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MAY/JUNE 2022

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EDITOR'S Desk

BY DAVE CARPENTER

Bring Back the Cask

It's time to fall in love with cask ale again. *Zymurgy*'s veteran readers may remember a time when American taprooms made a big deal of British-style real ale. Some of the more devoted outlets installed proper beer engines with swan-neck faucets and welcomed heated debates over the merits (or horrors) of the sparkler. Others were content to plunk a cask on the counter for Firkin Friday and gravity dispense.

This wasn't all that long ago. Remember BridgePort India Pale Ale? I sure do. It combined American and UK hops in a flavorful beer of only 5.5% ABV. You probably couldn't call it IPA today. One of my fondest beer memories involves having enjoyed a couple of pints of BridgePort IPA, served cask-style, in the now-defunct brewery's taproom in Portland, Ore. The brewery and its beer may be gone, but that memory remains. And it was less than a decade ago.

But where are the casks now? Today's U.S. beer consumer is hard-pressed to find real-deal cask ale. Sure, a handful of breweries have built businesses around cask-conditioned ale, and they are to be applauded and frequented. A few others augment kegged offerings with the occasional real ale. But, on the whole, it appears to have fallen out of fashion.

It was thus a welcome diversion to have recently enjoyed a long-overdue vacation to the UK. Between London sightseeing and walking in the picture-perfect countryside of the Cotswolds, many opportunities for liquid refreshment presented themselves. Every day included at least one stop at a pub with several handles of real ale.

Just a few notable highlights include Proper Job from St Austell Brewery; Portobello Brewing Company's Westway Pale Ale; Ghost Ship from Adnams Southwold; Titanic Brewery's Plum Porter; Oakham Ales Citra; and the much-celebrated Timothy Taylor's Landlord. There was also, of course, Fuller's London Pride.

Some readers might have enjoyed London Pride as their first "real" (i.e., not macro lager) beer. Anyone who has studied for a beer exam has come across London Pride as one of the classic commercial examples the BJCP lists for the Best Bitter style. Maybe you've recently purchased a bottle for nostalgia's sake.

London Pride in a bottle and London Pride served from a cask are two different beers, quite literally. The bottled ale is brewed to 4.7% ABV, while the cask version is an even more sessionable 4.1% ABV. It's common practice in the UK to have two versions of the same brand—a low-alcohol cask ale to enjoy in the pub and a higher-strength formula for the bottle.

I was delighted to tour Fuller's historic Griffin brewery in Chiswick. Owned by Japanese brewing concern Asahi since 2019, the brewery still manages to retain much Victorian charm, even if the old coppers are long since out of use. Fuller's do continue to use a grain mill that most breweries would have replaced years ago. It's still serviced by millwright Ronnie Lee, whose name is well-known in Scotch whisky circles as the Welshman who maintains many antique mills that keep the *uisce beatha* flowing.

London Pride is an excellent beer, but like so many beers, it is at its best close to its birthplace. Homebrewers know this intuitively, which is why I suggest we all spend some time making our own cask ale.

I would wager that the proportion of us who enjoy a good cask-conditioned pint is higher than that of the wider population of beer consumers. If you appreciate real ale as much as I do, consider doing it yourself. Before I came on as *Zymurgy*'s editor-in-chief, I penned an article on DIY cask ale in this very publication ("(Un)real Ale: Cask Conditioning at Home," Jul/Aug 2013).

You don't really need a beer engine. You don't even need an actual cask. All you

really need for stylistic fidelity is to naturally carbonate modestly (1.1 vol or 2.2 g/L) and serve at cellar temperature, about 50–55°F (10–13°C). Try it this year. Maybe you'll be so delighted that you'll encourage your local brewery to bring back the cask.

Dave Carpenter is editor-in-chief of Zymurgy.

Photos courtesy of Dave Carpenter

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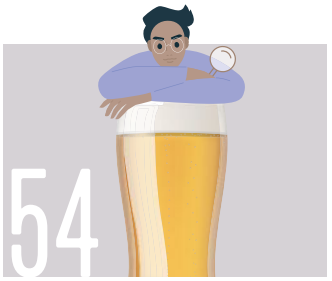

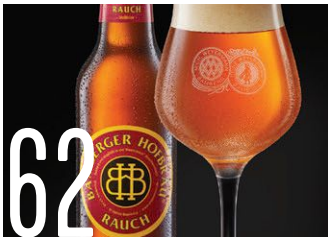

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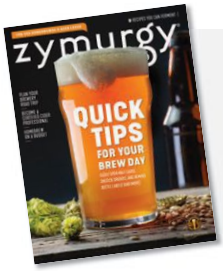

Cover Photo
Luke Trautwein

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zymurgy®

(zī'm ɜr jē) n: the art and science of fermentation, as in brewing.

ON THE WEB
Find these homebrewing recipes and more on our website @ HomebrewersAssociation.org/homebrew-recipes

New Products

NOW ON Tap

ALCHEMY PEPPERS HOPP SAUCE

Alchemy Peppers recently announced the launch of its new line of hop-infused Hopp Sauces. The three debut hot sauce varieties include

- **Fresno Peppers + Simcoe Hops**, which mixes Fresno and red bell peppers, strawberry puree, Simcoe hops, and garlic.
- **Jalapeno Peppers + Citra Hops**, which blends jalapeños, Citra hops, and a dash of lime to create the brand's mildest hot sauce.
- **Scotch Bonnet + Mosaic Hops**, the brand's hottest variety, which is made from yellow bell peppers, Scotch Bonnet peppers, Mosaic hops, and pineapple.

Each variety of hot sauce is made from all-natural fruits and vegetables and is infused with hops to deliver one of the first hop-forward hot sauces created for—and by—beer lovers.

Hopp Sauces are made in small batches using real hops. The hot sauces are not built on a vinegar base, which allows the fresh chile flavor to take center stage.

Alchemy Peppers Hopp Sauces range from 3,000 to 45,000 Scoville heat units (SHU) and showcase superior craftsmanship with quality ingredients. Each 5-ounce bottle retails for $12.95, or puchase a three-pack sampler for $38.85.

To learn more, visit alchemypeppers.com.

TAPCOOLER NANOCANNER

With its innovative Counter Pressure Bottle Filler, Tapcooler brought simple, reliable counter-pressure filling to homebrewers who bottle from kegs. Now the Norwegian company has done it again for cans!

Counter-pressure filling is the preferred way to fill cans and bottles with carbonated beer because it reduces foaming and preserves the intended CO_2 level of the finished beer. Homebrewers have long used counter-pressure fillers to fill bottles from kegs, but Tapcooler's Counter Pressure Bottle Filler changed the game by attaching directly to a draught faucet.

The new Tapcooler Nanocanner Counter Pressure Can Filler includes everything you need to fill cans of homebrew under pressure, though you'll need to supply your own cans, lids, can seamer, and, of course, beer.

The Tapcooler Nanocanner works with industry-standard 202 end cans. The included beer valve connects to your keg's liquid disconnect via a 1/4" MFL swivel nut, and the gas adapter accepts ball-lock gas disconnects. A telescoping tube permits filling different-sized cans, as long as they use standard 202 ends. Use the push-button CO_2 purge valve to purge cans of oxygen before and after you fill them, and adjust the pressure relief valve (PRV) to regulate fill speed. The PRV also doubles as an overflow drain for beer and foam to escape while filling, reducing mess.

Everything that touches your beer is fabricated from 304 stainless steel, while the drain barb and ball-lock CO_2 adapters are made from aluminum. Add one of two optional mounting brackets to secure your Nannocanner, or use the included screws to mount it wherever you like. The kit includes the Tapcooler counter-pressure filler, Nanocanner can attachment, and all necessary connectors and adapters, but it does not include a can seamer.

Available from Great Fermentations, the Tapcooler Nanocanner starts at $227.99.

For more information, visit GreatFermentations.com.

AHA Governing Committee Election

Congratulations to Matt Bolling of Fredericksburg, Va.; Melissa McCann of Orangevale, Calif.; and Doug Piper of Greenville, S.C., your newly elected AHA Governing Committee members. These new members officially join the Governing Committee on June 1 and will participate in the annual in-person meeting at Homebrew Con in Pittsburgh.

The Governing Committee advises AHA staff and provides input on the future of the organization. The members of the Governing Committee volunteer many hours of their time each year to serve the community of homebrewers through the Governing Committee and its many subcommittees. Pictures and contact info for all Governing Committee members can be found at HomebrewersAssociation.org/ahagc.

