosaic® hops (whirlpool)
1 oz. (28 g) Mosaic® Cryo™ hops (dry hop during fermentation)
1 oz. (28 g) Mosaic® Cryo™ hops (dry hop post fermentation)
SafLager W-34/70, Wyeast 2124 (Bohemian Lager), or White Labs WLP830 (German Lager) yeast
¾ cup corn sugar (if 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 corn 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. When the boil is complete, cool the wort to 160 °F (71 °C) before adding the whirlpool hops. Stir, and let rest for 20 minutes before proceeding.

Chill wort to 59 °F (15 °C), pitch yeast, and ferment until complete, allowing the temperature to rise to 64 °F (18 °C). The first dry hops go in the fermenter after two days of high active fermentation. Allow fermentation to completely finish and then rack to secondary and add the post-fermentation dry hops for three days.

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

with additional tropical fruit character, but all classic American IPA hop descriptors could be used. A fresh dry-hopped character is typical.

The body is low to medium-low (possibly a shade lighter than West Coast IPA), and the beer is well-carbonated. The palate seems smooth, and any alcohol should not be too evident. Fermentation character can seem relatively neutral to lightly fruity and should complement the hops, not clash with them. The sulfur content (from any source, including water) should be relatively low to not fight with the hops.

From a sensory standpoint, the beer is slightly different from a West Coast IPA, but not so different that a reworked American IPA style description couldn't cover it. I worry more about the potential overlap between a hypothetical cold IPA style and the American or West Coast IPA style, and whether judges could reliably distinguish these differences in competitions.

BREWING INGREDIENTS AND METHODS

This is where the differences between excellent commercial examples comes into play. If we examine Wayfinder's version, they use corn or rice adjuncts — which have the same starch composition as barley with 75% amylopectin and 25% amylose, but the absence of a husk leads to a lighter resulting beer with less soluble protein. Firestone Walker, on the other hand, uses an all-malt grist with a German-inspired step mash. Which is correct? Both are, since they each lead to a similar sensory result. But this causes problems if attempting to define the beer by its use of adjuncts since there is such a notable counter-example.

Malt is generally a pale North American variety without too much flavor. I think some German Pilsner malt could be used in the grist as well, but I wouldn't want it to add a dominant flavor. Adding too much additional character malt could give the beer too much color as well. The modern West Coast IPA trend of avoiding crystal malts at all costs is fully in play. Anything dark has no place in this style.

Lager yeast is typically used for fermentation, but with a warmer fermentation to help drive off sulfur. The classic German SafLager W-34/70 strain is frequently mentioned as suitable for this style. Neutral ale yeast or a Kölsch yeast are often mentioned as possible substitutes, especially when used with a cooler than standard ale fermentation regime. Again, multiple paths to get to the same sensory goal — a low-sulfur, clean, well-fermented beer.

Water composition eschews the Burtonization methods and sulfate-rich composition for a more neutral profile. Any calcium additions to aid mash performance should be done with the goal of keeping the finished sulfur levels low, which leads me to choose calcium chloride more frequently.

The hop methods pick up some modern methods from hazy IPAs that are more frequently being applied to American IPAs, including biotransformation through dry hopping during active fermentation. Various late hopping techniques can be used, with nothing ruled out. Hop choices are up to the brewer, as long as they display modern American IPA characteristics, even if they come from New World locations such as New Zealand. Again, the sensory goal is the target more than the method. New hop forms and products may be used if they are increasing hop character while minimizing detrimental effects of overhopping, such as hop burn.

I realize these descriptions are not very explicit in the path, but that is intentional since I am trying to characterize the goal is more important than the many possible methods and ingredients to reach it. Finding an approach that works on your system is the key to success.

I would like to emphasize that the methods I'm describing really do illustrate the ways that modern ingredients and techniques used in other styles (even hazy IPA) are finding their way into this style. This helps support the notion that the American or West Coast IPA may be evolving, as it did in the late 1990s and early 2000s when brewers started moving away from crystal malts and started developing (or rediscovering) additional methods of late hopping.

HOMEBREW EXAMPLE

My example uses some of the modern IPA techniques advocated by Kevin Davey and Matt Brynildson, while using some of my tried-and-true favorite IPA methods. It uses a neutral pale American base malt and rice, but without any cereal mashes. I use step mashing for extra attenuation as well. The hopping is all Mosaic®, something I have used to great success in double IPAs, with the nod to Firestone Walker by making some of them Cryo™ hops. Lager yeast is fermented warmer than typical, with both fermentation hopping for biotransformation and traditional dry hopping.

There is some wiggle room on this recipe, of course. Any pale, neutral malt combination can be used as the base. Corn can be used instead of rice, but I'm not looking for any corn flavor or impression of sweetness, so I stick to rice, which also helps keep the color light. Step mashing is my preferred choice for dry, well-attenuated beers, but if you can only do a single infusion, keep it low, like at 149 °F (65 °C).

Cold IPA is indeed a blank canvas for hops, so you can use your own choices as well. I'm not going super bitter since it is a dry beer, and I'm emphasizing the late additions for maximum aroma and flavor. Normal hops can be substituted if Cryo™ hops are unavailable, but I would still use the two-stage dry hopping approach.

Other yeast can be used, as long as it is a low sulfur producer. A clean, neutral ale yeast can be used. Some use a Kölsch yeast, although I find they can be a bit sulfury. The warmer lager fermentation temperature is more for reducing sulfur than producing esters, and can be conducted slightly warmer if desired (64–68 °F/18–20 °C).

The goal here is for a very light colored, dry, clean, and crisp beer with a strong hop character and a smooth palate. The hop aroma should be substantial, but the overall profile should seem relatively neutral. For those who like lagers, especially hoppy lagers, this beer should be appealing. Just don't tell me what it's called or ask me how to categorize it; I'm still thinking about how best to handle it. In the meantime, bring me another one of these. The last one is gone. BYO

BEER EDUCATION

Looking to advance your brewing knowledge? Check out some of the beer education programs on the following pages to start your journey down the path to a higher education in beer brewing or the business of beer.

Explore the World of Perry

Juicing pears into cider

by Adam Wells

Perry is one of the world's most misunderstood, overlooked, and underrated drinks. Made much in the same way as hard cider, but from pears, it has existed in some form or another for over 2,000 years and has survived extinction— sometimes by a whisker — through the grit and determination and sheer bloody-mindedness of a small group of people who know it to be too great a treasure to lose.

Like cider, its flavors derive from a bewildering host of literally hundreds of varieties of pears, each one with a different aroma, character, and texture. Some of these pears, so-called "perry pears" — particularly those most prominently grown in France, the U.K., and Central Europe — have no other use but the making of this drink. They're totally inedible — 17th century historians wrote that even pigs wouldn't touch them — but their drink is sublime. Others are dessert pears such as you might find in cans and pastries. Perhaps even more exciting are the perries made from wild, randomly growing trees, the legacy of lost orchards, and seeds strewn in the droppings of birds and animals.

Again, as with other drinks fermented from fruit, these flavors can be ameliorated and manipulated across a dazzling array of styles according to the methods and intentions of the maker. There are perries made the same way as Champagne, every bit as elegant as their grapey counterpart. Others are big and robust, perhaps aged in oak and bottled still. There are sweet, frothy, gorgeously scented perries made in the classic Normandy style, and there are super fruity, dangerously crushable perries that demand hot days and cold, generous glasses. There are even huge, rich fortified perries, crackling with the warmth of Ports or barrel-aged barleywines.

Photo by Charles A. Parker/Images Plus

Whatever the pears, whatever the style, perry offers the patient maker and dedicated drinker a host of possibilities. As aspirational cider has continued its rise around the world, so perry has followed along behind it. But increasingly this much-overlooked drink is gaining its own spotlight and appreciation. On both sides of the Atlantic, and indeed all over the world, from Australia to Japan, from Chile to Canada, the best perries that have ever been made are sitting on shelves right now. If you have not already, there's never been a better time to discover it and to make your own.

A BRIEF HISTORY

As with all drinks, we'll never know for certain exactly when the first perry was fermented. Beginning in the wild forests of what is now western China, the pear headed east and west, hybridizing, mutating, and ultimately being specifically cloned and grafted as it went. The first mention of a drink that we would recognize as perry comes in Pliny the Elder's *Natural History* of 77 AD, in which he describes "the Falernian pear, so called from the drink it affords."

For the following millennium it was fairly quiet, appearing mainly in ecclesiastical references from France, where it was even drunk as penance by saints — Saint Redegonde, for instance, retired to a convent where she allegedly drank nothing but water and perry! By the thirteenth century it was achieving prominence in central Europe — for a while it was the favored drink of the Bavarians, even ahead of beer. In the 17th century, when continental wars slowed down supplies of wine to England, perry had a brief heyday alongside cider as "the native wine" of the English.

In the United States, perry achieved surprising popularity, particularly in the Northeast, until an incurable bacteria called fireblight appeared in the Hudson Valley of New York, to which pear trees proved particularly susceptible. Since pear trees on traditional rootstocks take decades to come to fruit-bearing maturity, their devastation by fireblight proved a death knell for American perry, until modern makers once again turned their hands to it.

As recently as 1950, you could have drawn a band across Europe, through the U.K., northern France, Austria, Luxembourg, Switzerland, southern Germany, and conceivably even further, and all along that band perry pear trees were grown by the thousand, and perry was a central part of rural life. But, largely following the mechanization of agriculture, pear trees were cut down to make way mostly for cornfields by the million. Austria's Mostviertel had a million perry pear trees — today they have somewhere around 200,000. France's Domfrontais boasted a collective orchard of 1.5 million, but by 1999 only 100,000 remained. In the U.K., numbers would have been very similar, but no one even bothered to keep count. Switzerland, once the heart of the perry world, cut down 11 million fruit trees between 1950–1975 and now I am only aware of two perrymakers in the whole country.

Photo courtesy of Shutterstock.com

Wild pear trees, which are common in New England and the Pacific Northwest, make for great pears to turn into perry if you can forage them.

> You can use absolutely any pears in the making of perry, and don't listen to anyone who tells you otherwise.

Perry could easily have disappeared entirely; indeed, in some countries it almost did. But thanks to the modern movement around the world, this miraculous drink has been given yet another life.

A WORD ON THE PEARS

You can use absolutely any pears in the making of perry, and don't listen to anyone who tells you otherwise. In the drink's three modern heartlands — Domfrontais in France's Normandy, Mostviertel in northern Austria, and the U.K.'s Three Counties of Herefordshire, Worcestershire, and Gloucestershire and just over the Welsh border into Monmouthshire — perry is almost exclusively made with so-called "perry pears." These varieties are packed with acidity and tannins, like Thorn, Barland, Plant de Blanc, Speckbirne, and Grüne Pichelbirne. You wouldn't want to eat any of these. Indeed, some are so bitter or sharp that they'll almost skin the roof of your mouth (trust me, I've been there). But these properties can be precisely what lend themselves to the most flavorful and beautifully-structured perries of all. Many of these treasured varieties have now been grafted in American orchards, especially in Washington, Oregon, and New York State, and the comparisons with the flavors of their European equivalents make for fascinating drinking.

Eating pears, generally lower in acidity and entirely without the bitterness of tannin, make a much lighter, subtler perry. All perries are famously hard to make, but without the crutch of lower pH, dessert pear perries can be particularly troublesome. But persevere! Some truly delicious perries around the world, from makers like Oregon's Blossom Barn, England's Vagrant and Nightingale, The Netherlands' Elegast, and Japan's Kamoshika have used pears like Bartlett, Conference, and Anjou.

The final option is to go wild. America, particularly some of the states already mentioned, has an abundance of randomly grown wilding pear trees, often the legacies of native orchards disrupted or devastated by European settlers, such as those of the Haudenosaunee Confederacy in the area of New York's Finger Lakes, now harvested by makers like Eve's. Wild pears offer a whole new world of flavors: Any of these trees has the potential to be the next great perry variety. What's more, pears that have grown in this way, in U.S. soil, likely have greater inherent resistance to fireblight. As the bacteria continues to decimate pear trees around the world, perries from these varieties may prove to be the most important of all.

MAKING PERRY

The good news, for makers of hard cider, is that the similarity between these beverages means you're already well equipped to tackle making perry. And homebrewers who have never made cider should not shy away from perry either, because the availability of cider nutrients and cider yeast make perry an approachable thing for good and adventurous brewers.

The basic premise is the same as cider from apples or even wine from grapes. Harvest your fruit, crush and press it, ferment it with pitched or ambient yeasts, and package it when ready. And indeed your choice of styles, maturation vessels, and packaging equipment is effectively identical to those you would consider if working with apples.

There is a "but" (or this section would be very short!). Perry is generally accepted as far more troublesome to make than either cider or wine, which is likely the main reason it doesn't have the same prominence as those drinks. "If it didn't make that drink we would stop making perry tomorrow," Tom Oliver, one of the world's most renowned perrymakers tells me. "It's too demanding, it takes too much. Making cider's a piece of cake compared to making perry, the risks are not there — and then you can't sell the bloody stuff once you've made it! But it's that drink, honestly. Cider's great, but if I want to show off to somebody, it's usually a perry I go for. What a drink."

So, let's start from the top with the making of perry and the challenges you'll face along the way. Though they may sound daunting, they can all be overcome by those who are determined, as homebrewers tend to be.

HARVESTING

Depending on the rootstocks, pear trees can grow 60-feet (18-m) tall, with 50-foot (15-m) canopies, and can ripen more than a ton of fruit on a single tree. Sounds great, doesn't it? Until you consider that you have to get those pears down somehow, and that 60 feet (18 m) is a long way for a piece of fruit to fall undamaged.

Nightmarishly, some varieties won't drop their entire fruit load, and you may need to take a very long stick and encourage the remaining pears down. (Being hit on the head by falling pears is a perrymaker's rite of passage). Even worse, some varieties like Yellow Huffcap may begin to rot from the inside out whilst they're still on the branch.