Many thanks to outgoing Governing Committee members Denny Conn, Donna Reuter, and Carvin Wilson for their years of service on behalf of the AHA membership.

Thank you to the 12 candidates who ran in this year's election, and thanks to all AHA members who voted!

Big Brew

May 7 is National Homebrew Day, and the AHA's annual Big Brew is always celebrated on the first Saturday in May. In 2022, those two happen to be one and the same! At this year's Big Brew, which is now in its 25th year, we're asking homebrewers worldwide to participate by firing up their kettles and raising a glass to the greatest hobby there is—homebrewing!

This year's two official Big Brew recipes are Dark Inception Imperial Porter and Tha CommUNITY Lager. You'll find recipes for both right here. For more information on Big Brew, visit HomebrewersAssociation.org.

Dark Inception Imperial Porter

This imperial porter recipe was contributed by Marcus Baskerville of San Antonio's Weathered Souls Brewing Co. He's also the leading force behind the Black Is Beautiful collaborative brewing project. This recipe was initially created after hearing 2013 Homebrewer of the Year Annie Johnson featured on the Brewing Network. Seeing an African-American woman win Homebrewer of the Year provided Marcus with bright hope for his future in homebrewing, and this first foray as a homebrewer led to his love of brewing big, dark beers. This thick-bodied, luscious, flavorful beer features additions of raspberry, cacao, and vanilla, and is bursting with notes of toffee, caramel, coffee, chocolate, malt, liqueur, and fruit. It's a perfect pairing with rich desserts, or as a standalone finale for your evening.

Note: Original gravity is measured before the addition of fruit puree. Calculated ABV% includes contribution from fruit puree addition.

Dark Inception Imperial Porter

Batch volume: 5 US gal. (19 L)
Original gravity: 1.085 (20.5°P)
Final gravity: 1.023 (5.8°P)
Color: 40 SRM
Bitterness: 20 IBU
Alcohol: 8.4% by volume

MALT EXTRACT

6.6 lb. (3.0 kg) Briess CBW Pale Ale LME
4.0 lb. (1.8 kg) Briess CBW Traditional Dark DME

SPECIALTY GRAINS

0.5 lb. (230 g) 120°L crystal malt
0.5 lb. (230 g) 10°L Munich malt
0.5 lb. (230 g) chocolate malt
0.13 lb. (60 g) black malt
0.13 lb. (60 g) chocolate wheat malt

HOPS

1 oz. (28 g) Cascade, 6.0% a.a. @ 60 min
0.5 oz. (14 g) Cascade, 6.0% a.a. @ 15 min

ADDITIONAL ITEMS

1 lb. (450 g) maltodextrin
2 L Boiron Raspberry Puree
7.8 oz. (221 g) cacao nibs
2 Madagascar vanilla beans, soaked in bourbon for 1 week (or substitute 2 Tbsp. pure vanilla extract)
3 tsp. Fermax Yeast Nutrient, divided (optional if your yeast is fresh)

YEAST

2 sachets (22 g) Lallemand LalBrew BRY-97 West Coast Ale Yeast or any other brand of "Chico" yeast

BREWING NOTES

1. Bring 1 gallon (3.8L) of water to 175°F (80°C). Place grains in a strainer bag, and add to water, making sure that they are completely saturated.

2. Steep grain for 30 minutes at approximately 165°F (74°C), stirring occasionally. Remove, rinse, and top off kettle to your normal boil volume.

3. Stir in the 4 lb. (1.8 kg) of DME, making sure that it is completely dissolved, then bring to a boil.

4. Total boil time will be 60–90 minutes (depending on desired level of caramelization and desired original gravity). 30 minutes after reaching boil, add the 60-minute hop addition.

5. With 15 minutes of the boil remaining, turn off burner. Stir in the 6.6 lb. (3 kg) of LME, maltodextrin, and 1½ tsp. yeast nutrient, ensuring that they are completely dissolved before turning burner back on. Once having reached boil again, add second hop addition and complete the final 15 minutes of boil.

6. Chill to 70°F (21°C). Transfer to fermenter, top off volume with water if necessary, and sprinkle yeast directly into wort.

Once you've pitched the yeast, you can create the vanilla bean tincture. Slice the two vanilla beans lengthwise, and place in a pint-sized canning jar. Add 1 cup (235 mL) of your preferred bourbon. Seal jar, set aside, and allow the beans to macerate (soak) for at least a week, shaking jar occasionally. The vanilla beans will be added to the fermenter 1 week before packaging (2 Tbsp. pure vanilla extract can be substituted in place of the vanilla beans just before bottling or kegging).

Ferment at 64–72°F (18–22°C) for 14–21 days.

On 6th day of fermentation: Add 1½ tsp. yeast nutrient, and 2 liters of fruit puree to your fermenter. Gently swirl fermenter, if possible, to rouse yeast.

1 week before kegging or bottling: Pre-heat your oven to 300°F (150°C). Line a cookie sheet with foil or parchment paper and spread the cacao nibs out evenly in a single layer. Place sheet on middle rack and bake for 10–12 minutes until aroma is released from cacao. Remove and allow to cool for a few minutes. Place vanilla beans and cacao nibs in muslin bag, add to fermenter, and infuse for 7 days before packaging (if using vanilla extract add it just before packaging).

ALL-GRAIN OPTION

Replace malt extract and specialty grains with:

11.5 lb. (5.2 kg) Crisp Finest Maris Otter
2.25 lb. (1.0 kg) Weyermann Munich Type 2, 10°L
1.5 lb. (680 g) Simpsons DRC Double Roasted Crystal, 105–120°L
0.75 lb. (340 g) Simpsons Chocolate Malt, 400–500°L
0.25 lb. (115 g) Simpsons Black Malt, 550–700°L
0.13 lb. (60 g) Weyermann Chocolate Wheat Malt, 375–450°L

Please note that grain bill is calculated for a brewhouse efficiency of 65%; adjust as needed. Mash at 151°F (66°C) for 75 minutes. Marcus recommends a 180-minute boil for the all-grain version of this recipe, but a 90-minute boil may be sufficient.

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THE WORLD'S LARGEST BIG BREW MAY 7, 2022

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Tha CommUNITY Lager

Tha CommUNITY American Lager was contributed by April Dove, a homebrewer in South Carolina who is using her brewing education to make a difference in the brewing community. In 2021, Dove (also known as the Traveling Hoptista) started a multi-brew initiative to offer a more diverse and inclusive taproom experience throughout the tri-county Charleston region. These efforts led her to release an American lager (Tha CommUNITY) in partnership with Holy City Brewing, becoming the first Black woman to do so. Her career highlights not only include brewing a flavorful and inclusive beer, but also encouraging the City of North Charleston to recognize October 1 annually as Tha CommUNITY Day. April loves what she does and hopes to diversify the palate of her community "one beer at a time." Follow her at @thacommunity.brew.

This simple and delicious American lager is an approachable first step into lagering since the temperature can easily be achieved with something like a cold-water bath, towel, and fan. If the specific malts, hop, and yeasts indicated here aren't available, substitutes are readily available. Your local homebrew shop can point you in the right direction!

Batch volume: 5 US gal. (19 L)
Original gravity: 1.057 (14°P)
Final gravity: 1.015 (3.8°P)
Color: 5 SRM
Bitterness: 30 IBU
Alcohol: 5.6% by volume

MALTS

9.22 lb. (4.2 kg) American Pilsner malt
0.5 lb. (230 g) honey malt
0.5 lb. (230 g) flaked maize
0.1 lb. (45 g) Briess Carapils

HOPS

1.25 oz. (35 g) Tettnanger @ 60 min
0.5 oz. (14 g) Saaz @ 30 min
0.25 oz. (7 g) Hallertauer Mittelfrüh @ 15 min

YEAST

Lallemand LalBrew Diamond Lager yeast or White Labs WLP800 Pilsner Lager Yeast

BREWING NOTES

Mash at 150° F (66° C) for 60 minutes. Boil 90 minutes, adding hops as directed. Ferment at 59°F (15°C) for 25 days.

PARTIAL-MASH OPTION

Replace malts with:

1 lb. (454 g) American Pilsner malt
0.5 lb. (230 g) honey malt
0.5 lb. (230 g) flaked maize
0.1 lb. (45 g) Briess Carapils

and

6.6 lb. (3 kg) Pilsner liquid malt extract

Mash the grains at 150° F (70.5° C) for 60 minutes and dissolve malt extract in the resulting wort. Top up with water to desired boil volume and proceed with the boil.