Pears also have notoriously slim ripeness windows. Think of the pears in your fruit bowl — rock hard for days, until you look away for two minutes and suddenly they've turned to mush. You can't ripen many of them off the tree as you can apples; varieties like Thorn need to be harvested and pressed within two days. Moorcroft, also known in the U.K. as "Stinking Bishop," can be as little as 24 hours.

MILLING (OR CRUSHING) AND PRESSING

As anyone who has eaten a pear will

Photo courtesy of Shutterstock.com

Pears primarily grown for eating and readily available from grocery stores work best for light, refreshing versions of perry.

know, its structure is very different to that of an apple. Milling and pressing overripe pears can be a very messy business. Pears love nothing better than to clog a mill or a press, and since, unlike apples, they don't float, even washing them is a more tiresome business than it is when making cider.

Nevertheless, despite the clogging and the extra cleaning, any sort of press that can be used for cider can be used for perry. Traditional rack and cloth presses or hydropresses are common amongst small makers, while larger producers might deploy a belt or pneumatic press. We've included links at the end of this article for a couple of DIY builds that can help you crush and press your pears (or apples).

YEASTS AND FERMENTATION

Again, yeast selection depends on what you're attempting to achieve. Amongst small makers in the U.K. and France, native yeasts tend to be commonplace. For larger, more industrial makers, but also amongst many of the makers in Austria who are looking to emulate the style and some of the flavors of still white wine, choosing a particular strain of yeast is more common. Often, though not always, strains of white wine yeast are used for perry production. Cider yeast is also available from some manufacturers in small sachets perfect for 5-gallon (19-L) batches of perry at home, and will work quite well. I've even had a perry fermented with kveik, the fast-fermenting Norwegian farmhouse ale yeast.

A note on sulfites is worth making here. Very few varieties of pear — even the perry pears of the U.K. and continental Europe — have pHs as low as those of most apples. Pear juice is far less stable than apple, and far more susceptible to the impacts of oxygen and biological infection. So much so that I know many makers who take a zero-zero approach with their cider or wine, but will still add a small dose of sulfite to their perry. Those who make stupendous perries without sulfites have my absolute admiration; it is very hard indeed to achieve, and not recommended for a new perrymaker.

Pear juice is also — there's no other word for it — plain weird. In the first place it contains more sorbitol than apple juice. There's a long-standing myth that this sorbitol content is at laxative levels. Trust me, if this were the case, I'd be a ghost. The myth almost certainly came about thanks to the historic inclusion of overripe fruit at pressing. Where sorbitol definitely causes headaches is with judging when fermentation is finished. This unfermentable sugar doesn't sit at the same level each year, so especially for makers looking to bottle pét-nat perries (that is, bottling prior to fermentation completion so it naturally carbonates in bottle), judging how far along a fermentation is can be trickier than with cider or beer. Even when you think fermentation is complete, give it another week and check again to be sure.

Pear juice also contains a high concentration of a compound called procyanidin, a type of polyphenol, which binds together in all sorts of different and often unsightly ways. I've seen two perfectly clear perries which, blended

together, became as opaque as milk. I've seen sediment thrown that looks — there's no nice way of saying this — like an alien's brain. Most frustratingly, I've seen perries disgorged to remove this sediment and then gone on to make it again even after filtering. None of this sediment is harmful in any way. But without an exceedingly tight filter, the use of pasteurization, or heavy fining, it may be something you simply need to explain to those you share your perry with. In Austria especially, it is commonplace to mitigate the worst of this by extensive maceration of the pears prior to pressing.

MATURATION AND PACKAGING

Whilst it's by no means universally true, the majority of pears and perries tend to err on the more delicate side compared to ciders. Their flavors can be gentler, more floral, and graced with more elegant nuance. For this reason, most perries tend to be fermented in plastic, stainless steel, or extremely neutral oak.

With that said, varieties that are bolder in character, or makers looking for richer styles such as mistelles or fortified perries, can often deploy oak with delicious results. Mostellos, Austrian fortified perries from Destillerie Farthofer, mature in casks for at least four years. Flakey Bark, from Herefordshire's Ross-on-Wye, can spend months in active casks and barely change in the intensity of its unique flavor at all. I've had perries that aged in wine casks, spirits casks, even casks that held Islay whisky or tequila. And you know what? I loved them all.

Options when it comes to finishing and packaging your perry are identical to those available to cidermakers. To arrest fermentation prematurely, retaining natural sweetness, perry can be simply pasteurized, or if a more natural style is intended, cold-racked multiple times to remove yeasts, as is common practice in the Domfrontais. Alternatively, the perry can be allowed to ferment to dryness, though care must be taken to ensure any remaining gravity is purely sorbitol, rather than unfermented sugars. (Unfortunately there is no definite way of telling what is sorbitol and what is not with a hydrometer — for most makers this is a matter of patience and experience!) The dry perry can then be backsweetened, if that is the preference, or simply packaged as it is.

Still perry remains a popular option in Austria and the U.K., whether it is bottled, as is the general Austrian preference, kegged, or packaged in a bag-in-box, as draught perry, as is often found in the U.K. However, it is more common to find perries sparkling. In the Domfrontais this is generally achieved by bottling 'pét-nat' – allowing the primary fermentation to finish in its bottle. There are also increasing numbers of traditional method perries, where a secondary fermentation is induced in bottle by the addition of yeast and sugar (around 25 g/L) to a finished perry, in the style of Champagne (Champagne yeast such as EC1118 is the most popular choice here).

Perry, pear cider, or pear wine?

A common question I'm asked about perry is: "Is it the same as pear cider?" Or even, "Is it the same as pear wine?" These questions cultivate strong feelings; there are plenty of makers and drinkers who won't countenance the term "pear cider," whereas the word "perry" is barely known outside its tight circles of dedicated drinkers.

What's more, in some perry-making cultures, especially in central Europe, the words for perry — *birnenmost*, occasionally *birnenwein* — literally translate as "pear cider" and "pear wine."

I've heard numerous opinions on what the difference between pear cider or pear wine and perry might be. Some people have said it's the varieties of pears used — not true, I'm afraid. Others have suggested that it's the dividing line between full-juice products and those using water and concentrate. That isn't true, either.

Amidst this confusion, it's important to be clear. As far as the legislators in almost every country in the world are concerned, there is no legal difference between pear cider and perry. They are merely different names for exactly the same product. The sole exception, in fact, is the United States, where pear cider might also be used for an apple-based product flavored with pears.

As for "pear wine," well in the U.K., if a cider exceeds 8.4% ABV, it is officially taxed as a "made wine." So you might argue that at that strength the government no longer considers it a perry. Calling a high-ABV perry a pear wine may give consumers a better idea of what to expect. In my view, however, these technicalities often confuse consumers. An overwhelming proportion of the time, it is safe to assume that if a product reads "pear cider" or "pear wine," it is simply perry by any other name.

If a completely clear perry is desired, maceration prior to pressing as well as heavy fining and filtration are necessary. Because of the biological makeup of pear juice, I have even seen perries reform a sediment after filtration or disgorging. In some instances, the efforts required for absolute clarity in the liquid may come at the cost of considerable amounts of character and flavor. Since perry (other than certain perry pears) has a naturally higher pH than cider, it may also be desirable to adjust acidity and dose with a small amount of sulfite before packaging. BYO

Related Links:

- *If starting with fresh pears, you will need a good way to crush the fruit prior to pressing. This DIY scratter utilizes a garbage disposal to pulverize the fruit:* **www.byo.com/project/build-apple-scratter**
- *Once the fruit is ground to a sauce consistency, this homemade press will juice your pears with ease:* **www.byo.com/project/build-cider-press**

Photo courtesy of Shutterstock.com

Perry, like cider, comes in many forms including robust oak-aged and fortified versions made for deep contemplation and slow sipping.

Perry Recipes

Draught English-Style Still Dry Perry

(1 gallon/3.8 L, scale as needed)
OG = 1.050–1.065*
FG = 1.002
ABV = 6.3–8.3%

* *The original gravity of the juice is dependent on pear varieties, vintage, and growing conditions. Perrymakers in the U.K. generally ferment the juice as is without worrying too much about where in this range it falls.*

INGREDIENTS

1 gallon (3.8 L) tannic perry pear juice (or foraged wild seedling pears)
¼ tsp. Fermaid O or other yeast nutrient
Potassium metabisulfite (KMBS) powder

STEP BY STEP

Mill and press the pears (if working with raw fruit) and rack into fermentation vessel with 50 mg/L sulfite, sealing with an airlock. (This recipe utilizes wild yeast that comes in on the pears, though you can pitch your favorite white wine yeast to ensure fermentation if you prefer, which should be pitched at this time.) At least 24 hours later add the Fermaid O.

Fermentation with native yeasts will likely take a few months. My preference is to leave it on lees for additional oxygen protection, though this requires a little longer in tank to completely remove reductive aromas. Other makers prefer to rack once or twice, though excess racking will reduce lees protection as well as slowing fermentation. Once fermentation is complete — specific gravity around 1.002, depending on sorbitol levels — rack it off the lees into a separate container and package into bottles or a keg to serve on draft, again with a small dose of sulfite (if desired).

Modern Sparkling Perry

(1 gallon/3.8 L, scale as needed)
OG = 1.068
FG = ~1.010
ABV = ~7.6%

INGREDIENTS

0.9 gallon (3.4 L) pasteurized pear juice
0.1 gallon (380 mL) pasteurized apple juice (the lower pH, the better)
Brown sugar to hit desired original gravity
¼ tsp. Fermaid O or other yeast nutrient
Potassium metabisulfite (KMBS) powder
5 g Lalvin D47 yeast (or similar strain)
¼ tsp. malic acid mixed in half cup of boiled water
30 g corn sugar (if priming)

STEP BY STEP

Mix the pear juice, apple juice, malic acid solution, and brown sugar together until the sugar is fully dissolved. Note that the amount of brown sugar needed is dependent on the sugar content of the pear and apple juices used. Start small and measure after stirring the brown sugar until it is dissolved. Once you reach the desired original gravity, add yeast and seal fermentation vessel with airlock. Add yeast nutrient between 24 and 48 hours later.

Ferment until specific gravity reaches about 1.010, then cold crash and rack into a fresh container. Once the perry has dropped clear and fermentation has ceased, stabilize with ~50 g/L sulfite. Rack into a small keg and force carbonate or stir in priming sugar. You can also stir in the priming sugar (dissolved in a bit of hot water) and then rack to beer bottles and cap to carbonate, which will take a week or two. Keep refrigerated once carbonated. BYO

The Next Great IPA

Where homebrewers may take the evolving IPA style

by Drew Jackson

For homebrewers and consumers of a certain age, we have experienced the IPA style going from maltier English IPAs to beers we'd today refer to as pale ale with much lower hop usage than modern craft brewers use, to extremely bitter West Coast IPAs, to hazy IPAs that fall on the other end of the bitterness spectrum. There have been numerous detours with other sub-styles along the way, of course. More than any other style, IPA seems to constantly be evolving, and each iteration has been popular with consumers. As such, the question being asked by homebrewers once again is, "What will emerge as the next really popular IPA for homebrewers to make?"

I know it is presumptuous for one homebrewer to make the leap thinking he/she knows what the next great homebrewed beer will look like, but I have an opinion. I am pretty sure that anyone who would have predicted the craft beer revolution three decades ago would have been considered crazy. And who thought at that time that hazy beers would become what they are now?

Today, we find ourselves living in the first few years of a flattening of the growth curve of craft beer and wondering what might come next. We have seen the tip of the beverage iceberg with the growth of ciders, low- or no-ABV beers, hard seltzers, gluten-free options, canned cocktails, and other similar beverages. But there are still many people like us out there who love — and make — beer. And we aren't going away any time soon.

The last decade has filled the homebrewers' beer making toolbox with new yeasts, hops, grains, and science. Ten years ago, we never talked about hops adding much in flavor; we only talked about bittering and aromatics. Now, new products and beer science have provided a cornucopia of new flavors for brewers to dive into. How can these advances be used differently to make something new and different?

I believe the *next great homebrewed IPA* trend will be a well-balanced American IPA; assertive bittering balanced by a solid malt build and hoppy fruit/spice notes on the finish that is enhanced by local products, giving it a nuanced terroir. It will be fresh and taste like the place it was made. And I'm not alone in this prediction — as I interviewed numerous brewers who have helped form, and narrow, my definition of the next great IPA.

OK, so there are some parameters. But how did I come by this prediction, you ask? Let me explain.

LOCALISM

I started sourcing my water from a local spring about five years ago. I have it tested by Ward Labs yearly and have built all of my water chemistry based on this testing. I use dandelion leaves, roots, and flowers from my yard as well as other local flora like wild chamomile, nettle, and candy cap mushrooms. I also grow my own hops. I like to think that all of these add to the local nature and flavor of the beers I make. We've already seen the trend of increased attention to local foods, and I think beer has the same appeal for local ingredients.

Michael Ivanicic has been brewing professionally for 13 years, nine of those at Logboat Brewing Company in Columbia, Missouri. Logboat recently went through a major expansion and

Photo by Charles A. Parker/Images Plus

Photo courtesy of Shutterstock.com

Local hops and grains often express a unique flavor indicative of where they are from.

now distributes beer throughout the state. In regards to the changes in craft beer, Ivanicic believes a greater focus on localism has already begun. "The pub idea has always thrived off of this concept. Beer made right here; in the space you are drinking it."

Logboat Brewing works hard to have all of their beer consumed as fresh as possible and really believes that the place it is made matters. "I think one of the biggest changes in craft beer is the reversion to localism. I think most consumers who are into craft beer, have their favorite local brewery, and for a good reason, it's probably their freshest option," Ivanicic said.

This is one area where homebrewers really shine; we usually drink the freshest beer.

Another way to look at "localism" is using local ingredients to make something distinctive and unique. When you love where you live you want to make something that speaks to that love; it becomes more than just beer. Beer that speaks to the place where it is made will always resonate with the lovers and makers of beer.