DIRECTOR'S *Cut*

BY JULIA HERZ

Immaculate Fermentation

Ahhhhh, my first column. What to say, what to call it, how to make you each proud? No pressure, considering I've been religiously reading *Zymurgy* since the 1990s when the stars aligned, the universe spoke, and the one and only Charlie Papazian, founder of the American Homebrewers Association, drew my name from a top hat to win a membership. →

Right before that *immaculate* moment, I had been struggling to sneak peeks of judges and stewards in action as I floated through the hallway that housed both the hidden goings-on of serious beer entry sorting and judging, as well as the restrooms, at a Beaver Creek, Colo., beer festival. While stewards properly poured and judges sniffed and slurped, I was desperate for a glimpse of anything or anyone who could help me, one day, become a beer judge. Needless to say, that day put me on a trajectory that has manifested itself in epic proportions.

A lot has happened since then. So many homebrews, brewery tours, beer festivals, BJCP and Cicerone study sessions (and testing), plus competition judging. I am a kid in a candy store. You know how beer teaches us science, art, culinary exploration, innovation, geography, agriculture, history/herstory, about ourselves and each other? Well, no wonder we homebrew, right? And always along the way of my homebrewing journey, the American Homebrewers Association has been there. Collectively, since 1978, *Zymurgy* has been giving the world reasons to brew, ways to brew better, and a direct avenue to tap into the community and support that comes along with it.

Speaking of community, it is not lost on me that those who read this incredible publication include a wide array of innovators, leaders, and like-minded folks, including homebrew clubs, retailers, suppliers, allied trade members, distributors, and media. So, since I have your attention as a member of this prestigious group, it's good to align us on the incredible and immaculate contributions of the AHA and how the association has fueled and forwarded the entire beverage of beer as we know it.

Did you know the AHA...

- Helped establish the Beer Judge Certification Program (BJCP)?
- Founded the Great American Beer Festival®?
- Helped ensure homebrewing was legalized in all 50 states (Mississippi and Alabama came on board in 2013 as the two last to legalize) and still protects homebrewers' legal rights to brew, sample, and share their creations?
- Offers 1,300 medal-winning recipes for beer, mead, and cider, in addition to recipes for craft beer clones, fermented foods, and other fermented beverages via HomebrewersAssociation.org?
- Today supports 2,200 homebrew clubs, 377 of which take advantage of the AHA club insurance program?
- Keeps track of more than 630 retailers, hundreds of BJCP annual competitions, and 2,200 member deals?
- Created and celebrates annual homebrewing holidays, including Big Brew, Learn to Homebrew Day, and Mead Day?
- Is showcased in the Smithsonian National Museum of American History, thanks to the work and effort of the Brewers Association, parent organization of the AHA?
- Annually hosts the world's largest homebrew competition, the National Homebrew Competition (NHC), which in 2022 will be 44 years strong? Since 1979, NHC judges have evaluated 156,830 brews, with the 2021 competition having judged 5,045 entries from 2,037 homebrewers located in 50 states, Washington, D.C., Puerto Rico, and 13 countries. Wow.
- Most importantly, has 37,000 members, including you?

Simply put, the AHA is the most trusted and established resource advocating for homebrewers today. What I share is nothing short of immaculate, just like the glories of fermentation and our collective hobby of brewing. Thus, that is the title of this first installment of my column in this incredible magazine.

On that, and I'm sure you each can relate, offering somebody one of my homebrews, every time, feels nothing less than immaculate. Immaculate fermentations gets close to capturing the marvel and wonder of brewing and fermentation and the wonders of the incredible institution we each contribute to as members. Please consider following my new @immaculatefermentation Instagram channel, where I'm sharing all things homebrewing through my lens to the world.

Here's to 2022 and beyond. Hold onto your mash paddles because you ain't seen nothing yet. We are just getting started and I cannot wait to connect with each of you on how we can continue to help homebrewers reach our goals. The future looks bright, and I am honored to have the chance to lead the AHA.

Cheers,
Julia

Julia Herz is executive director of the American Homebrewers Association.

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Of Crocks and Pi

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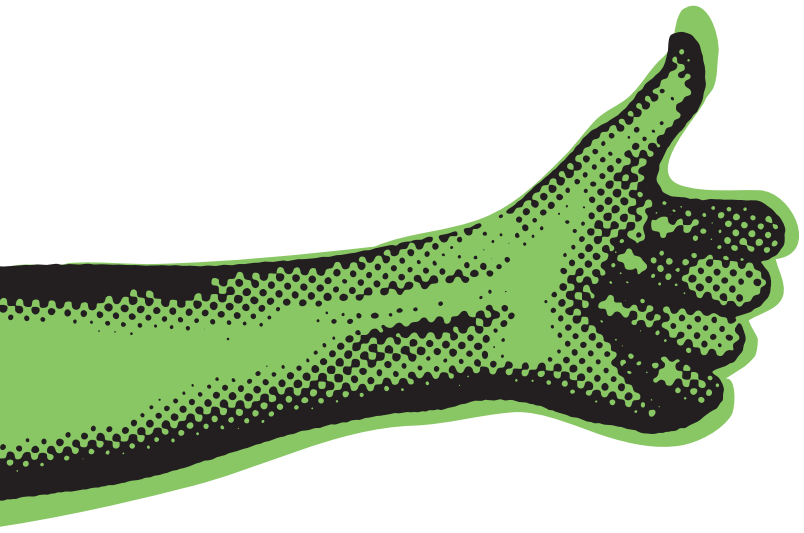
***Dear* Zymurgy,**
I enjoyed the article "My Grandfather's Crock" (Mar/Apr 2022) about old-school homebrew and have some comments based on Bill Paciesas's and my homebrewing adventures in San Diego in the early 1970s. Our hand-me-down from the Prohibition era was my grandfather's cast-iron bottle capper. He had been a grocer, and he used excess produce from the store to make fruit wines.

We had some experience using Blue Ribbon extract. My recollection is that even one 3-pound tin of the light malt extract in a 5-gallon batch would produce an amber beer. Any modern light malt extract would be too pale. We found that two tins of dark Blue Ribbon for 5 gallons made a decent (and cheap!) beer. I think it might have been reminiscent of Pabst Bock of the era. We used untreated San Diego city water, compressed whole hops that were never fresh, and packets of dry beer yeast. We fermented at ambient San Diego temperatures. I think some of our homebrew could have been very similar to the results mentioned in the article. Most of our batches used 5 to 6 pounds of extract with sugar for bottling.

The article brought back good memories, even about the times when the beer didn't quite measure up. I haven't brewed beer for over 30 years, but I did recently open a nearly 40-year-old extract homebrew. It tasted fine!

Arnie Moodenbaugh
Westhampton, N.Y.



***Dear* Zymurgy,**
Any Editor's Desk note that begins with *The Hitchhiker's Guide to the Galaxy* automatically catches my eye. As I read about Dave Carpenter's homebrewing odyssey, I thought about mine. Maybe because I started brewing about a decade earlier than Dave, I'm both a "one piece at a time" and DIY homebrewer.

I built my first all-grain system using Charlie Papazian's *Joy of Homebrewing* as my bible. Following Charlie's instructions, I fashioned a mash-tun out of two 5-gallon plastic buckets. I brewed for three years using that mash tun, an 8-gallon enamel canning pot as a boiler, and a garden hose counter-flow chiller.

As I developed my skills, I started coveting a three-tier system. Using the materials that were handy, I built a wooden, three-tier, gravity-fed keggle system, which I dubbed the "half-a-buck-a-pound" brewery. In 2004, I wrote a tongue-in-cheek article that appeared in *Zymurgy*, which compared my brewery to Randy Mosher's "buck-a-pound" brewery ("The Half-a-Buckapound Brewery," Nov/Dec 2004).

I brewed silver- and bronze-medal beers on that system. I should have kept it, but my son took a welding class in high school. He needed a project and I wanted "Big Brutus." I moved my three keggles over to Brutus, added a March pump, and brewed on Brutus for a decade.

Even 15 years ago, there were relatively few off-the-shelf homebrewing systems that didn't cost beaucoup pesos (pardon my French and Spanish). But as prices for brewing equipment became more reasonable, I finally caved—not in a big way, but I caved. That damned Blichmann RIMS Rocket is one great piece of engineering that my DIY abilities just can't replicate. I did build my own PID controller, but my brewery is no longer a DIY haven. I don't mind.

Today, I've gone to a one-keggle brew-in-a-bag system. I still use my RIMS Rocket, but Big Brutus is in mothballs. It's a sign of the times that I can't find anyone to take my old three-keggle system. But I'm not through—I have plans to further modify my system. After Zooming into the 2021 Homebrew Con's session on automating homebreweries, I bought a Raspberry Pi, learned a little Python programming, and downloaded CraftBeerPi 4. Over Christmas, I built a control box, complete with solid-state relay (SSR) controllers and have successfully navigated controlling my RIMS Rocket and pump with CraftBeerPi 4. Next, I plan to add a 240-volt heating element to an old boil keggle and buy some electrically controlled two- and three-way valves.

I will keep adding "one piece at a time" until I have a system that is automated. Just load the recipe, mill the grain, add some water, push the button and in a few hours, voilà—wort! But my system won't be a Nutri-Matic Drinks Synthesizer because I don't want to brew something that is "almost, but not quite, entirely unlike" beer.

Joe Aistrup
Auburn Brew Club
Auburn, Ala.

***Dear* Zymurgy,**
The March/April 2022 issue arrived, and I enjoyed your "Share and Enjoy" Editor's Desk piece. I consider fully automated brewing machines similar to one of those devices that attaches to the neck of a guitar to hold down four popular chords by using only one finger for each chord. I realize that different people learn in different ways, and some may need the physical help. But if you have both the physical and mental means to learn, I believe it pays to take the time and go through the entire process.

In cooking, you slice, dice, measure, and stir. When playing guitar, you work through the pain, build the calluses, and develop speed and dexterity. And unless you're a prodigy, it's going to take some time.

In homebrewing, many of the same things apply. And don't be afraid to make a mess or make mistakes. And pick up a book or two to help you learn and understand the concepts involved in the craft. Yes, there are shortcuts. But I believe taking one's time to learn the process and everything involved can only make you better. And that feeling of accomplishment, when things really start to click is priceless!

Cheers!
Mike Laemmrich
Waunakee, Wis.

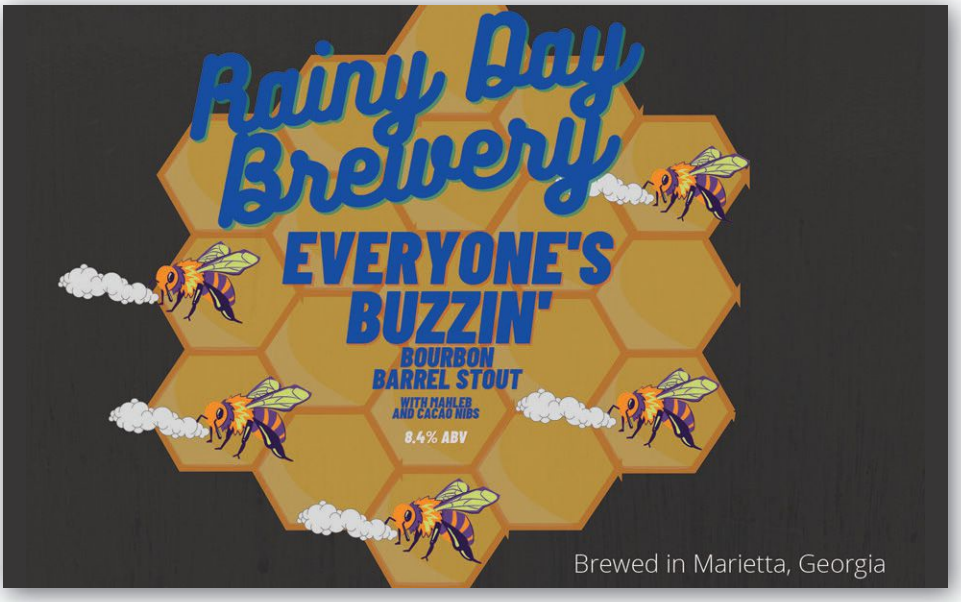
Zymurgy editor-in-chief Dave Carpenter responds: *Mike, I'm comfortable slicing and dicing, but I'm pretty sure I'd need one of those chord thingummies were I ever to take up guitar!*

DEAR *ZYMURGY*
Send your Dear *Zymurgy* letters to **zymurgy@brewersassociation.org**.
Letters may be edited for length and/or clarity.

YOUR HOMEBREW LABELS

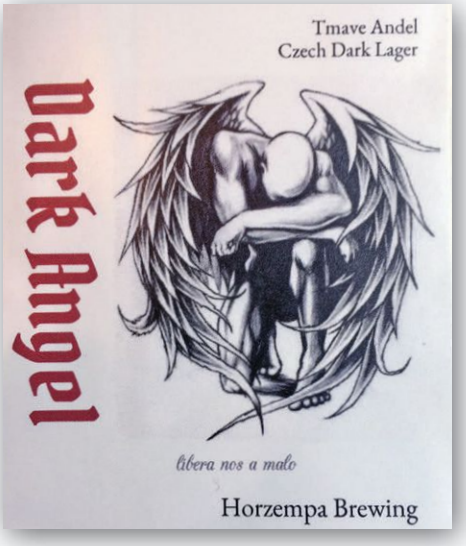
In 2016, Jorge Montero and I started this journey. We initially used a 20-liter rig and then evolved to 40, 60, and now 80 liters per batch. We lost count, but for sure we have already brewed more than 2,000 liters and enjoyed them with friends and family.

Pablo Cardenas
Homebrewer 15 years,
AHA member 1 year
YESCA BREW CO
Providencia, Chile



My brew partner Ron Mitchell and I do all our beers as a team. Several years ago, we brewed our first stout, a dry Irish stout. The beer's name had the word *Buzzin'* in it. Since then, the names of all our stouts have included that word. We had been aging an imperial stout in a bourbon barrel and decided to blend it with an American stout we had fermented on mahleb and cacao nibs. Since this was our most complex stout to date, we gave it a fitting name—Everyone's Buzzin'—and look forward to sharing it.

Michael Syrop and Ron Mitchell
Homebrewer 7 years, AHA member 6 years
Covert Hops Society
Marietta, Ga.



This label is for my husband's Czech dark lager. It is a particularly yummy beer and quite popular with our friends. We were in the Czech Republic on vacation in the fall of 2019, so I wanted to name it something that reminded us of our trip. We stayed one block off of Andel square in Prague. *Andel* is Czech for "angel," so I decided I'd call it Dark Angel, *Tmave Andel* in Czech! I made the label using Grog Tag which I like because we can reuse it.

Kathleen Horzempa
(Jack Horzempa, brewer)
Homebrewer 27 years, AHA member 5 years
King of Prussia, Pa.

Michael and Ron serving an earlier imperial stout at a cask ale festival.

SUBMIT YOUR LABEL

Do you make custom labels for your homebrew? Want it featured here in the pages of *Zymurgy* for all to see your work?

Send them to us at **HomebrewersAssociation.org/magazines/submit-bottle-label** and we will take it into consideration!

YOUR HOMEBREW EXPERIENCE

Homebrewing is all about sharing, and we get hoppy when *Zymurgy* readers share their homebrewing and fermentation experiences with us. We'd love to show the AHA community what *your* experience looks like. From 1-gallon batches on the stovetop to 20-gallon brew days on your custom sculpture, we all have fun with family, friends and pets while we make and enjoy our favorite beverage. Show us your brewing/fermentation day, who you brew with, the ingredients you include, what special processes you use, and how you enjoy the final product of beer and beyond.

Upload photos of your homebrew-related fun at
HomebrewersAssociation.org/your-homebrew-experience

This is Locust Hill Brewing Company's assistant brewer Stout, with a peanut butter chocolate stout just brewed on this half-barrel system. Cheers!

Kevin Cassidy
Homebrewer 8 years, AHA member 1 year
Rochester, Mass.

From bine to brew kettle. My own hops planted along the back fence and then put to good use in a batch of Kölsch.

Mike Ultee
Homebrewer 35 years, AHA member 30 years
Princeton Ale and Lager Enthusiast Society (PALE ALES)
Hillsborough, N.J.

My dogs Woody and Jessie waiting for me to turn my back so they can sneak a taste of the wort.