Each year, in Northern California where I live, we have a release of Pliny the Younger at Russian River Brewing Company. The success of this limited release triple IPA has spurred a competition of sorts amongst local brewers who try and have their best triple IPA released around the same time. One of the breweries to do this is Henhouse Brewing, which has gained a large following of local beer enthusiasts in a very short time. The promotion of their 2023 "Big Chicken" release hits to the point of localism. From the brewery:

"As we are about to launch our smaller pub brewery in Fairfax, California, our brewers are excited about the fact that the smaller scale of these batches, and less mechanized processes we will be using in Fairfax, will open them up to working with smaller local producers of malts and hops. With this on the horizon (and on our brewers' minds) our Big Chicken 2023 recipe is indicative of the locally sourced West Coast Style IPAs they plan to make a large part of our West County Pub brewery output. Big Chicken 2023 will feature: Barley grown in Petaluma by our friends at Crane Ranch. This barley will then make the short trip to Alameda, California, where it will be malted by our friends at Admiral Maltings. (It) will feature Mosaic® hops from Loftus Ranches, Simcoe® hops from Coleman Agriculture, Cascade hops from Green Acre Farms, and Centennial hops from our friends at Crosby Hop Farm."

Brewers across the country have released beers with similar themes — locally grown malts, hops, and other ingredients. Tim Decker from Admiral Maltings thinks grains could be the key for many brewers to make their next IPA more "local."

"Hops have always been at the forefront of IPA, and continuous research and development have unlocked diverse hop expressions. New England IPAs, for example, sparked conversations around water chemistry and non-barley malts, while West Coast IPAs pushed for leaner, paler base malts to emphasize hop flavors. However, this hop-centric approach often overshadowed the importance of a complex malt foundation. Today, there's a growing awareness among brewers about the role of malt in shaping IPA's flavor profile."

While we homebrewers in Northern California do not have access to many locally grown grains, there are some that are more local than others. We have a maltster based in Sonoma County called Grizzly Malts that offers small batches of California-grown grains. The beers I have had using these grains do have a unique quality to them, which is a common trend I've heard from homebrewers across the country, and beyond, about products from small-scale maltsters who are often working with grains grown outside of the most popular areas where the big maltsters' grains come from. Unique flavors and, again, a sign of your terroir in ever glass.

THE AMERICAN IPA RETURNS

To better grasp where the future of IPA lies, we need to get a feel for what trends are happening in tasting rooms.

"Currently we are seeing a shift back to traditional styles from consumers, which is validating for being a stalwart for more traditional styles and methods. Styles and traditions that exist for so long continue to thrive because they work," Ivanicic said.

J Shilling, Head Brewer at Dirt Road Brewing in Philomath, Oregon, says he's noticing a similar trend. Shilling has been brewing professionally for eight years, during which time the beers being consumed, and made, have evolved. The juicy and hazy IPAs used to be the majority of the IPAs being sold at Dirt Road. "I can report that the pendulum has swung back. We are about 50/50 on sales of our West Coast vs. our juicy/hazy IPAs," Shilling said.

Brian Rooney, who along with his wife owns BKS Artisan Ales in Kansas City, Missouri, says he has seen a shift from what used to be extremely

bitter West Coast IPAs and hazy IPAs with very little bitterness to a balance somewhere between the two. "I think we are seeing both West Coast and hazy becoming much paler in color and I'm also seeing an interesting trend with softer bitterness in IPA. What I mean by 'softer bitterness' is the IBUs aren't as 'grippy' on the tongue. They're still there, and balance the entire beer, but come across the taste buds much smoother and softer," Rooney said.

These trends are significant to the homebrewer because we are guided and influenced by the beer we drink in our particular area. Sometimes, what we have at our local watering hole makes us pine for something different. Sometimes, we love what we have available and want to make a beer like it. Clones of favorite local beers are spoken about with pride amongst local brewers and unusual addends attract the attention of those who taste our beer. Often, we think we can make them better.

NEW SCIENCE

Another development in beer science that might find its way into the next IPA might be an even greater focus on biotransformation. This topic has been discussed with excitement for the past decade and continues as more is being learned all the time. Thiol-producing yeasts from Escarpment, Omega, and Lallemand have the potential to unleash new hop flavors and aromas during fermentation, and this trend seems to be continuing to grow.

Steve Thanos, a primary contributor to the Brülosophy blog, believes this is the area that will continue to gain steam as IPAs evolve. "Maybe this 'new IPA' will contain some biotransformation when it comes to yeast," he mused.

Lance Shaner, from Omega Yeast, thinks so: "From a yeast perspective, thiol-producing yeasts are certainly one thing to mention. And it's not just on how to maximize thiols but instead how to work thiols into the overall profile so that they're not dominant, but complementary."

Thiol enhancement has been the buzz for a while now but is talked about very little by commercial makers. I think this technology has the ability to change the face of what we know about hop flavors and aromatics in a significant way. Products like Phantasm powder and thiol-enhanced yeasts are becoming the subject of stories in the craft beer world more and more these days and the target of these conversations is IPAs.

Other new hop products that pack a punch of hoppiness without the green matter are also changing the IPA landscape. "What I am seeing is the refinement of West Coast IPA and hazy IPA through the use of new hop products, new types of malts, and yeast products. Things like Incognito®, HyperBoost™, SubZero Hop Kief®, hop terpenes, modified yeast strains, and integrating lighter-colored Pilsner malt into hoppy beer to continually pull back malt character and put hops at the forefront as much as possible," says Rooney, of BKS Artisan Ales.

I did some experiments with my brew partner a few years ago with thiol-enhanced products. Between the two of us, we made eight different thiol-enhanced IPAs in a two-year period using Omega Cryo Pop, Omega Cosmic Punch, and Omega Helio Gazer yeasts. We became convinced that these beers maintained enhanced aromatics over a longer period of bottle time. This alone makes the whole thiol trend worth exploring. Add to this the possibility of opening up new flavors from older, less expensive varieties of hops and it is very appealing.

I have also had good results boosting aroma using Lallemand's Aromazyme™, a food-grade enzyme preparation derived from *Aspergillus niger* to help release additional volatile aroma compounds. Biotransformation offers a lot of possibilities and many of them have yet to be fully explored. Thiols and terpene adjustments add other powerful elements to the homebrewers' toolbox. It will be interesting to see how these tools will impact the beers of the future.

So how does all this information affect the homebrewer and what they might make as the *next great homebrewed IPA?* I believe craft beer makers are driven by what is commercially available in their part of the world. Sometimes they want to make something very different from what is available, but more often than not, what is in the market leads them towards clone recipes and attempts to duplicate their favorite beers or make them even better. We are innovators and experimenters. With our smaller volumes we can push the boundaries.

The key word I am hearing from many different brewers right now regarding IPAs is "balance." The days of beers boasting about containing 100 IBUs is done and gone. The days of BU/GU (bitterness units divided by the gravity units) ratio is here to stay.

EVOLUTION

"Through all this change — the evolution of IPA, advances in technology, access to unique ingredients, and shifting industry dynamics — brewers are beginning to approach IPA recipes holistically. Every ingredient must earn its place, working together to create a beer greater than the sum of its parts. Looking ahead, I believe IPAs will continue to reflect a diverse range of approaches shaped by individual brewers' philosophies," Decker said.

These individual philosophies will drive us homebrewers to experiment with new products and techniques and lead to the discovery of new flavors.

Craft beer took off because consumers wanted something different from the monoculture of light American lager. Ironically, one could argue, many of these brewers who wanted to diversify what is available to beer drinkers have created the same paradox today with non-descript hazy IPAs that fill out a tasting room's menu. This, in turn, could create the next wave of brewers bringing a different approach.

Marika Josephson, Owner of Scratch Brewing in Ava, Illinois, believes the way to change what's available today may require the next generation of craft brewers (today's homebrewers). "(Today's brewers) are fighting a monoculture of hazy IPA and sticky imperial stouts. To make craft beer relevant to a wider net of people requires a diversity of voices. That's just a fact. Without that diversity we'll only be able to keep court-

ing the same small demographic, and quite frankly that demographic is getting burned out by the same flavors."

I am hopeful that what we are seeing and hearing about in the commercial beer world is true; a return to the American IPA. An IPA that has balance and full flavor. An IPA that can incorporate everything we have learned, and continue to learn, about enzymes, yeasts, hops, grains, and processes. An IPA with new twists, unique local flavors and aromas, and the freshest ingredients. An IPA that will have broad appeal to all the craft beer lovers of the world; both makers and consumers. I look forward to the next great homebrewed IPA, and leave you with a few bullets on how one may design that beer:

1. Recipe Development:
Begin by making your recipe. A typical American IPA might have an OG (original gravity) around 1.055–1.070, with a moderately high ABV (around 6–7.5%). You can adjust the bitterness (IBUs) to your preference, but aim for a balanced approach.

2. Terroir:
Highlight the local characteristics in your flavor profile. For example, if your region is known for citrus fruits, consider incorporating those flavors through the hops or adjuncts. Is there a small maltster nearby? Check out their offerings and how the unique flavors they offer may shape your beer.

3. Experimentation:
Don't hesitate to brew small test batches with different combinations of hops, adjuncts, and thiol-enhancing products to find the perfect balance. This is a great way to refine your recipe before scaling up.

4. Fermentation:
Use a clean-fermenting yeast strain (like the Chico strain, or even the Lutra kveik strain from Omega) that allows the hop flavors to shine through, or consider a thiol-enhancing yeast for an added boost.

With this approach, I took a stab at creating a very pleasant IPA that hits on many of the factors discussed in this story, which you can find on page 37. Will it be representative of the next great IPA homebrewers are enjoying in years to come? Only time will tell, but I'm enjoying it today!

Related Links:

- *Learn more about what thiols are and how they can be elevated in your homebrews at:* **www.byo.com/article/intro-to-thiols-tropical-flavors-in-beer**
- *Biotransformation relies on yeast to transform the aroma of hops during fermentation. Learn more about the science behind biotransformation and how to get the most from it at:* **www.byo.com/article/biotransformation**

Recipes

WHALE SPIT IPA

(5 gallons/19 L, all-grain)
OG = 1.072 FG = 1.012
IBU = 61 SRM = 7 ABV = 7%

INGREDIENTS

10 lbs. (4.5 kg) 2-row pale malt
1.2 lbs. (0.5 kg) Carapils® malt
1.2 lbs. (0.5 kg) white wheat malt
1 lb. (0.45 kg) flaked oats
8 AAU Columbus hops (60 min.)
(0.5 oz./14 g at 16% alpha acids)
10 AAU Cryo Pop® Original Blend hops (30 min.)
(0.5 oz./14 g at 20% alpha acids)
7 AAU Chinook hops (30 min.)
(0.5 oz./14 g at 14% alpha acids)
1 oz. (28 g) Mosaic® hops (dip hop)
0.75 oz. (21 g) El Dorado hop hash (dip hop)
0.5 oz. (14 g) Cryo Pop® Original Blend hops (dip hop)
3 oz. (85 g) Callista hops (dry hop)
0.5 oz. (14 g) dried nettle
0.5 oz. (14 g) chamomile
1 Whirlfloc tablet (15 min.)
1.5 tsp. Wyeast yeast nutrient (15 min.)
Omega Yeast OYL-071 (Lutra Kveik) yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Mash the grains at 150 °F (66 °C) for 45 minutes and then conduct a 170 °F (77 °C) mash out step. Sparge at 170 °F (77 °C) with enough water to collect 6 gallons (23 L) of wort. Total boil time is 60 minutes. After boiling 10 minutes, remove 2 quarts (2 L) of wort and cool to 180 °F (82 °C). Add the dip hops, nettle, and chamomile to your fermenter and then add this cooled portion of wort on top. Close the fermenter with an airlock and leave this portion to rest until the boil is complete.

Continue boiling wort, adding hops as indicated. When the boil is complete, chill to 90 °F (32 °C) and then transfer wort to the fermenter on top of the dip-hopped portion.

Pitch the kveik yeast and oxygenate heavily if using a liquid strain. I have found kveik to be very nutrient-dependent and use a nutrient at 3 times the manufacturer's recommendation. You should see signs of fermentation within hours. After three days the fermentation should be slowing. Reduce temperature to 80 °F (27 °C) and then add the dry hops. After four more days, transfer beer to a keg and force carbonate or add priming sugar and bottle as usual.

WHALE SPIT IPA

(5 gallons/19 L,
extract with grains)
OG = 1.072 FG = 1.012
IBU = 61 SRM = 7 ABV = 7%

INGREDIENTS

7 lbs. (3.2 kg) light liquid malt extract
1 lb. (0.45 kg) wheat dried malt extract
1.2 lbs. (0.5 kg) Carapils® malt
8 AAU Columbus hops (60 min.)
(0.5 oz./14 g at 16% alpha acids)
10 AAU Cryo Pop® Original Blend hops (30 min.)
(0.5 oz./14 g at 20% alpha acids)
7 AAU Chinook hops (30 min.)
(0.5 oz./14 g at 14% alpha acids)
1 oz. (28 g) Mosaic® hops (dip hop)
0.75 oz. (21 g) El Dorado hop hash (dip hop)
0.5 oz. (14 g) Cryo Pop® Original Blend hops (dip hop)
3 oz. (85 g) Callista hops (dry hop)
0.5 oz. (14 g) dried nettle
0.5 oz. (14 g) chamomile
1 Whirlfloc tablet (15 min.)
1.5 tsp. Wyeast yeast nutrient (15 min.)
Omega Yeast OYL-071 (Lutra Kveik) yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Add crushed Carapils® malt to a steeping bag and add to kettle with 5 gallons (19 L) of water as it slowly heats. When it reaches 170 °F (77 °C), remove grains and bring to a boil. Once boiling, remove from heat, carefully stir in the malt extracts, and then return to heat. After boiling 10 minutes, remove 2 quarts (2 L) of wort and cool to 180 °F (82 °C). Add the dip hops, nettle, and chamomile to your fermenter and then add this cooled portion of wort on top. Close the fermenter with an airlock and leave this portion to rest until the boil is complete.