Brian Wescott
Homebrewer 6 years, AHA member 5 years
Poquoson, Va.

I always wanted a personalized license plate for my car and, honestly, what a better way to honor and celebrate my favorite hobby! Who would have thought a Mr. Beer kit for Christmas back in '08 would start such a journey? I did one batch and that was it—I was hooked. The rest, as they say, is history.

Blake Morillas | Homebrewer 14 years, AHA member 9 years
That Dam Brew Club; Brewers of Paradise | *Loomis, Calif.*

YOUR HOMEBREW EXPERIENCE

Mr. Hank the grain inspector. Every brew day he has to "help." When he's not inspecting the grain, he likes to assist by clearing the brew bench of small objects such as pens, brew notes, etc.

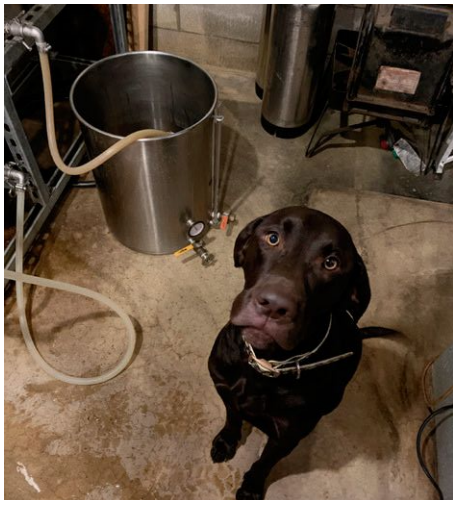
Ron Mellum
Homebrewer 23 years, AHA member 20 years
Rogers, Minn.

Here's my brew buddy, Dusty! He helps by looking cute while I do all the lifting and stirring. Today we made an oatmeal stout with cocoa.

Ben Centra
Homebrewer 6 years, AHA member 3 years
Post Modern Brewers
Medford, Mass.

June-bug, the Spinone Italiano, enjoying the lovely Bozeman, Mt., brew day.

Wyatt Cross
Homebrewer 10 years, AHA member 3 years
Bozeman, Mt.



Brew dog Wes, our Chocolate Lab, waiting for his sweet wort cleanup duty.

Mike Bernard
Homebrewer 9 years, AHA member 4 years
New Holland, Pa.

My trusty duo Maeby (white cattle dog mix) and Sir Robert Burns (Rottweiler mix) overseeing the hot break with me.

Stephen Hopkins
Homebrewer 5 years, AHA member 2 years
Spokane, Wash.

Lenny making sure we're maintaining the right temperature.

Ben Hock
Homebrewer 8 years, AHA member 8 years
Denver, Colo.

SHARE YOUR BEST HOMEBREWING SHOTS!
Homebrewing is all about fun and sharing. We would love to show others in the community what your homebrewing/fermentation experiences looks like. Upload photos of your homebrew related fun at **HomebrewersAssociation.org/your-homebrew-experience** and you may see it in the pages of *Zymurgy*!

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PROTEIN	FLAVOUR INTENSITY	HAZE INTENSITY	BODY CONTRIBUTION
Low – High	Light-Smooth – Intense	Clear – Hazy	Light – Full

Check your local homebrew store for this item

CAMEMBERT

By Gabe Toth

Camembert is a surface-ripened cheese from the Normandy region in northwest France. It is similar to brie in flavor and texture, though smaller and faster-ripening. Often described as earthy, mushroomy, nutty, and fruity, the character of a ripe camembert is largely the result of enzymes produced by *Penicillium camemberti*, a white mold that grows on the rind of the cheese and gradually transforms the cheese from the outside in. →

While the MA11 lactic acid bacteria used here will acidify the milk, the *Penicillium* will gradually transform the cheese into an oozy, funky paste. Much of this character is created by enzymes from the *Penicillium*, which belongs to a genus well known for its robust production of a variety of enzymes for different uses, also including blue cheese (*Penicillium roqueforti*) and the group of antibiotics known as penicillins. In the case of *P. camemberti*, proteolytic and lipolytic enzymes gradually break down the proteins and lipids (fats) in the cheese, creating robustly flavorful compounds in the process.

Camembert is traditionally made from unpasteurized milk. The version made in France and protected under the name *Camembert de Normandie* cannot legally use pasteurized milk. For the purposes of general availability, this recipe assumes pasteurized, homogenized milk, but if the cheesemaker has access to high-quality raw milk, it can be substituted and the calcium chloride omitted. For readers interested in learning more about raw versus pasteurized milk, I discuss the issues involved in *The Fermentation Kitchen* on pages 85–86.

I like to use a Dutch oven for cheesemaking. The heavy-duty construction offers good heat retention and good heat dispersion—it won't give you as many hot spots, which can scorch the milk, as you might get from a thin-bottomed pot. Nonetheless, even with a Dutch oven, my milk cools by about 5°F (2.8°C) over a 90-minute rest, so I'll bring the milk back up to 90°F (32°C) prior to adding the rennet. I use a small refrigerator plugged into a temperature controller to age my cheeses and charcuterie, and a humidistat to keep an eye on the ambient moisture. A curing box with a fitted lid will retain enough moisture to keep the humidity up and can be cracked or left partially ajar if the humidity gets too high.

Finally, it is important to mix the cultures and the rennet into the milk using an up-and-down motion. If these are simply added to the milk and stirred in a circular motion, the cheesemaker runs the risk of having pockets of milk or stratified layers of milk where the culture or rennet isn't equally dispersed.

HOW TO MAKE CAMEMBERT

You'll need some equipment, much of which you probably already have.

- ❍ Measuring spoons/cups
- ❍ Nonreactive pot (stainless steel or enamel Dutch oven) with lid
- ❍ Thermometer
- ❍ Long, thin metal spatula (such as an icing spatula) or similar tool for cutting curds (those who want the precise tool for every job might seek out a curd knife, widely available for purchase online)
- ❍ Slotted spoon
- ❍ 4- to 4.5-inch round cheese molds
- ❍ Drying mat
- ❍ Ripening box with lid and draining tray
- ❍ Curing chamber, temperature-controlled fridge, or other space that maintains about 50°F (10°C)

Many homebrew shops stock the necessary cheesemaking ingredients. They're also readily available online.

- ❍ 1 gal. (3.8 L) cow's milk (whole, pasteurized, and homogenized)
- ❍ 1/4 tsp. calcium chloride ($CaCl_2$)
- ❍ 1/4 tsp. MA11 cheese culture
- ❍ 1/16 tsp. (a pinch) *Penicillium camemberti*
- ❍ 1/2 tsp. liquid rennet
- ❍ 15 g salt (about 1.5 Tbsp.)

Add 1/4 cup of unchlorinated, room-temperature water to the cheese bacteria and molds (MA11 and *Penicillium camemberti*) to hydrate.

Gently bring milk to 90°F (32°C), being careful not to heat it too quickly, which could scorch the milk. Add calcium chloride while heating and whisk in. Once the milk is up to temperature, add the hydrated cheese cultures, whisking them into the milk using an up-and-down motion to fully incorporate. Let the milk rest 90 minutes. At around minute 75, low heat may be needed to return the milk to 90°F (32°C) before proceeding to the next step.

After a 90-minute rest, add 1/2. tsp rennet diluted in 1/4 cup of unchlorinated water. Mix rennet in using an up-and-down motion to fully incorporate into the milk. Let rest another 90 minutes.

After the second 90-minute rest, once the curds have coagulated and are cleanly separated from the whey (testable by performing an initial cut into the curds to see if they have knit together), use the spatula, curd knife, or another long, thin tool to cut vertically through the curd in 1/2-inch increments. Turn the pot 90 degrees and repeat the cuts, giving you 1/2-inch by 1/2-inch square curds. Turn the pot again and, rather than cutting vertically, angle your cutting tool 45 degrees and cut again at 1/2-inch increments. Turn the pot once more and cut again at diagonal 1/2-inch increments. Gently stir the curds, which will be very delicate still, to check for large masses of curd that didn't get cut.

Let the curds sit for ten minutes, gently stirring every couple of minutes to prevent

Cheese cultures ready for inoculation.

Rest the inoculated milk for 90 minutes.

Rennet promotes coagulation of the milk.

Photos courtesy of Gabe Toth

them from matting and to encourage them to release additional whey.