Continue boiling wort, adding hops as indicated. When the boil is complete, chill to 90 °F (32 °C) and then transfer wort to the fermenter on top of the dip-hopped portion.

Pitch the yeast and oxygenate heavily if using a liquid strain. I have found kveik to be very nutrient-dependent and use a nutrient at 3 times the manufacturer's recommendation. After three days the fermentation should be slowing. Reduce temperature to 80 °F (27 °C) and then add the dry hops. After four more days, transfer beer to a keg and force carbonate or add priming sugar and bottle as usual. BYO

Recipe Notes:
If you wish to skip the additions of dried nettle and chamomile you may, though I find they add a nice touch of spice to the finished beer that complements the hops. Less nutrients will be necessary if using a conventional yeast.

ADVANCED DRY HOPPING

TIPS, TECHNIQUES, & TRAPS

Maximizing hop aroma

by Michael Tonsmeire

Dry hopping isn't just for IPAs anymore! A dose of citrusy, herbal, or tropical hops in the fermenter can be a wonderful addition to West Coast Pilsner, barrel-aged saison, or amber ale. While one approach to dry hopping might work for a hazy IPA, you may want to adjust your process for other styles. You can trade off concentration, temperature, agitation, and time. Higher concentrations, warmer temperature, increased agitation, and extended time all extract more aromatics . . . but also compounds you may not be as excited about like astringent polyphenols, grassy aromatics, and bitter alpha acids. Let's take a look at how each of those parameters change the finished beer.

HOP EVALUATION

The first and most important step in dry hopping is to evaluate your hops. Whether it's a new variety or hops you've used before, give them a smell! The quick and dirty way is to rub a few pellets between your palms. I find this to be a more "true" representation of what the hop will contribute to the beer compared to smelling the bag. Rubbing also gives you a chance to evaluate the pellets themselves. Denser pellets are more likely to sink and require agitation to suspend them into the beer. Another option is to follow the American Society of Brewing Chemists (ASBC) method of steeping the hops in cool water for 20 minutes in a French press before pressing and smelling, which we previously covered in "Ingredient Sensory Methods" found online here.

If you don't like the aroma of the hops, reseal the bag and use them for a whirlpool addition on your next batch. In most cases a little "weirdness" from the hops will blow off with heat or be scrubbed away by fermentation.

COMBINING HOPS AND BEER

There isn't anything that ruins a good hazy IPA like oxygen exposure. While the deleterious effects may be more subtle in other styles, I treat all of my beers with the same oxygen-phobia. While brewers (rightly) focus on transfers and packaging, one of the most important and treacherous steps is dry hopping. For our first double IPA at Sapwood Cellars I poured the hops into the top of a 10-bbl tank through the "dry hop port." Within seconds a plume of hoppy foam was shooting at the ceiling (and raining back down onto me). Think 300 gallons (1,100+ L) of Diet Coke and a case of Mentos . . . After that we learned to add a pound or two of hops, close up the tank and allow it to degas. At home it's rarely so dramatic, but be careful if you are dry hopping a beer that was spunded or fermented under pressure!

We now use a hop doser from MARKS that attaches to the dry hop port, allowing us to purge the hops with CO_2 and then add them to the beer under pressure. Some homebrewers have similar contraptions fashioned from a sight-glass and butterfly valve, and they are a great option if you use a conical or a modified keg with a tri-clamp fittings on the lid.

Another great option is to transfer the beer onto the hops. At the brewery we do this in our infusion tank or brinks (both fitted with mesh screens on the outlets to keep the hops in). We add the hops to the empty vessel, purge it with CO_2, and finally fill it with beer under pressure. As a homebrewer, I did this in a Corny keg with the hops in a tube screen. Fill the screen less than halfway to allow room for the hops to expand and extract. Even still, this may reduce aroma extraction — one study found a 50% drop in extraction of linalool from bagging hops.[1]

If none of these are options with your equipment, dry hop during the tail end of primary fermentation. Active yeast will uptake oxygen quickly and prevent most of the damaging effects of oxidation. Just be warned, active fermentation dry hopping can promote hop creep (discussed later) and will make it more difficult to harvest and reuse the yeast.

Photo by Charles A. Parker/Images Plus

TEMPERATURE

According to that same study, extraction of linalool (fruity aromatic) was nearly as rapid at 39 °F (4 °C) as it was at 68 °F (20 °C). The advantage is that colder temperatures reduce the extraction of the harsh/bitter resins and polyphenols. This study was conducted on a small scale. When we tried it on a commercial scale, we found that the cold extraction requires increased agitation to promote contact between the beer and hops. After our first attempt we found whole unextracted pellets at the bottom of the tank.

Colder dry hopping imparts a more "true to pellet" aroma, with fresher, more intense hop aromatics. That said, it can smell like sticking your nose right into a hop bag, rather than highlighting the citrusy and fruity aromatics. This is because warmer mid-to-late fermentation additions lead to a reduction in myrcene (woody/herbal). I prefer colder dry hopping in beers that are drier and less likely to "stand up" to astringency, including most drier or lower-alcohol beers (e.g., West Coast Pilsner, saison, non-alcoholic beers). For hazy IPAs we usually perform one dry hop addition after soft crashing and another close to freezing to get some of each character. Warmer dry hopping also promotes haze formation by releasing more polyphenols to bind with yeast mannoproteins.

AMOUNT OF HOPS

Higher dry hopping rates result in diminishing returns. A beer dry hopped with 1 oz. per gallon (7.5 g/L) isn't twice as aromatic as one with 0.5 oz./gallon (3.8 g/L). That is because it is more difficult to fully extract a larger dose of hops, some compounds saturate, and the green material of the hops reabsorbs compounds already in solution.

To deal with the extraction issue, you can add dry hops in multiple stages. However, if you don't have a way to remove the spent hops and introduce another dose without oxygen ingress you may be better off with a single dose. My preference as a homebrewer was to add half of the hops loose to primary and the rest to the keg in a weighted metal tube screen. The hops in primary settle out with the yeast, while the tube screen reduces issues with clogged poppets (at the expense of lower extraction).

For the absorption issue, advanced hop products can help. I often like to replace 25–50% of the traditional T90 pellets with concentrated/lupulin "enriched" pellets like Cryo Hops®, T45, CGX™, and LupoMax®. Generally, we use traditional pellets for the first dose and concentrated for the second. Concentrated pellets tend to be higher in oil and more finely ground, and as a result stay in suspension longer even at colder temperatures.

If that doesn't get you the intensity you are looking for, then hop extracts, oils, and terpenes like Yakima Chief Hyperboost™, Abstrax Quantum Brite, and Spectrum from Barth-Haas are a great final addition. These are ideal because they can be dosed to taste, even in the glass (an easy way to make hop water if you have a keg of seltzer). While they are often sold for breweries looking to maximize yield by reducing reliance on hop pellets, none of them can completely replace dry hopping. IPAs without actual hops just don't have the right mouthfeel or breadth of hop flavor and aroma. To my nose they tend to "brighten" the aroma, covering up dull aromatics with more fruitiness.

Replacing some hop pellets with oils can also lead to a more durable hop aroma. Hops include a variety of compounds that can accelerate staling (e.g., metal ions). Hops can also have air trapped inside the pellets. Adding oils reduces these risks and creates a beer that still smells "hoppy" well after a heavily dry-hopped beer would fade. Extract companies have suggested to me that 2 lbs./bbl (1 oz. per gallon/7.5 g/L) is around the sweet spot for saturating the beer with a variety of hop compounds, and then topping up with oil; though we still most often add 4–5 lbs./bbl (2–2.5 oz./gallon or 15–19 g/L) for IPAs and double IPAs, and I can taste the difference.

AGITATION

There are many options for agitation: Dissolved carbonation in the beer, physical agitation of the fermenter, rousing with CO_2, recirculating pumps

Photo by Michael Tonsmeire

At Sapwood Cellars, dry hop additions are poured into a doser attached to the dry hop port, allowing us to purge the hops with CO_2 and then add them to the beer under pressure.

. . . I've even attached a Mighty Dwarf speaker onto a fermenter, which generates sound by vibrating the object it is placed on! I hooked it up to a tone generator and adjusted the frequency until it created a resonance with the beer.

The most traditional method is to simply allow the trapped carbon dioxide in the beer and produced during the tail end of fermentation to agitate the hops. The risk here is that the CO_2 exiting the beer can scrub out delicate hop aromatics and the yeast can pull some of them out of suspension. That said, the more fragile aromatics tend to be "green" like myrcene, and as a result less desirable in many styles. While I had decent results as a homebrewer with mid-fermentation dry hopping, it never seemed to work for us on a commercial scale. The aroma just never popped, and if we tried to agitate the hops we'd get harsh astringency. These days we rely on whirlpool hops and flowable CO_2 extracts (Incognito®, DynaBoost™, or TerpSauce®) for "saturated" fruity hop flavor.

As a homebrewer, I would wait a few hours for the tail end of fermentation to purge out the fermenter's head space after dry hopping. Then I'd rock the closed fermenter to increase contact and resuspend the hops. With 620-gallon (2,350-L) tanks that isn't an option, so at Sapwood Cellars we use a high-flow CO_2 regulator to bubble CO_2 through the beer for 1–2 minutes several times. I've talked to other brewers who will pressurize a piece of hose to send one large "blast" of CO_2 through their beer.

As tanks become even larger, the only option is to recirculate the beer with a diaphragm pump to keep the hops in suspension. Impeller pumps can pull in air if the seal leaks and can increase astringency by beating up the leaf material. Peter Wolfe's thesis "A study of factors affecting the extraction of flavor when dry hopping beer" found most hop aromatics peaked between 6–24 hours at room temperature.[2] This was on a small scale with a relatively low dry hopping rate. Mitch Steele (New Realm Brewing Co.) suggests that anecdotally, he has achieved the best results with "periodic" agitation over the first 48 hours after dry hopping.

If you have an opaque fermenter, pull a sample after rousing to check that the hops are in suspension. Check again in an hour or two to see how well they are staying in suspension to determine how frequently you need to rouse.

EXPOSURE TIME

Traditionally, English brewers dry hopped in the cask until the beer was consumed. Most American brewers now prefer one to three days (although I've heard as long as seven). Again though, that really comes down to time, temperature, and agitation. Taste the beer each day and consider stopping your agitation or crash chilling if you've achieved the aroma you are looking for or you're worried about extracting more astringency or vegetal aromatics. Both of these can be difficult to judge on a flat sample, but you'll learn by tasting and taking notes.

HOP CREEP, DIACETYL, ALDC, AND GM YEAST

Hops contain amylase enzymes that turn unfermentable dextrins in the beer into fermentable sugars.[3] If you are dry hopping warm with active yeast it could happen to you. Zach Bodah of Allagash is credited with investigating this and drawing attention to hop creep in 2017 after a dry-hopped beer over-carbonated during bottle conditioning.[4]

In addition to lowering the final gravity slightly, this renewed fermentation can lead to diacetyl (buttery off-flavor). Bob Kunz from Highland Park (Los Angeles, California) suggested we add Alpha Acetolactate Decarboxylase (ALDC) enzyme to a warm dry-hopped West Coast Pilsner we brewed in collaboration with him. ALDC prevents diacetyl production by "skipping" a step and using up the precursor (alpha acetolactate) by converting it to acetoin. As a result, it has to be added at the same time or before the dry hops, as it isn't effective at removing diacetyl once it is created. Another option is to ferment with a brewing yeast that has been genetically modified to not produce diacetyl (sugh as Omega Yeast's "Plus" series of strains).

Hop creep is not a new concept. Gareth Young from Epochal Barrel Fermented Ales in Glasgow, Scotland, showed me a 19th century Scot-

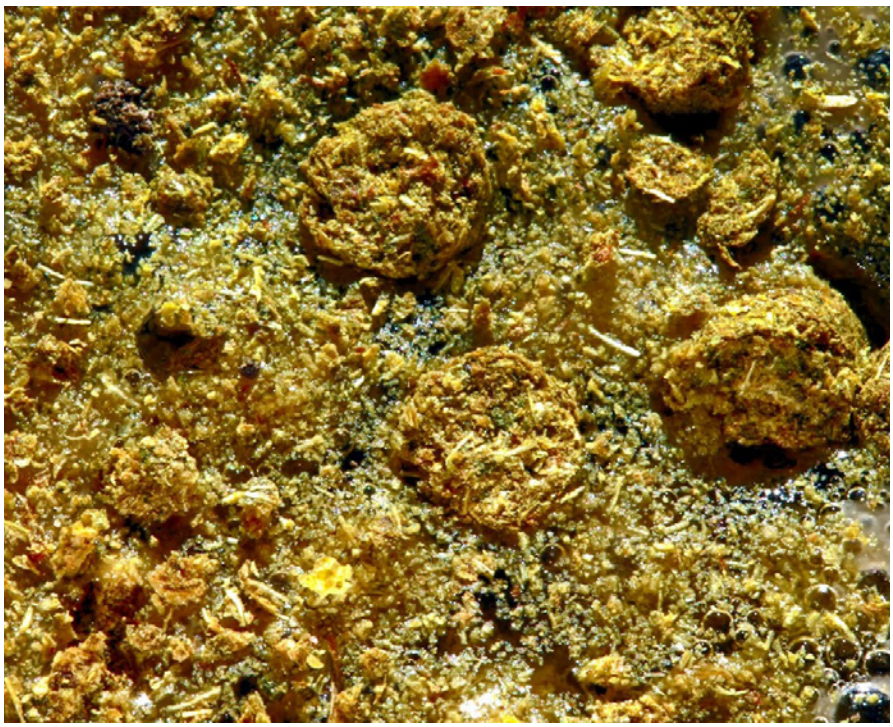


Photo by Michael Tonsmeire

The more hops you add to your dry hop addition, the more aroma it will contribute, but there are diminishing returns. Staggering additions helps, as does supplementing hops with hop oils.

tish brewing textbook that spelled out the exact same issues. Gareth uses the technique at his brewery intentionally to create uniquely delicious mixed-fermentation beers, allowing the enzymes from the whole hops in the barrels to free sugars for an extended mixed fermentation while the hop aromatics interact with the *Brettanomyces*.