Place two round cheese molds about four to four-and-a-half inches in diameter onto a draining mat on a draining tray in a ripening box or other space that will allow whey to drain off the rounds. Using a slotted spoon, gently ladle off the curds into the cheese molds and let drain for at least two hours, until the curds have firmed up enough to flip the molds. After the initial hours of sitting, flip the molds and let sit for an hour. Continue flipping once an hour for five hours. The easiest way to flip the cheeses is to have an extra mat and tray to put on top of the molds, which allows the cheesemaker to put one hand under the bottom tray and one hand over the top tray, pick everything up at once, and turn it over in one swift motion.

After five hours of flipping every hour, remove the plastic molds. The curds should be consolidated and the cheeses firm enough to stand on their own. Pat them dry and evenly salt all surfaces of the cheeses. Handle gently—they will still be fairly soft. Place both rounds on a drying mat, on a draining tray, inside of a plastic ripening box. Leave the ripening box open at room temperature overnight or for up to a day, wiping out any residual moisture that accumulates in the tray. This stage will help excess moisture to evaporate and encourage the growth of the surface mold, though it won't be visible yet.

When the room-temperature rest is complete, put the lid on the ripening box and move to a space that is about 50°F (10°C) and 80 to 90 percent humidity. If the aging box begins to collect moisture, the humidity is too high, and if the cheese rind begins to dry out, the humidity is too low. Too moist an environment will allow the surface mold to form, but the layer just inside the cheese rind will age too quickly, resulting in a gap between the rind and the interior of the cheese and a rind that can slip right off of the cheese. Insufficient humidity will interfere with the growth of the *P. camemberti*.

Condition for five to seven days in the aging space, after which a layer of white fuzz should be developing on some of the cheese surface. This is the *Penicillium* gaining a foothold and starting its work. Flip the cheeses and let age for another three to five days as necessary, until white mold covers most of the cheese (it doesn't have to be completely covered). When the cheeses are mostly covered with white mold, they can be wrapped in cheese paper or wax paper and put into the regular refrigerator for another month.

The cheese is ready when the center feels soft or when it's at the preferred ripeness. Camembert will continue to ripen as it sits in the fridge, moving gradually from firmer and more delicately flavored to very soft and pungent. As with many fermented foods, "ready" is a very subjective point on a spectrum of ripeness, and it may take eating some too-fresh and some too-ripe Camemberts to determine the Goldilocks moment when it's just right. Because cutting into the cheese will interrupt further ripening, it helps to make a few cheeses at once, especially when still learning to gauge the desired level of ripeness.

MUSHROOM CAMEMBERT

This one is a real mouthful. Mushrooms do a great job playing off of and amplifying the fermentation character of the cheese, and the intensely flavored porcini mushroom, also known as the king bolete and revered in Italian cooking, is a great place to start. If porcinis seem too strong, a milder mushroom or blend of dried mushrooms can be used, including oyster mushrooms, morels, chanterelles, shiitakes, or a blend of wild mushrooms.

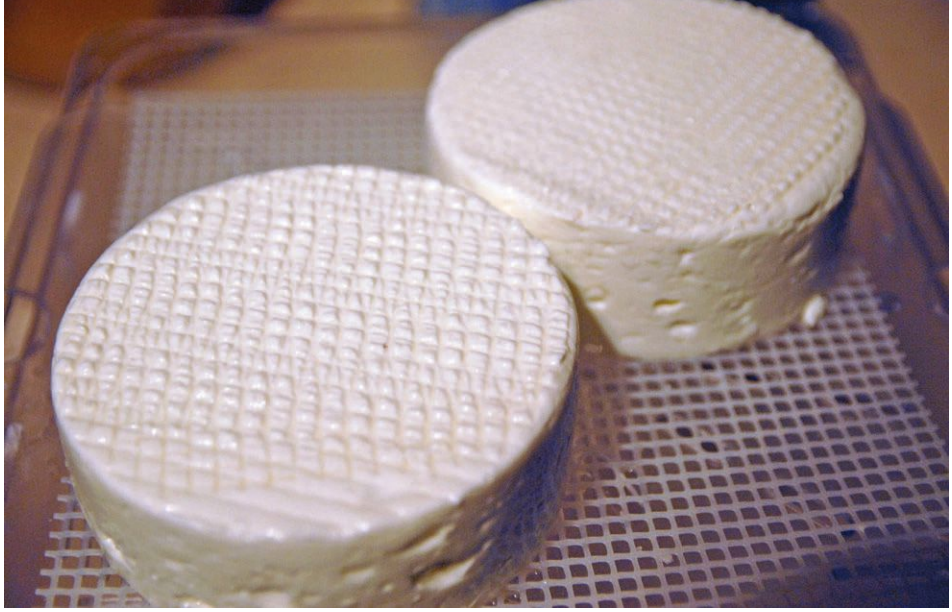
It is important to use dried mushrooms rather than fresh mushrooms since the moisture in fresh mushrooms will leach out into the cheese over time. For this recipe, they're added in two stages: half are used to infuse mushroom flavor into the milk, while the other half are broken down and added the cheese, giving it an extra bump in flavor and some visual texture.

To make mushroom Camembert, start with 0.5 oz. (14 g) of dried mushrooms. Bring a half gallon (1.9 L) of milk up to 100°F (38°C) and add 0.25 oz. (7 g) of mushrooms to infuse for an hour. While the first half of the mushrooms is steeping, buzz the second quarter ounce in a spice grinder or food processor to break down into small pieces (less than a quarter inch, or 6 millimeters, in size). After an hour, strain the mushrooms out of the milk and add the second half gallon (1.9 L) of milk. Bring the milk back up to 90°F (32°C), whisking in the calcium chloride in the process, and add the second half of the mushrooms.

Mushrooms steeping in the milk.

Cut curds with perpendicular cuts.

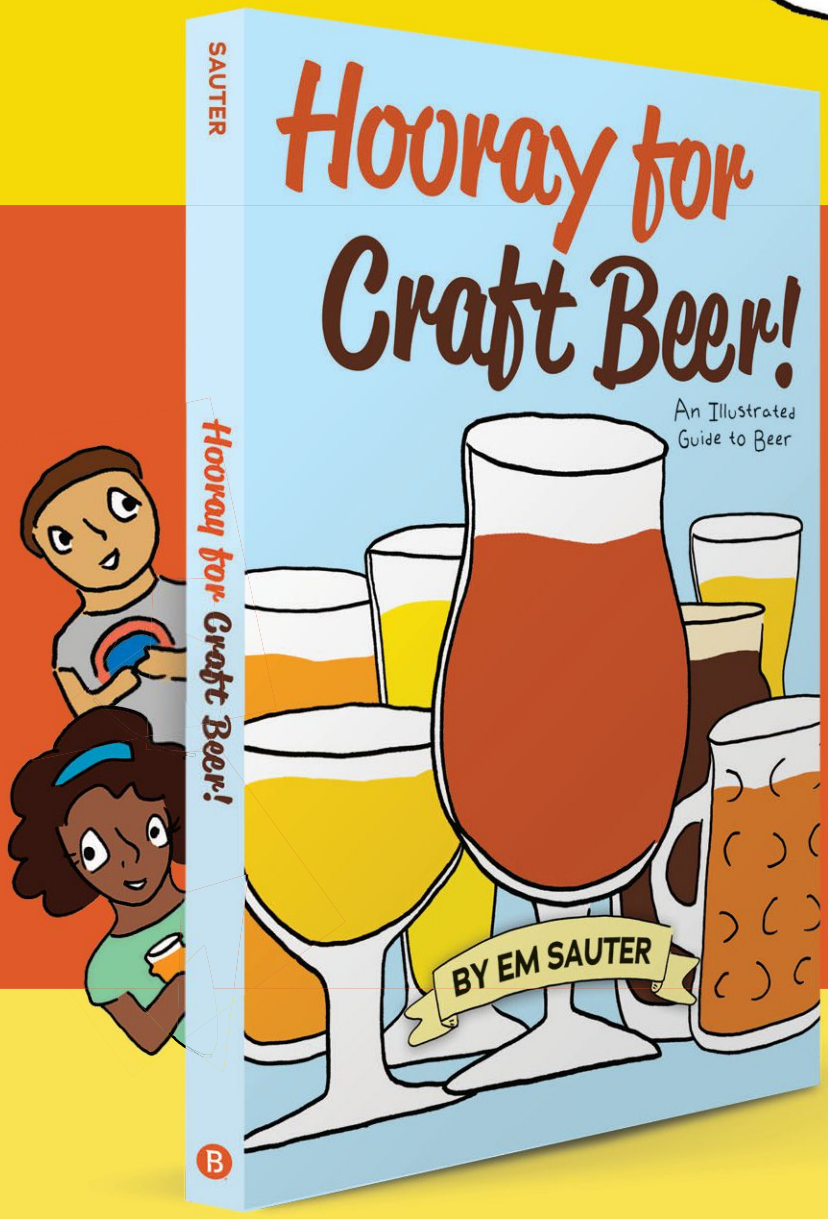
Curds pressed into molds.