At Sapwood Cellars, dry hopping cold after dropping out the yeast has prevented hop creep . . . but then we store our beer cold after packaging and don't send much beer out to distribution. As a homebrewer, you can do the same.

EVALUATING THE RESULTS

IBUs

For a recent triple IPA we targeted 40 IBUs/ppm of isomerized alpha acids in the kettle. That drops considerably through fermentation, and absorption by the green material in dry hops. After dry hopping we sent a sample to Hopsteiner for analysis with HPLC (High-Performance Liquid Chromatography). The result was only 7 ppm of iso-alpha in the finished beer. However, all of the additional hop compounds from the dry hopping added 90 IBUs. The problem is that while alpha acid, humulinones, and xanthohumol are detected as IBUs with the traditional tests looking at light absorbance at 275 nm, they don't taste as bitter as iso-alpha — that puts the approximate bitterness perception at 27.9 IBUs. All that is to say, it's easier to talk about the perceived bitterness than the actual "number" of IBUs (especially because residual sweetness, polyphenols, alcohol, and other factors affect how bitter a beer tastes).

pH

Dry hopping raises the pH of the beer. Our solution is to acidify with phosphoric acid in the kettle into the high-4s at the start of the boil. This has the added benefit of lowering the rate of Maillard reactions in the kettle, producing a paler, less "malty" wort. Be warned though, it also lowers alpha acid isomerization (~10% fewer IBUs at a pH of 4.8 compared to 5.2 in one study.[5] Fermentation drops that pH further into the low-4s. Dry hopping generally raises the pH back to 4.5 or so. That works for us — and helps promote beer stability — but in the end I'd be more concerned about how the beer tastes to you. A little lower pH can help a double IPA read crisper and more drinkable, while a higher pH can cause a pale ale to read richer and fuller.

Sensory

One of the most important things you can do to improve your beer is to drink it critically and evaluate the results. Whenever I can, I sit down with our freshest batch next to something similar from another brewery. I try to be analytical, noticing trends (are my beers always more astringent, or contain a certain aromatic?). Do I notice a particular note from one of the hops that carried through, or are there ar-

omatics that were lost? Almost as important is the hedonistic "enjoyment" (which beer do I find myself going back for another sip of?).

TIPS AND TRICKS

For a long time, I underappreciated how much the right yeast strain could enhance hop aroma. Don't be afraid to think like a Belgian when it comes to maximizing yeast character. Consider warmer fermentations, manipulating pitching and aeration rates, and blending yeast strains! Pair a hop variety with a complementary yeast strain. Here are some examples:

- Cosmic Punch with Galaxy® (passion fruit)
- Conan with Amarillo® (stone fruit)
- London with Strata® (grapefruit)
- Sacch Trois with Citra® (orange)
- Hefeweizen with Cashmere (banana)
- Belgian with Krush™ (bubblegum)

Don't confuse adding more hop varieties with increasing complexity. Most hops contain the same set of aromatics in different ratios. Blending four or five varieties often creates an "average" hop aroma. That's great if you are a big brewery trying to make a consistent core beer, but not if you want something unique and varietal. Stick to dry hopping with no more than three varieties in a single beer unless you really have something specific in mind.

HOPPY TIME

It's easy to forget that homebrewed dry-hopped beers start with a huge built-in advantage — freshness! I get to go to Yakima to select hops each fall, have all the equipment and gizmos, and package beers with <30 ppb total package oxygen (TPO), but if that can sits warm for a month it loses that amazing "fresh" hop aroma! Like home cooking, homebrewers also have the advantage of using the ingredients and process that create your ideal beer without worrying about sales, marketing, or consistency! BYO

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21 GAL
20 GAL
80L
75

GROWING and BREWING with MUSHROOMS

Unlocking a wide new array of flavors

Story and photos by Jason Simmons

Narrow Gauge Forest Farm is a farm in Perry County, Pennsylvania, that cultivates mushrooms using hardwood logs from the forests of Pennsylvania. Chris and Lauren Chubb use the back portion of their property in the forest to grow several varieties of mushrooms on a cleared area where an abandoned rail line is located (the common rail sizes of the era were standard gauge and narrow gauge, which inspired the farm's name).

After meeting the Chubbs at the local farmer's market, we started discussing the possibility of brewing a beer using mushrooms. Besides my homebrewing, which I still do regularly, I am also the brewer at Lindgren Craft Brewery in nearby Duncannon, Pennsylvania. With our brewery motto being "Adventurously Brewed," we felt like we had to take on this opportunity to make a special collaboration. To be adventurous we wanted to go along for the ride with Narrow Gauge Forest Farm and help them with all the tasks that it takes to grow and harvest mushrooms, then use those mushrooms in the brewing process. The process was one I believe many homebrewers may enjoy taking on as well.

MUSHROOM VARIETY SELECTION

We started by selecting a mushroom variety that we wanted to use. You can grow and/or use any mushroom variety you would like. For our project we reviewed the several varieties that Narrow Gauge cultivates, which includes lion's mane, oyster (golden, white, and grey), nameko, and shiitake being their main crop. For this year's inoculation we chose the Night Velvet variety of shiitake mushrooms, which have a unique rich white chocolate character. At Narrow Gauge they have many log stacks from prior years that were inoculated with other shiitake varieties such as WR-46, West Wind, Halo, and Double Jewel. By stacking the logs by variety when harvest time arrives you can keep your varieties separate for individual variety use or mix them as they are harvested. For our project we wanted as much weight as possible so we harvested all of the varieties when they were ready for picking.

If you plan on skipping the cultivating section and purchasing your mushrooms from your local store then the world is your oyster (mushroom). Whatever variety you choose, it is best to do a little research on the flavor profiles before making your selection. A great example is lion's mane as it is said to taste like lobster or crab, and is known for making crab cake-like dishes. This may, or may not, be what you are looking for in a beer.

Shiitake *(Lentinula edodes)* mushrooms, which we used, are native to East Asia and were introduced into the United States for cultivation in 1972. In Japanese, "*shii*" comes from the shii tree *(Castanopsis cuspidata)* which is a hardwood tree similar to oak that mushrooms prefer to grow on, and "*take*" means "mushroom." The flavor profile of shiitake mushrooms ranges from earthy, smokey, meaty, buttery, and chocolate. We have noticed that we got all of these descriptors in the mushrooms, but it is all dependent on the growing conditions and especially the time and quality of mushroom during harvest.

GROWING MUSHROOMS

If you're into gardening and growing ingredients for your brews, mushrooms are a fun project to take on. We'll next go through the steps of growing mushrooms, beginning with log selection; however, if you prefer to purchase mushrooms for your brew, feel free to skip ahead and we will pick back up in the brewing section on page 48.

LOG SELECTION

I was surprised to find out that the logs we selected were not going to be ready until the following year as it takes 9-18 months for the spores to start sprouting. Once the mushrooms fruit out of the logs they will continue to produce throughout the season and will last 4+ years depending on the thickness and quality of the wood.

Different types of mushrooms prefer different types of wood to grow on. shiitake mushrooms are best grown on deciduous hardwood trees such as oak, sugar maple, beech, alder, ironwood, and sweet gum. It is said the wood variety does not impact the final flavor of the mushrooms, though some chefs would debate that point. This is our second year doing this collaboration project and both years we primarily harvested mushrooms from white oak, with a few from sugar maple logs as well.

*Disclaimer: We sourced our logs from forests that were located on private property with permission to log. Be sure that you have permission of the property owner before entering and harvesting logs.

During the cold winter months, the deciduous trees are in hibernation mode, so January is when we go out into the forest looking for logs. It is best to find areas with large limbs or trunks that have already fallen to the ground. It is best not to go cutting down trees that are alive and well. We do not want large logs that are difficult to move, instead we would rather have smaller logs that are cut to 3-4 feet (0.9–1.2 m) long with a diameter of 4-6 inches (10–15 cm). Keeping the logs small helps with moving from the woods to the soaking tanks, and then to the fruiting area.

After the tree limbs have been cut into the desired size you must wait roughly four weeks for the tree's natural immune system to then die off. If you do not wait there is a possibility that the tree's lingering immune system will kill the mycelium inoculation. At the beginning of this waiting period, stack the logs in a square to allow the most surface area exposed to the air.

INOCULATION

For shiitake mushrooms in Pennsylvania, the end of March and early April are warm and damp enough for inoculation of the logs with mycelium. Mycelium is the living mother fungus network where the spores for reproduction are underneath the cap. We are not interested in cultivating from spores; rather we want the living organism to be inoculated. Mycelium

Freshly harvested shiitake mushrooms are ready to be chopped for brewing.

mixed in oak sawdust can be purchased online in 5-lb. (2.3-kg) bags through various suppliers for about $30. A 5-lb. (2.3-kg) mycelium mix is good for inoculating roughly 30 logs, depending on size. Once you receive the mycelium, store it in the refrigerator until ready for use.

You are going to need to drill holes about 4 inches (10 cm) apart in an off-centered pattern around the log. Each hole is ⅞-inch (18-mm) wide and 2 inches (5 cm) deep. Avoid drilling in knots. Drill out the holes on the log first then fill the holes with the mycelium mix, called a plug. There is a useful tool that is simply called an inoculation device that can pack the right amount of mix into a plug and release it with a plunger in the holes for optimal use. This speeds up the process and makes it much easier, but you can also use a funnel and stick.

Once the holes are filled with the mycelium mix you seal the holes with melted food-grade wax at around 300 °F (150 °C), which is warm enough to melt the wax, but not so hot to kill the living mycelium. This wax protects against insects. The wax can be heated on the stove with a temperature gauge to monitor heat, however Chris and Lauren Chubb held a large chunk of wax and used a hot rounded griddle with a temperature setting on the heating element from the thrift store. There is a sponge on a metal stick that makes applying the hot wax easy and fast (shown in the bottom image to the right).

Once the logs have been inoculated and waxed, a Mason jar lid was screwed into one of the log ends and the date and variety of mushroom the log is inoculated with is written on it.

The lots are then restacked in a log cabin-like square about chest high in an area with about 60–80% shade and 30% or higher humidity levels. Sometimes it is appropriate to cover the stacks with pine branches for extra shade and retention of humidity. While stacked the logs rest to allow a spawn run of 9–18 months. This is where the living mycelium works its way into the wood before fruiting into mushrooms. Logs that are inoculated in March will be ready for fruiting in late May of the following year.

After cutting logs into manageable sections, leave them stacked for up to a month to allow the tree's natural immune system to die off (or else it may kill the mycelium inoculation).

Drilled holes are first filled with a plug of mycelium/sawdust mix.

The mycelium plug is then sealed with a food-grade wax to protect against insects.

SOAKING AND GROWING

The cold wet environment of early spring helps start the fruiting process of shiitake mushrooms. Using this knowledge, mushroom cultivators can use a cold water soak for 24 hours, which will help jumpstart the mycelium to produce fruiting mushrooms just as in nature, but faster. Once the logs have been soaked you restack the wood and await fruiting and harvest. If you do not soak the logs for that initial jumpstart then the logs are just left stacked as the mushroom's fruit. The mushrooms that are grown outside on logs are more likely to experience stress from the weather causing the mushrooms to grow slower, but they result in heartier and more flavorful mushrooms than those grown inside.

Shiitake mushrooms sprout in about four days and pop out of the log, then in about four more days the mushrooms begin to fruit. In early spring and late autumn, cold temperatures at night that drop below 58 °F (14 °C) can stop the growth. Colder autumn weather towards the end of the season in October will slow the growth and stunt the quality of the mushroom. On the positive side with cold temperatures, there is no need to soak the logs.

For those that raise free range poultry like chickens and ducks, they are great to have around the logs as they eat many of the pests such as slugs.

HARVEST

At first I was mistaken by thinking that you only get one harvest per season, however that is not the case. Shiitake mushrooms start fruiting in early May–June and will continue to produce throughout the season until early- to mid-October when colder weather arrives.

It is best to harvest the mushrooms when the outermost part of the cap called the fringe separates from the underside of the cap where the gills and spores are located. Once the fringe separation has occurred the mushroom is ready to harvest. You don't want the mushroom to fully open like a pancake. The log will continue to fruit and produce mushrooms through the season so how long and how big you want the mushrooms to be is up to the grower. Every decision you make in the growing and harvesting process, and how long you have them between harvest and brewing, will slightly alter the flavor of the mushrooms.

When brewing homebrew-sized batches, we found that you can usually harvest enough mushrooms in one harvest then move on with your brew day. However, when brewing larger commercial batches — unless you have a huge mushroom farm — multiple harvests will be necessary to meet the recipe quota. The few days waiting from harvest and brew will cause various drying rates and a blend of mushrooms from freshly picked to dried/aged 3 or so days. This will give slightly different characteristics based on your particular situation. I find it similar to single-hop variety blending when you have multiple days worth of harvest from larger farms vs. a smaller farm's single day harvest during the golden picking time of "now."

A general rule of thumb is that you can harvest roughly 1.5 pounds (0.68 kg) of fresh mushrooms every year per foot of log. Depending on log size and weather conditions, a single 4-ft log could yield 6 pounds (2.7 kg) per year, or upwards of 24 pounds (~11 kg) over a log's average lifespan of four years before the decomposition of the wood makes the log unusable. If you choose to dry the mushrooms then the percentage of weight loss will depend on your drying method. I suggest using the mushrooms as fresh as possible.

BREWING WITH MUSHROOMS

Our test batch was a 12-gallon (45-L) post-boil recipe using 30 pounds (13.6 kg) of fresh shiitake mushrooms (2.5 pounds of mushrooms per gallon, or 300 g/L). We really enjoyed the beer and how the fresh shiitake mushrooms complemented the overall beer profile. The plan and recipe for the following year's batch was on the 3-bbl system (110 gallons/415 L actual post-boil volume). Using the same dosing rate we would need a whopping 275 pounds (125 kg)! Concerns were made that we might be exceeding Narrow Gauge's yearly capacity, as well as concerns around handling our own harvesting and storage for that amount. For the second year we had a poor growing season for everyone, including our state's hop growers. Given that poor growing season, we were not sure if we could achieve our absurd target harvest goals. We eventually decided to brew another small, this time 20-gallon (76-L), batch. Narrow Gauge Forest Farm harvested shiitake mushrooms from our stack throughout the harvest season and yielded a total of 23 pounds (10.5 kg) of mushrooms that were frozen after harvest. This included the entire range of mushrooms from early harvest to late harvest. We used them all in the batch to create a uniform flavor that I think actually added a bit of mushroom flavor depth that we initially did not consider vs. using all fresh from a single harvest.

Depending on if you grow your own or are buying mushrooms, you have options of using fresh, frozen, or dried mushrooms, which are each unique:

FRESH

Fresh is best! The shiitakes at harvest were lightly earthy in aroma, but when you cut them open you were hit with an intense, sweet white chocolate aroma and soft butter meaty flavor. The aroma really filled up the brewery and we laughed all day about how that white chocolate aroma came from those shiitake mushrooms. Depending on your recipe size, if you plan your brew day in alignment with harvesting you might be able to use 100% fresh mushrooms.

If you are not growing mushrooms and are choosing to purchase your mushrooms from the store it is best to choose a place that has the freshest products. Many farmer's markets offer a wide variety of fresh mushrooms from local growers that you can choose from for your recipe.

FROZEN

We had some freshly harvested shiitake mushrooms frozen in a common household deep freezer and we noticed that the mushrooms held up fairly well. Some of the lighter delicate aromatics faded, but overall the flavor, character, and firmness were still intact. For our second batch we came across an equipment issue at the brewery that pushed back our scheduling and

3-barrel batch size, but when it comes to farming and harvesting there is no waiting. For this reason we fell back on freezing the majority of the harvest in a deep freezer in Ziplock bags until we could brew with them.

This situation was not ideal, but with no way to dry and package the full mushroom harvest, along with a generally poor growing season, we chose to brew another small batch with what we had frozen and their last harvest. With a look into Google's searches on the topic of toxicity of deep freezing shiitake mushrooms I did not find any evidence of toxins being formed when storing in a deep freezer. We did not see much change in the physical character of the mushroom, however there is a chance of them getting mushy. In the end, you are placing these frozen/thawed mushrooms into the mash tun/whirlpool so I am not too picky on appearance. There are articles and instructions on freezing mushrooms for culinary purposes that include steaming or adding oil to keep them plump once thawed. I personally feel that actions like these will take away from the overall character of the mushroom, this includes freezing, and I will again recommend that fresh is best when possible.

DRIED

It is said that you can pick up a pleasant smoky undertone as the mushrooms age and begin to dry or dehydrate. This is something that we noticed as the older mushrooms from the earlier harvest started to age. The smoky character was more in the aroma than the flavor, and was reminiscent of a deep, rich, sweet raisin, pipe tobacco. I feel that having a portion of these aged/dried mushrooms really added to the overall complexity of the resulting mushroom character in the beer.

Please note that we used naturally aged and partially dried mushrooms to get this mushroom profile — not rapid dehydration and packaging of fresh mushrooms at the time of harvest. We have yet to experiment with that option, mainly due to the logistics and better options. Shiitake mushrooms have around a 75% water content, which is lower than most mushroom varieties. This means that you should get a denser mushroom with more flavor impact per pound, and have less loss if deciding to dry and package.

CHOOSING A BEER STYLE

When we get to brew with a unique ingredient, we brewers can't help but to think of fun styles to apply it to. When given the chance, it is best to try a sample of the mushroom variety as the descriptions for them are good and close, but there are small nuances that will make the beer shine and might have been missed. With that said, know your mushroom variety and typical character profile and let your imagination run wild.

Some fun examples of mushroom and beer styles include:

- Lion's mane (crab-like): Kölsch, lager
- Shiitake (white chocolate, buttery): Golden Belgian strong ale, barleywine or big beer, saison, IPA
- Oyster (anise, woody): Brown ale, saison
- Portobello (earthy, meaty): Porter, stout, imperial stout
- Button mushroom (meaty, light and delicate umami flavor): Light American lager, cream ale, IPA
- Turkey Tail (earthy, bitter): ESB,

Shiitake mushrooms ready to be harvested. It is recommended to use 1–3 lbs. of fresh mushrooms per gallon of beer (120-360 g/L).

Scottish ale, Irish stout, Baltic porter, pale ale, IPA.

For our collaboration using shiitake mushrooms we decided to brew a saison as we felt the saison yeast character would play off the mushrooms.

HOW TO USE THE MUSHROOMS

By doing this collaboration we are able to purchase a large portion of Narrow Gauge's yearly shiitake harvest. With that being the case, we can only brew this beer once a year and need to maximize our usage of the mushrooms while keeping the delicate flavors intact. We thinly sliced each mushroom to maximize surface area then placed them in an emptied mash tun. This acted as an extended whirlpool/hopback style "mushroomback." At such a large dosing rate, we felt that using a nylon bag or cheesecloth would be too problematic and that using the mash tun was the best choice to maximize our ingredient extraction, as well as the ease of brewing logistics and taking clear wort from kettle and off the trub for ideal mushroom wort interaction. As an added benefit, this also allowed us to easily reclaim the mushrooms for later use than had we added them to the kettle or used a bag. We feel the mash tun/whirlpool is the best choice of when to add the mushrooms, however feel free to do what works best for you, your equipment, and your recipe.

Just like asking a hop head where to add hops in an IPA, you can add mushrooms at any point in your process to achieve different results. You can use them whole, sliced, blended for boil/whirlpool/fermenter additions, or any other inventive way you can imagine at any point of the brewing process to impart the character you are looking for. Just understand the reasoning on why you have chosen the form of mushroom and where you add it.

HOW MUCH MUSHROOMS TO USE

If you are growing mushrooms then I would suggest using as much as you can harvest. If purchasing from a store, where costs can add up quick, then I would recommend using 1-3 lbs. per gallon post-boil (120–360 g/L). Mushrooms have a unique character that will be imparted on your beer, so the key is to balance it with a compatible beer style and its supporting ingredients to let the mushroom character shine through. In the end, it is up to the brewer to decide on variety, type, when, how, and how much mushrooms to add to their recipe.

OUR SAISON COLLABORATION

We have brewed two saison collaborations on a small scale. Our first version was a 6.1% ABV beer that used 2.5 lbs. of sliced shiitakes per gallon (300 g/L). Our second version was also a saison but with a much higher 11% ABV in which we used 1.15 pounds of sliced shiitakes per gallon (140 g/L). The reason for the lower dosing rate in this second batch was due to a larger batch volume dictated by new brewery equipment and a lower harvest yield. Both were delicious, however I believe we were all in agreement that the 6.1% version with the higher mushroom addition rate had the best character, flavor, and drinkability. As such, it's the recipe provided on the next page.

A NOTE TO FORAGERS

This article has been a story of our brewing collaboration with professionals that know their mushrooms. While we enjoy foraging, it is advised against unless you are 100% certain of the mushrooms you are harvesting and what its possible lookalikes are. Consuming the wrong mushroom can make you extremely ill, hospitalized, or even cause death in some cases.

Related Link:

• *Find more advice on brewing with mushrooms, including a recipe for an imperial stout with candy cap mushrooms (that contribute a flavor similar to maple syrup) at:* **www.byo.com/article/brewing-with-mushrooms**

– RECIPE –

LINDGREN CRAFT BREWERY'S NARROW GAUGE SHIITAKE MUSHROOM SAISON CLONE

(5 gallons/19 L, all-grain)
OG = 1.053 FG = 1.006
IBU = 25 SRM = 3 ABV = 6.1%

This beer features what you would expect in a saison in regards to the malt and hops balance and the fruity esters and phenols derived from the saison yeast. The shiitake mushrooms provide a notable sweet white chocolate flavor and aroma that pairs very well with the yeast to create a beer like no other.

Fun fact: September is known as National Mushroom Month so if you plan your September harvest and brew just right you should be ready to enjoy your mushroom creation on October 15, which is National Mushroom Day.

INGREDIENTS

9.4 lbs. (4.3 kg) Dingemans Pilsner malt
1.3 lbs. (0.6 kg) Weyermann Spelt malt
1.25 oz. (36 g) aged Spalt hops (first wort hop)
1 Whirlfloc tablet (15 min.)
2 g yeast nutrient (15 min.)
15 lbs. (6.8 kg) fresh shiitake mushrooms (sliced)
2 packs SafAle BE-134 or your favorite saison strain

STEP BY STEP

Slice the mushrooms as thin as you can to maximize surface area. You can choose to do a single infusion mash anywhere around 151 °F (66 °C), however we did a single decoction mash: Mash in at a beta amylase temperature of 140—145 °F (60–63 °C) and rest for 20 minutes. Pull roughly one quart (1 L) of thin mash and bring it over to a small kettle where it is slowly brought to a boil and allowed to simmer for 15 minutes. Be sure to continually stir the boiling mash to prevent scorching. Pour the boiled mash back to the main mash and stir well. The new mash temperature should be close to 152 °F (67 °C). Rest at this temperature for 30 minutes before proceeding to vorlauf.

Sparge with 172 °F (78 °C) water and lauter wort, collecting until you reach 7.5 gallons (28 L) in the kettle on top of the aged hops. Bring to a boil and boil 90 minutes, adding whirlfloc and yeast nutrients with 15 minutes remaining.

After the boil is complete, transfer the wort to the mash tun filled with the sliced mushrooms. Once full, allow the wort to rest for at least 30 minutes for a respectable flavor and aroma character. You can rest for longer, but it is recommended not to go below 160 °F (71 °C) in fear of wild infections.

Chill to 74 °F (23 °C) into a fermenter and pitch yeast (we used LalBrew Belle Saison, though it is no longer available in homebrew quantities). Ferment at 74 °F (23 °C) until final gravity has been reached before cold crashing the fermenter to 30 °F (-1 °C). Keg and force carbonate or bottle condition as usual.

Spent Mushrooms

By using the mash tun to soak the mushrooms you are able to get nice clear wort and leave behind all the hot break and trub. This clean sugary wort soaks into the mushrooms, exchanging flavors as they marinate. After knockout you are left with these spent sliced mushrooms that are coated in delicious sugary wort, making for a great culinary opportunity. They can be used immediately or scooped into a freezer bag and frozen. The world of culinary ideas for the use of these wort-soaked mushrooms can be enormous and is up to the creativity of the chef. We were able to partner with our friends at Old Trail Tavern & Steak and sell them our spent mushrooms at a reduced price to reclaim some of the production costs. The idea to reuse these unique spent mushrooms in different cuisines went over very well and really should be a focus of topic for any brewer brewing with mushrooms.

Recipe notes:

We had access to 14-year-old unopened and well-stored Spalt hops. We used the given 5.3% alpha acids in recipe calculations, though actual alpha acids may have been lower due to aging. Feel free to sub in any aged, or even fresher hops that you like for saisons.

Extract option:

Replace the Pilsner and spelt malts with 6.5 lbs. (2.9 kg) Pilsner liquid malt extract and 11 oz. (315 g) wheat dried malt extract. Heat 5.5 gallons (21 L) of water to a boil and then remove from heat to stir in both malt extracts. Return to heat and boil for 60 minutes, following the remainder of the all-grain recipe instructions. BYO

BY DREW BEECHUM & DENNY CONN

BREWING FRUITED BEERS

Maximizing fruit character

We've been fond of saying over the years that if there's one weird development of modern humanity it's been the increased procrustean standards that we place our foods and beverages against. "Is it *authentic*?" "Is it *real* beer?" When you dig into humanity's alcoholic history, it's terrifically clear that our forerunners didn't hew to "this is a grain-based beverage," "this is a sugar beverage," etc. Time and time again you see confounding mixtures of grains, sugars, and fruits — if it could ferment, then humans used it.

And maybe some of that modern "guidelines" habit is passing into the mores of yesteryear as we see craft brewers throwing everything they can think of at their brew kettle, fermenters, and kegs in an attempt to entice a patron to spend a little cash. Looking at you – double fruited, double dry hopped sour milkshake hazy IPA (an actual commercial beer that Drew tried).

Fruit has a long history in beer, even with the obsession with beverage purity, and it's easy to see why. Fruit is fun and colorful, it tastes great, and it adds a different zip to the usual mixture of barley and hops. With relatively little work, fruit can dramatically alter your beer.

Fruit is fun and colorful, it tastes great, and it adds a different zip to the usual mixture of barley and hops.

Photo courtesy of Shutterstock.com

WHY AM I ADDING THIS?

Before you start thinking about how you're going to use the gargantuan cornucopia of fruit available to the modern brewer, we'll remind you of our continual plea: Ask yourself, "Why am I adding this to my beer? Does this make sense?"

As an example, if you've got a potently bitter IPA, throwing fruit into the mix just doesn't make any sense. If the strongest fruits get lost in the noise, then there's little point.

But let's say you're planning ahead and say, "Self, I'm really fond of strawberries and I need my IPAs. How can I combine these loves of mine?" Then you can structure your IPA in a way that makes sense to allow strawberries to carry forth (use less bitterness, bring in the strawberry-lime flavors from Belma® hops, and get a couple of different strawberry additives).

Conversely, a lesson that every brewer should commit to memory is the rescue powers of strong fruit flavors. Sometimes your beer doesn't quite turn out the way you want it to (maybe it's slightly phenolic or in the case of one of our porters, incredibly tannic) — a quick use of an appropriate fruit or fruit extract product can erase the flaw and make a stellar beer drinking experience!