Cheese ready to mature (left) and ready to enjoy (below).

Once the milk is up to temperature, add hydrated cheese cultures and continue with regular Camembert recipe above.

Gabe Toth is a brewer, distiller, and journalist in northern Colorado who has earned awards from the Great American Beer Festival®, World Beer Cup®, ADI, and ACSA. He now oversees operations at The Family Jones production distillery. Toth is author of The Fermentation Kitchen *and is a current contributor to* Artisan Spirit, Distiller, *and* The New Brewer *magazines. He holds degrees in communications and sociology and brewing and distilling certifications from the Institute of Brewing and Distilling (IBD). He has been applying his fermentation knowledge to home-fermented food and drink since 2005.*



Em Sauter's wit, humor, and whimsical illustrations take readers on an entertaining and informative journey through the history and world of craft beer.

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Brewing on a Budget

By Steve Ruch

As I stood surveying the available space in our new house, I had a brilliant flash of inspiration: I had room for a three-tier brewery! I jumped onto the internet and found a fantastic unit. I drool-ingly prepared to add it to my basket and then saw the price: more than $6,000. That figure didn't include the cost of running a 220-volt line and installing an exhaust vent with a fan. Not so brilliant after all. The natural gas option seemed to cost about the same, but it carried the added cost of running a gas line into my brew room.

I found several three-vessel systems that looked really spiffy, but the least expensive was still close to $2,000. It was time to scale back my avaricious desires.

I won't name names, but yowser, some all-in one rigs approach a couple thousand dollars just to brew 5 gallons, more for larger batches. I ruled out any system that required increasing the electrical service

to our house to accommodate a 220-volt circuit. I also eliminated several 110-volt systems that still pushed a thousand bucks. The few left were still too pricey for my budget. I wondered if it was time to start buying lottery tickets and crossing my fingers.

Feeling vaguely discouraged and unwilling to throw money at the long odds of the lottery, I lowered my expectations and proceeded to price check individual pieces of brewing equipment. I found stainless-steel conical fermenters for hundreds of dollars and plastic ones for not much less. Kegging systems went for $200 or more, grain mills for $100 and up (some way up), and top-of-the-line brew kettles for hundreds of dollars. Even plastic mash tun setups were going for nearly $200.

I added up the cost of the a-la-carte components and spent 20 minutes catching my breath. What must a curious wannabe homebrewer think? And how many new homebrewers has our hobby lost to sticker shock?

Fortunately, you don't need to spend thousands of dollars to brew great beer at home. Homebrewers are a clever lot, and all it takes is a little planning to turn out excellent homebrew without breaking the bank.

EXTRACT BREWING AND NO-BOIL KITS

Before you shop for equipment, first consider how you'd like to make wort: extract only, extract with specialty grains, partial-mash, or all-grain. New homebrewers almost always used to start brewing with malt extracts, and it's still a great way to start with minimal equipment outlay.

Here are some representative pre-tax costs for some of the basic equipment a new brewer might need to purchase to brew 3-gallon batches:

- ❏ $30 for a 5-gallon brew pot, available at most homebrew shops and big-box retailers for under $30
- ❏ $4 for a long-handled spoon
- ❏ $7 for a hydrometer (optional but recommended)
- ❏ $11 for a 5-gallon food grade bucket with lid can be found at Lowes
- ❏ $3 for a stopper and airlock
- ❏ $6 for a five-pack of hop bags
- ❏ $12 for a bottling bucket
- ❏ $4 for a racking cane and 5 feet of tubing
- ❏ $25 for two cases of bottles (or just drink some craft beer and reuse the empties)
- ❏ $2 for a bottling wand
- ❏ $3 for 144 crown caps
- ❏ $13 for a wing capper

Steve's Sterling Pilsner

Pilsner, 100% malt extract

Batch volume: 3 US gal. (11.4 L)
Original gravity: 1.050 (12.4°P)
Final gravity: 1.008 (2.1°P)
Color: 4 SRM
Bitterness: 35 IBU
Alcohol: 5.6% by volume

EXTRACT

3.3 lb. (1.5 kg) Briess Pilsner dried malt extract

HOPS

0.66 oz. (19 g) Sterling hops, 9% a.a. @ 30 min
0.2 oz. (6 g) Sterling hops, 9% a.a. @ 10 min

YEAST

1–2 packs Fermentis SafLager W-34/70

ADDITIONAL ITEMS

Pinch Irish moss @ 15 min
3.5 oz. (100 g) corn sugar to prime

BREWING NOTES

Thoroughly clean and sanitize all your equipment. Place the two hop additions in two separate hop bags. Heat 3.5 gal. (13.25 L) distilled water to 160°F (71°C). Distilled water works well with extracts and eliminates the need to treat the water for chlorine. Remove pot from heat and, using a long-handled spoon, thoroughly mix in the Pilsner dry malt extract (DME). Return the pot to the heat and bring the wort (unfermented beer) to a boil. Add 0.66 oz. (18.5 g) Sterling hops and boil 20 minutes. Add 0.2 oz. (5.6 g) Sterling hops and boil 10 more minutes. Boil time is 30 minutes because a longer boil would darken the resulting beer more than I want. Remove hops and chill wort by immersing the pot into a large tub of cold water, or seal around the pot and lid with plastic wrap and leave it overnight. Transfer to fermenter. Add 2 packs of W-34/70 if you've achieved a wort temperature in the low to mid 50s °F (10–13°C) If you don't have temperature control, you can pitch 1 pack of W-34/70 and still get good results in the mid to upper 60s °F (17–20°C). Ferment 3 weeks, optionally monitoring specific gravity with a hydrometer. When fermentation is complete, add priming sugar, bottle, and hold bottles at room temperature for two weeks. Chill and enjoy.

If you use a no-boil Pilsner kit that contains hopped extract, simply heat water enough to mix in the extract, chill, and pitch the yeast.

> “It was time to scale back my avaricious desires.

This adds up to $120 plus tax. Prices can vary widely, so shop around. You may already have some of these items in your kitchen, like a 5-gallon pot and a long-handled spoon. If you're brewing with extract exclusively, a hydrometer is not strictly necessary as the original gravity is simple to compute just by knowing how much extract and water are in the recipe. A wort chiller ($60 or more) is also helpful, but it's not always necessary, particularly if you brew a concentrated wort and top up with cold tap water.

See the accompanying recipe for Steve's Sterling Pilsner for an easy extract-only option.

Festivus Festbier

Festbier, malt extract with specialty grains

Batch volume: 3 US gal. (11.4 L)
Original gravity: 1.049 (12.2°P)
Final gravity: 1.009 (2.3°P)
Color: 8 SRM
Bitterness: 20 IBU
Alcohol: 5.3%

MALT EXTRACT

3 lb. (1.36 kg) Briess Pilsner DME

STEEPING GRAINS

6 oz. (170 g) Munich malt, 10°L
4 oz. (113 g) Vienna malt
1 oz. (28 g) Weyermann Carafa I malt

HOPS

1 oz. (28 g) Tettnanger, 3% a.a. @ 45 min

YEAST

2 packs Fermentis SafLager S-189

ADDITIONAL ITEMS

Pinch Irish moss @ 15 min
3 oz. (85 g) corn sugar to prime

BREWING NOTES

Thoroughly clean and sanitize all your equipment. Place milled specialty grains in a grain bag and the hops in a hop bag. Add 3.75 gal. (14.2 L) distilled water to brew pot, add bag of specialty grains, and heat to 170°F (77°C). Remove specialty grains. Using a long-handled spoon, thoroughly mix in DME and heat to boiling. Add hops and boil 45 minutes. Turn off heat and remove hops. Seal around the pot and lid with plastic wrap and let cool overnight. Transfer to fermentation vessel in the morning and pitch yeast. Mix in priming sugar and bottle after three weeks. Leave bottles at room temperature for three weeks. Chill and enjoy.