WHAT BEERS TO FRUIT

Now the question comes, "What beer am I going to fruit?" Since fruit is an added expense to your brew day, brewers tend to look to styles that let it shine like a Klieg light searching the skies for enemy planes. If you look at the world's fruit-filled beer styles, what do you see? A lot of pale wheat beers, spontaneously fermented ales, and kettle sours. Wheat gives a soft doughy taste that conjures up sunny summer days filled with pies and tarts. Wild sours deliver a diverse and complex canvas to match with fruits. And quick kettle sours mix the world of "ades" (e.g., lemonade) and slushies with an acid bite that pops the fruit character even harder.

Those are the easy answers, but what about something not all "pale and wheaty?" You know Drew and his love of Belgian styles has led him to add fruit to saisons and tripels galore (including the Dole Whip Tripel at the

end of this article).

As you look at more intense styles and beer flavors, you need to think about more intense fruiting. Leave the subtler stone fruits behind and focus on strong berries and tropical fruits. It wouldn't be out of bounds to create a chocolate cherry stout — actually, that sounds really delicious right now — but maybe more of a fall/winter project! Even an intensely malt-forward barleywine could be enhanced with the addition of dark dried fruits like figs, prunes, and raisins, and Belgian Quad screams for something to play with the naturally occurring plum flavors.

And while you might be tempted to just think malt vs. hops, note how many of these examples depend on an aspect of fermentation — sours as bright fruit punchers, spicy Belgian strains enhancing warm fruit flavors, and plummy/estery yeasts pushing those dark fruits.

WHAT FRUITS TO BEER

Hopefully by this point you know what fruit you want to add. You probably chose it first and we can't think of one that hasn't been used in beer to "great" effect (looking at you Durian Lambic from the 2024 Southern California Homebrewers Fest). Berries are the longtime go-to for brewers — particularly big bold flavor powerhouses like raspberries, blackberries, and blueberries.

Some fruits are more difficult to capture like the stone fruits. Peach character fades in a New York minute. Watermelon, after fermentation, tastes nothing like watermelon — often coming across as more of the rind character.

The harder it is to keep the flavor around, the more fruit you'll need! We once had a strawberry lager project that required pounds and pounds of fresh fruit, that was then augmented with more frozen fruit and even some concentrate and it still tasted like the faint memory of your grandma's strawberry candies from a block away (read on for the final fix to that fiasco).

Oh, and while we're talking about impacts – what about the alcohol impact? Fruit is sugar and sugar is booze, right? At least in the case of your less processed/unconcentrated fruits – there's also a fair amount of water in fruit. Things like orange juice usually come in around 1.048 gravity. If you add a gallon of OJ to a beer that is less than 1.048, you've boosted your overall level of sugar. If you add it to a 1.070 IPA, you've actually increased your volume, but reduced the overall alcohol concentration! Always check the gravity of the juice to see how it will impact the beer instead of just assuming that an addition of fruit will boost alcohol after fermentation is complete.

FRUIT FACTOR

You've chosen your beer, you've chosen your fruit, now you've got to decide how to squish all that fruity goodness into your glass. The first question in front of you is, "What form of fruit do I go with?" You've got options:

Fresh: The obvious choice — pick (or buy) fresh fruit! That's what our ancestors always did. A few things to consider: If you're buying fresh fruit, only buy stuff that's actually in season and hasn't been shipped halfway around the world in a container and gassed to appear bright. These fruits are often devoid of flavor to eat, and much worse when used to brew with. The best trick up Drew's sleeve is to roam his local farmer's markets right around closing time. Look for the fruit that's too ripe to hold onto and grab a deal because produce going back to the farm is money not made with extra labor costs. Seriously, one time Drew made a blood orange saison with in-season, beautifully ripe organic Moros for 75% off because they didn't want to load another 50 lbs. (23 kg) of oranges into the truck!

Once you get your bounty home, give it a quick wash, cut it up (the more surface area, the faster the flavor absorption), bag it into freezer bags, and freeze the fruit. The average household freezer works relatively slowly, creating large jagged ice crystals that work for our "give me all your flavor and sugar" needs. What about sanitation, you ask. Even Drew, who's normally as paranoid as a tin foil hat, doesn't sanitize his fruit. He trusts the combination of washing, freezing, and a hostile fermentation environment keeping stray microbes at bay. Depending on the intensity of the fruit you've selected, we recommend 1–3 lbs. of fresh fruit per gallon of beer (120–350 g/L).

Frozen: What if you want to brew a beer with a fruit that isn't in season and you can't get it fresh? The easy answer is to skip all that washing and prep work required before you freeze fresh fruit and just buy frozen fruit. It's convenient, if not slightly more expensive, and has the advantage of being better quality produce than most of what you could buy at the average supermarket, even in season. Just like when brewing with fresh fruit, there is no real need to worry about sanitation — just thaw and dump the previously frozen fruit into the mix.

Juice: It's easy to find a thousand and one juices at the store, but in general we don't advocate using juice as your main source of fruit flavor because so many of them are either really cheap and watery (and mostly apple juice) or incredibly expensive and still fairly dilutive of your beer. If you do use a juice, make sure it's 100% your fruit choices and that it doesn't have potassium sorbate as a stabilizer (more on that in a bit).

Purees: All the convenience of a juice, but made entirely of the fruit we're after. If you look at what commercial breweries are doing for their beers, puree is what they use most of the time. Reputable companies like Oregon Fruit Co. produce aseptic fruit purees that are easy to grab and add to any beer on a whim. Just sanitize the package, open the can or pouch, and pour. You do pay more for these products, but they're high-quality and ready to go. In this case, we feel that both quality and convenience make the expense worth it. One or two cans/pouches (~3 lbs./1.4 kg) delivers the punch of many pounds of fruit. (Note to pay attention to — cans are usually pressure-cooked, so the fruit is "cooked" for a longer period than the aseptic packaging in pouches.)

Dried: Fruit has been dried for millennia to preserve it and have it at the ready. With their concentrated sugars, these can work well. But make sure you grab "natural" or "unsulfured" fruit to avoid adding sulfur dioxide to your beer. (The right stuff is invariably darker and less inviting to look

at, but we're not looking at it! This may just be a Drew aversion because adding sulfur – even when it should dissipate – is unappealing, so he sticks to the rule of least processing possible.) Just chop it up and let it go. Drew likes the impact of dried apricots over their fresh counterparts. Just a quick chop of 4–8 oz. (~110–225 g) and toss them into the beer.

And to be space agey, you can also buy "freeze-dried" fruits like strawberries and blueberries. The light-weight fruit can be crushed into a fine powder in the bag before adding to the fermenter. Drew keeps Trader Joe's freeze-dried fruit pouches on hand – just one or two of the ridiculous light-weight bags (~1.2 ounces/34 g per bag) adds an exhilarating amount of flavor.

Concentrates and Extracts: The last two options to talk about are far more processed. We're not really fans of the concentrates we've tried because — to Drew's taste — they tend to come off as cooked jam slurry thinned with a bit of water. Extracts, on the other hand, can be used to great effect, particularly in conjunction with actual fruit. On their own, they often read "chemically," but a hard-to-capture fruit like strawberry can be juiced up with a small addition of extract, which is how we solved the aforementioned strawberry beer in which fruit itself didn't offer enough flavor.

WHEN TO ADD FRUIT

The last thing to consider with your fruit is when to add it?

The general rule is the later you add a fruit in fermentation, the more aroma and flavor will remain. But keep in mind the later you add it, the longer it may take to bring the batch to a stable gravity due to reduced yeast activity. Another reason to consider later additions is that fermented fruit doesn't always taste great — see how many fermented orange juice projects taste like something has gone "global pandemic crisis movie" levels of wrong.

We both prefer our fermentations to come to a complete stop, both from a stability point of view and a balance perspective, but that's not the case with a wide swath of fruit beers today that try to arrest fermentation to create a full-on fruit slushy bomb. And a bomb they can be — remember that any yeast in the beer, no matter how tired or overwhelmed — will look at all that free sugar like a glutton looks at an all-you-can-eat buffet.

To create the slushy effect, allow the beer to ferment out completely and crash it clear. Rack the beer into a purged keg along with a dose of potassium sorbate (aka Sorbistat-K). Add the fruit puree to the keg, seal it, carbonate, and mix vigorously. Since we can't easily pasteurize, we need to depend on the mix of sorbate's prevention of a new fermentation with the stabilizing impact of chilling. We don't recommend bottling or canning the beer because we're paranoid about bursting fruit-powered hand grenades!

To enhance the slushy experience, you can add a dose of lactose (1 lb. per 5 gallons/0.45 kg per 19 L) to the boil kettle to lend an extra mouthfeel, but overdoing it can make for a beer that drinks like a protein shake.

If the resulting fruit beer (slushy or non-slushy) feels a bit "flabby" or flat on the palate, take a trick out of the vintner's playbook and add a small touch of citric, malic, and/or lactic acid. The human palate reads acid as a key component of fresh and bright. If you choose good fruit (or a well-manufactured fruit product), you probably won't need to do this, but keep it in your brewing toolkit.

Fruit is fun, fresh, and absolutely delivers a flavored punch that can attract non-beer drinkers to the party or scintillate jaded taste buds tired of the same old same old. Plus, didn't your doctor tell you need to consume more fruit?

DOLE WHIP TRIPEL

(5 gallons/19 L, all-grain)
OG = 1.082 FG = 1.013
IBU = 27 SRM = 4 ABV = 9.1%

INGREDIENTS

13 lbs. (5.9 kg) Weyermann Pilsner malt
2 lbs. (0.9 kg) fonio (or substitute wheat malt)
1 lb. (0.45 kg) lactose (0 min.)
3 lbs. (1.4 kg) Fierce Fruit pineapple puree (added after 7 days of fermentation)
7 AAU Magnum hops (60 min.) (0.6 oz./17 g at 12% alpha acids)
3.4 fl. oz. (100 mL) vanilla extract
Wyeast 3787 (Trappist High Gravity), White Labs WLP530 (Abbey Ale), Imperial Yeast B48 (Triple Double), or LalBrew Abbaye yeast
¾ cup corn sugar (if priming)

STEP BY STEP

I used the Bru'n Water "Yellow Dry" water profile for this beer and used a step mash. Begin by mashing grains at 122 °F for 12 minutes and then raise to 131 °F for 15 minutes. Raise to 142 °F for 30 minutes, and then raise to 154 °F for 30 minutes. Mash out and vorlauf until runnings are clear. Collect 6 gallons (23 L) of wort and boil for 60 minutes, adding hops at the start of the boil. At the end of the boil add the lactose and chill to fermentation temperature, 63 °F (17 °C). Ferment at this temperature for three days, and then raise the temperature to 67 °F (19 °C). After four days at this temperature, add the pineapple puree and allow to ferment out for about a week.

Add the vanilla extract to a keg and transfer the beer to the keg and force carbonate, or add the extract to the bottling bucket and bottle as usual.

Extract option:
Replace the Pilsner and fonio malts with 9 lbs. (4.1 kg) Pilsner liquid malt extract and 1 lb. (0.45 kg) wheat dry malt extract. Heat 6 gallons water to a boil and then turn off heat as you stir in both malt extracts. Return to heat and boil for 60 minutes. Follow the remainder of the all-grain recipe. BYO

BY JACOB HOOVER

PITCH TO PROFIT

How to make your yeast work (and work again)

Yeast isn't just an ingredient, it's a living, flavor-producing powerhouse of an organism. What other ingredients are still thrivin' and dividin' when it comes time to brew another beer? And because of this, brewers are afforded a massive opportunity to be their own propagators. Keep that culture healthy and viable; it will reward you in return. You need it, and it needs you, so why not make it a major focus in your operations? Every brewer should understand the nuances of their yeast cultures' flavor, smell, appearance, and behavior in fermentation. This makes you proactive rather than reactive, having a strong grasp on consistency and quality.

Today, breweries need to find savings in all aspects of their business. One of the biggest ways to save money when it comes to yeast is from maximizing each culture's potential. Step one? Set a yeast budget. Know your targets, track your spending, and make data-driven decisions. This is absolutely critical because you cannot make informed, data-driven decisions and achieve the greatest success if you do not have a starting place. What's too expensive? What cellar practices aren't worth the effort? We can use this information to identify what products to use, how often these products need to be repitched, and what methods may need to be employed for success. So, what does this look like for nanobreweries?

Nanobreweries may be quick to point out that the lack of frequent brew days or cellar space negates their ability to get much use out of a yeast culture. Combine that with a desire to frequently use different yeast strains and the fact that taprooms and brewpubs often achieve higher margins on pints served over the bar, you may ask how any of this applies. I implore you to reflect on your current standard operating procedures and look for opportunities to increase quality. For nanobreweries, frequent strain changes or limited cellar space might make yeast management seem impractical. But with smart planning, even small breweries can improve quality and cut costs. Over time, these savings add up, whether it's $50 saved today or thousands over years. So, continue on as we discuss strategies for scheduling, harvesting, and repitching while quantifying cost and methods to save on yeast.

SCHEDULING AND PLANNING

I can't emphasize enough that a little foresight goes a long way. Plan and strategize the use of cultures being brought into the brewhouse. A tentative schedule of future batches and styles is an easy-to-implement strategy that can lead to immediate cost savings. Ask yourself which upcoming beers can be fermented with this culture. And how often or frequently will these batches occur? This will help you identify an opportunity for scheduling fermentations so you can capitalize on harvests by minimizing storage time. Using a more flavor-neutral strain makes scheduling easy, but it can be more difficult with seasonal or "one-off" brands. But you can still get creative and schedule a second or even third sequential batch that can utilize any strain. If you're using a hefeweizen strain, think of other styles that can utilize this strain (dunkelweizen or weizenbock, for instance), and because two banana-flavored beers may not be the best sales strategy, adjust fermentation parameters to make a "cleaner," reduced-ester version. Think overpitching, spunding valves and pressure, or lowering the fermentation temperature.

One of the biggest ways to save money when it comes to yeast is from maximizing each culture's potential.

Photo by Colin Kaminski

Harvesting and repitching healthy, viable yeast leads to big savings for nanobreweries.

When planning new cultures, always document the batch, its original gravity, and the yeast culture generation (if repitching). A key strategy for reducing your cost is to use early generations in lower-gravity batches and pitching harvested yeast into higher-gravity beers requiring a larger pitch of yeast. You are your own propagator! High-gravity fermentations present a compounding financial challenge that many brewers overlook. When pitching into wort above 17–18 °Plato (1.070–1.074 specific gravity), breweries face both the immediate cost of doubling their yeast quantity and the hidden expense of losing repitching potential. The extreme conditions of high osmotic pressure and alcohol stress typically degrade yeast health to the point where reuse becomes inadvisable. A more strategic approach begins with mid-gravity wort in the 12–15 °Plato (1.048–1.061 SG) range. These gentler fermentations allow yeast to build biomass and vitality, creating opportunities for extended use. For example, a brewery could pitch fresh yeast into a 15 °Plato (1.061 SG) IPA, harvest healthy cells, and then deploy them in a subsequent 20 °Plato (1.083 SG) imperial stout. This progression not only stretches the initial yeast investment across multiple batches but also ensures the culture is at peak health when facing its most challenging fermentation.

ENSURING HEALTHY FERMENTATIONS

Once you've established your yeast strategy, the focus shifts to maintaining optimal fermentation conditions. Malt naturally provides most of the essential nutrients yeast needs — like carbohydrates for energy, vitamins for metabolic function, and amino acids for cellular functioning. These components are rarely deficient in standard all-malt worts, but brewers should remain vigilant in recipes with higher adjunct percentages, low original gravities, or poorly modified malts, as these can create nutritional gaps. Two elements demand particular attention: Oxygen and minerals.

Proper aeration at pitching is critical with liquid cultures because without adequate oxygen, liquid yeast struggles to synthesize sterols and fatty acids for building cell membranes during the growth phase (0–48 hours). This can result in sluggish fermentations and poor attenuation. Adequate oxygenation at pitching is less of a concern if using a dried culture due to sufficient sterol and unsaturated fatty acid reserves to support cell division.

Minerals like zinc and magnesium play equally vital roles as enzyme cofactors, influencing everything from flavor development to cell replication. Zinc deserves special consideration because it readily binds to trub during wort production and fermentation, often leaving insufficient amounts available for yeast metabolism. Over successive generations, this deficiency can progressively weaken cell health and reduce fermentation performance. The financial incentive is clear: Healthy yeast means more reliable fermentations and greater generational longevity, all resulting in high-quality beer. Each additional batch you can brew from a single yeast purchase directly lowers your per-batch cost, transforming what might seem like a minor process detail into a meaningful opportunity for savings. By prioritizing these fundamentals, you're not just nurturing your yeast, you're protecting your bottom line.

MONITORING YEAST HEALTH

Do I need to run tests to ensure my parameters are in spec for fermentations? In a perfect world, that would be great, but as a nanobrewery this is not always possible nor absolutely necessary. There are a few key parameters that are cheap and easy to monitor and will give you enough information to make informed decisions about your yeast culture.

Let's start with recording simple gravity and pH readings, as entry-level equipment is both inexpensive and capable of producing accurate results. The key lies in tracking trends, not just numbers. Daily gravity and pH readings during active fermentation tell a more valuable story than any single data point. Focus on the pH drop within the first 48–72 hours as a reliable indicator of yeast activity and vitality. Healthy fermentations' pH steadily declines during this time before slightly rising through the end of fermentation. Sluggish drops in these initial hours typically signal trouble and poor yeast health. A tip for identifying poor health early is to closely monitor pH drops about 12–16 hours after pitching because inactivity is easier to correct at this time. It may allow you to employ batch-saving techniques like raising the temperature, adding more dissolved oxygen, supplying yeast nutrients, rousing the yeast with CO_2, or pitching actively fermenting cultures from other batches. Document these patterns for each strain to create benchmarks; plot them on a simple Excel graph, and over time you'll recognize normal behavior versus potential issues.

These observations cost nothing but attention, yet provide critical insights into your yeast's condition. Consistency matters beyond fermentation metrics. If you want added verification that a culture is healthy, invest in a microscope ($250–$300) and the items necessary to perform cell counts and viability testing. Track and aim for consistent harvest sizes using weight (lbs./kgs) or volume (gal./L), and monitor slurry density by eyeballing a slurry through a sight glass or performing a cell count. Any substantial variations in collected yeast may indicate changing culture health. But remember, even without advanced equipment, consistent tracking of basic parameters gives you most of what you need to produce excellent, consistent beer.

The bottom line? You don't need a lab to make smart decisions. You just need good habits, basic tools, and an understanding of what "normal" looks like for your yeast.

HARVEST AND STORAGE

The culture just fermented a batch exactly to specifications and is ready to be harvested and stored until future use. This is a critical step because you don't want to negate the success you just observed in fermentation by improperly storing the yeast and impacting its health. Let's discuss a few key recommendations to ensure you maintain the highest viability and vitality between batches.

Aim to collect your yeast when the beer sits about 1 °Plato (5 gravity points) above terminal gravity, just before initiating a diacetyl rest. At this stage, the most flocculent cells have already settled in the cone, contributing little to finishing fermentation, and the remaining suspended cells will handle the final gravity drop and diacetyl cleanup. By

harvesting now, you rescue your yeast from the increasingly harsh conditions of the fermenter, where mounting pressure, rising alcohol levels, and insulating heat can rapidly deplete their energy reserves. This stored energy within the cell, glycogen, is needed when the cells are in storage to maintain their health until the next batch.

Perform standard transfer techniques, keep things clean, and slowly open the valve as you dump trub and transfer yeast into a storage vessel to avoid tunneling. Tunneling occurs when yeast remains impacted on the sides of the cone and prevents the entire slurry from being harvested. Trub dumps are key and can be performed daily during fermentation or when harvesting to avoid capturing dead or compromised yeast cells, hop matter, and coagulated proteins. Once collected, treat your stored yeast with the same care you'd give finished beer: Keep it cold (33–38 °F/1–3 °C) in a sanitized, CO_2-purged vessel to minimize oxidation and unwanted metabolic activity. Remember to vent storage vessels daily to prevent CO_2 buildup from stressing the cells. Storage time can be a concern for nanobreweries. Aim to repitch as soon as possible, but a rough rule of thumb is to store no more than 2–3 weeks after harvesting a healthy culture, as viability declines noticeably with most strains beyond this window. Note that different strains vary in their ability to maintain health in storage. The only way to truly know how long you may store a culture is by recording daily viability readings and identifying an average length for when declining viability occurs. One last tip: Avoid oxygen and warm temperatures because both will trigger metabolism and cause the yeast to begin consuming its stored energy reserves (glycogen).

REPITCHING YEAST

Repitching yeast at a consistent pitching rate is one of the best ways to improve your quality, flavor consistency, and generational use. The most accurate way to do this is to pick up a microscope and learn to perform viability and cell counts. However, excellent results can still be obtained through careful estimation and documentation. The foundation lies in establishing three key parameters: Your target pitching rate (typically 7.5–15 million cells/mL or 0.75–1.5 million cells/mL/°P), your estimated slurry concentration (generally 1–2 billion cells/mL), and your estimated viability (usually 80–95% for healthy cultures).

Without a microscope, the key here is that these are estimated values, and below are the steps to perform your own estimated repitching calculations. The calculations follow a straightforward approach: First, determine your total cell count needed to pitch based on batch volume and gravity, then divide by your slurry concentration to find the required volume, and finally, convert to weight, if necessary, using the approximate density of yeast slurry (1.15 g/mL).

Step 1: Calculate the total number of cells for the batch.

1 BBL = 117,348 mL

Pitch Rate (cells/mL) x Starting Gravity (Plato) x Batch Size (mL) = Total Cell Population (cells/mL)

Step 2: Calculate the volume of stored yeast to pitch.

Total Cell Population (cells/mL) / Slurry Density (cells/mL) = Volume of Slurry Density (mL)

Step 3: If necessary, convert to weight.

Volume of Slurry Density x 1.15 (g/mL) = Weight of Slurry (g)

The following table shows examples already calculated for a 7.5-million cells/mL repitching rate.

BBL	High Viability (~95%)	Low Viability (~80%)
1	1.6 lbs. (0.73 kg)	1.9 lbs. (0.86 kg)
3	4.7 lbs. (2.1 kg)	5.6 lbs. (2.5 kg)
5	7.8 lbs. (3.4 kg)	9.3 lbs. (4.2 kg)

METHODS TO MAXIMIZE VALUE

As a brewer, you are a propagator of yeast, so reap the bounty of your efforts and maximize the value of your yeast expenses by strategizing the movement of yeast through your cellar. A simple strategy is to split yeast harvests into two subsequent repitches. The yeast divides anywhere from 3–6x, depending on factors like fermentation temperature, strain, gravity, etc., providing you with much more yeast than initially pitched. You can split these into "cousin" lineages and track them separately as they move through the brewery. Nanobreweries are limited in brewhouse capacity, but utilizing this strategy even once can show worthy savings over time.

Example: Think about a month where you harvest week one, pitch half the harvest into a core high-ABV beer week 2, and pitch the other half into a second core beer week 3. That's a minimum of three batches with a single purchase, reducing your overall expense to a third of its original cost. It's not hard to imagine that over the course of a year we are talking about significant savings on yeast expense.

Double batching is another powerful savings tool. By brewing half your fermenter volume one day and completing the fill the next day, you leverage the yeast's 24-hour growth period to avoid a second pitch. Just pitch to the day-one fill volume. This halves your yeast costs immediately, with compounding savings across generations.

Last, pressurized lager fermentations are becoming more popular, especially with the rebirth of demand for lager brewing in many craft breweries. The concept is that warmer temperatures allow for greater metabolic activity and promote cell division in the initial growth phase. Traditional cold pitching (48–55 °F/9–13 °C) requires nearly double the yeast, but starting at 65–70 °F (18–21 °C) with 1 bar pressure (or 14.5 PSI) promotes natural cell growth while maintaining clean profiles through pressure-induced ester suppression. The benefits multiply: Lower pitch rates, faster fermentations (6–8 days versus 2–3 weeks), and reduced tank time, all while achieving lager character.

IMPLEMENT, DOCUMENT, & SAVE

Don't cut corners for convenience or upfront savings. Invest in quality yeast, track performance, and stick to your strategy, even if results take 6–12 months to materialize. Document every batch, generation, and cost to refine your process.

Yeast management isn't just about saving money, it's about brewing better beer. By treating your cultures as partners, not commodities, you will unlock consistency, creativity, and long-term profitability. BYO

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BY DON BETTENCOURT

ROAD-KILL IPA

Giving a purpose to fresh hops left for dead

In the fall of 2013 I was assigned to oversee construction crews for a local cable provider. My destination: Oregon's Yakima Valley. This area is one of the most important hop-growing regions in the world, harvesting 75% of the nation's hops. One of the sites we worked on was the new Bale Breaker taproom, a fresh off-the-farm brewing company that was expanding its operation to showcase their products. Nowadays you may have heard of Top Cutter IPA, their flagship IPA, though at the time they were still relatively unknown outside of those parts.

As a homebrewer, I was stoked to be involved in anything beer-adjacent, but that was just the start! Between the hop industry and the hopping craft brewery culture, Yakima is a true beer lover's destination. Each year, thousands of brewers from around the world visit Yakima during the annual hop harvest from the end of August through the end of September. It is a hub of activity with hop cutters and transport trucks seen everywhere you go.

If you haven't taken a drive through the lavish hop fields during this time of year, do it quick because the ingathering is a hasty, wild process to get the hops out of the fields at the perfect time.

Waking up every morning during this time, the aroma and the sight of the hops is in the air, literally.

While driving out into the valley, checking up on some of my jobs, I noticed a beaucoup amount of fresh hop bines on the side of the road. Who would leave these just sitting there in the sun? Then, watching all the truck traffic, it hit me. It seems that the trucks transporting the fresh hops to the processing centers lose a few, and the amount lost is insignificant compared to the volume of the crop yield. If you had 1,000 pennies, would you miss just one?

I figured I just discovered a lost treasure and went back to the shop to get some containers. Still wearing my company-issued safety vest, I probably looked like a county worker picking up roadside trash. Initiating my very own "fall harvest" I snagged up all the fresh bines that I could. My real job could wait!

Some of the bines of hops were starting to turn. Sitting in the hot Yakima sun, they were left to wilt. I was up to three totes full of the good ones, the survivors. It was like a battle triage, evaluating the wounded from the ones that were too far gone and weren't going to make it. I was frantic, almost like a traveler crossing paths with an overturned armored car spilling out cash. Logic finally overcame greed and I had to stop. Plus, I was still on the clock.

Heading back home, I was looking forward to putting these puppies to good use. At the time, my church had a men's group called We Brews. Our mission was to share our homebrew potions, along with some good ole fellowship and fun. I pulled out an IPA recipe I had and went to work. Since I prefer double IPAs, this was the eventual goal with my newfound treasure. Not knowing the hop varieties, I rolled the dice and used what I had for the bittering, end-of-boil, and dry hopping charges. A handful here, and a few more there. A mad scientist overjoyed with bins of fresh hops to use.

After the boil and chilling of wort, time to transfer. Peculiar . . . the valve was open, but no wort! I hadn't fully thought through my first experience with fresh hop cones. Reaching deep to the bottom of the kettle, I was able to clear the hop jam. Lesson learned.

The result was a pretty decent batch, a limited-edition session brew like no other. When it came time to name it, I thought back to my time spent on the side of the road collecting the hops that were left to die in the sun. The name was too obvious: Road-Kill IPA. BYO

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Photo courtesy of Yakima Valley Hops

During hop harvest truckloads of hop bines fill the roads transporting the fresh cut hops from field to processing plants. Along the way a few may fall to the side of the road, to the excitement of homebrewers.


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