BREWING FROM EXTRACT WITH SPECIALTY GRAINS

The only additional equipment needed to add specialty grains is a scale (around $21) and a nylon grain bag (about $4), for an additional outlay of $25. That brings the grand total to $145 plus tax. A hydrometer is recommended at this point if you haven't already purchased one.

You may be asking yourself, “Why should I increase my cost and workload by throwing specialty grains into the mix since I'm already brewing pretty good beer with extract?” This is a good question with a simple answer.

A lot of homebrewers start out with extract, and many are satisfied to stick with extracts only. But adding specialty grains to extract opens up the possibility of brewing far more styles of beer than you can with extract alone. It's a nice step up with only a small cost and not that much extra work for the gain.

Furthermore, steeping a little malt in your extract-based wort introduces fresh malt flavors and aromas that may be harder to achieve with extract alone.

See the accompanying recipe for Festivus Festbier for a beer that adds complexity with the addition of specialty grain.

PARTIAL-MASH BREWING

Partial-mash, or mini-mash, brewing involves mashing a small amount of base malts—usually 1 to 3 pounds—along with the specialty grains and then augmenting with malt extract.

You may be able to use your tap water without modification, but most brewers will at least want to filter out chlorine. An inexpensive Brita water filter will set you back about $25, which brings the total to $170. You'll also need to factor in the time spent treating your water.

Once again, the question comes up: why spend more money and prolong your brew day? Using base malt with specialty grains adds additional complexity to your beer and makes it possible to incorporate unmalted and flaked grains like flaked barley, oats, wheat, triticale, or rye.

You can now add styles like cream ale, Irish stout, and most other styles to your recipe file. While mini-mash is a step up, no one will think any less of you if you decide extract with specialty grain works for you. I spent almost three years in a living situation that restricted me to extract with specialty grains, and I would have happily kept to it had I not moved.

Brew up Three S Amber to see how a partial mash can introduce a grain that requires mashing, in this case Vienna malt,

Bag Of Grains

Stout, all-grain

Batch volume: 3 US gal. (11.4 L).
Original gravity: 1.055 (13.6°P)
Final gravity: 1.018 (4.6°P)
Color: 32 SRM
Bitterness: 33 IBU
Alcohol: 4.9%

MALTS

7 lb. (3.2 kg) pale ale malt
8 oz. (227 g) roast barley
4 oz. (113 g) Weyermann Carafa II malt

HOPS

0.4 oz. (11 g) Nugget, 14.2% a.a. @ 45 min

YEAST

2 packs Muntons ale yeast

ADDITIONAL ITEMS

3.5 oz. (100 g) corn sugar to prime

BREWING NOTES

Thoroughly clean and sanitize all your equipment. Add hops to a hop bag and place milled grains to a grain bag. Heat 3.5 gal. (13.25 L) filtered water to 165°F (74°C), add the grain bag to the pot, and make sure the grains are thoroughly wet with no dough balls. This should reduce the temperature to about 152°F (67°C). Insulate the pot. After 45 minutes remove the grain bag and, holding it over the pot (I use a colander), pour 2 qt. (2 L) of water over the grains to rinse additional sugars. Squeeze the bag after giving the water 5–10 minutes to run through the grains. Heat the wort to boiling, add hops, and boil 45 minutes. Turn off the heat and remove the hops. Seal the lid and pot with plastic wrap and let cool overnight. In the morning, transfer to the fermenter and pitch yeast. Mix in the priming sugar and bottle after two weeks. Leave bottles at room temperature for two weeks to carbonate. Chill and enjoy.

for character you can't get from extract and steeping grains alone.

ALL-GRAIN BREWING

All-grain brewing gives you complete control over the finished beer. You can spend as much as you like, but to simply and affordably ease into all-grain, just brew smaller batches and use a brew-in-a-bag (BIAB) method with your existing boil kettle. You'll need a larger grain bag, which might cost about $7, for a grand total of $177.

Many homebrewers consider all-grain brewing the absolute pinnacle of brewing, the ultimate brewing experience. That might be debatable, but what makes the upgrade to all-grain brewing worth the additional time, cost, and effort is gaining complete control over the entire brewing process.

There's no uncertainty over what variety of base grain went into the production of the extract, what mashing regimen was used, or what minerals were in the water used in the extract. You can make every style of beer using all-grain methods. I'm happiest when I brew all-grain, but I have no hesitation if time or space limitations lead me to brewing with any of the other methods.

THE CHOICE IS YOURS!

I hope this review of four *affordable* approaches to homebrewing helps you find a beer-making method that suits your available funds, time, space, and energy. Consider the cost of the equipment involved and the effort that each method takes to guide your decisions (or those of your inquiring friends).

You can spend whatever you can afford on whatever shiny gadgets catch your eye, but you don't have to break the bank to brew tasty beer at home.

***Steve Ruch lives in Fort Wayne, Ind., and is a regular contributor to* Zymurgy.**

Three S Amber

Amber ale, partial-mash

Batch volume: 3 US gal. (11.4 L)
Original gravity: 1.058 (14.3°P)
Final gravity: 1.012 (3.1°P)
Color: 14 SRM
Bitterness: 39 IBU
Alcohol: 6.1%

GRAINS

2 lb. (.9 kg) Briess 2-row
8 oz. (224 g) Briess crystal 80 malt
6 oz. (168 g) Briess Carawheat malt
6 oz. (168 g) Briess Goldpils Vienna malt

EXTRACT

2 lb. (.9 kg) Briess Golden Light DME

HOPS

0.125 oz. (3.5 g) Summit, 14.2% a.a. @ 45 min
0.125 oz. (3.5 g) Simcoe, 12.2% a.a. @ 45 min
0.75 oz. (21 g) Saphir, 3.8% a.a. @ 45 min
0.75 oz. (21 g) Saphir, 3.8% a.a. @ 6 min
0.5 oz. (14 g) Saphir, hop stand

YEAST

1 pack Lallemand BRY-97

ADDITIONAL ITEMS

Pinch Irish moss @ 15 min
3 oz. (85 g) corn sugar to prime

BREWING NOTES

Thoroughly clean and sanitize all your equipment. Put 0.125 oz. (3.5 g) Summit, 0.125 oz. (3.5 g) Simcoe, and 0.75 oz. (21 g) Saphir in hop bag 1. Put 0.75 oz. (21 g) Saphir hops in hop bag 2. Put 0.5 oz. (14 g) Saphir in hop bag 3. Place the milled grains in a grain bag. Heat 3.75 gal. (14.2 L) filtered water to 160°F (71°C) and add the grain bag to the water, making sure all the grain is wet with no dough balls. The temperature should fall to about 152°F (67°C). Insulate the pot. After 45 minutes, remove the grain bag (squeeze the grain bag over the pot) and, using a long-handled spoon, thoroughly mix in the extract. Bring to a boil and add hop bag 1. Boil 39 minutes, add hop bag 2, and boil 6 more minutes. Turn off heat and remove hops. Add hop bag 3 and let steep 15 minutes. Remove hop bag 3 and seal around the pot and lid with plastic wrap. Let wort cool overnight, transfer to fermenter, and pitch the yeast. Mix in the priming sugar and bottle after three weeks. Leave bottles at room temperature for 2 weeks. Chill and enjoy.

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Rapid-Fire Tips for the Short-Attention-Span Homebrewer

By Ron Minkoff

If you brew long enough, you'll eventually be surprised at how many bits of homebrew wisdom you've accumulated. What follows here is a vetted collection of some of the most useful techniques, in quick-tip form, never watered down, that are easy to explain and may even be instantly helpful to you. I, as well as several of my fellow Hogtown Brewers buddies, have long used these tips. Let's open a can of concentrate and get started!

STUCK FERMENTATION? BEANO TO THE RESCUE!

I think we've all been there. Your batch has completed fermentation, but its current final gravity is 4, 6, maybe 10 points from the desired final gravity. Sure, you could rouse the yeast. Or perhaps raise the temperature to try and squeeze a little more effort out of your yeast. But if the gravity doesn't change (and many times it won't), now what? Well, you're likely out of fermentables. That's why it's stuck. Just add some Beano to your carboy. Yes, *that* Beano! Just add one crushed tablet per additional gravity point.

If you need to lower your final gravity, consider using Beano.

Beano contains amylase, which breaks down unfermentable sugar and makes it fermentable. Can you buy amylase from your local homebrew shop? Yes, yes you can. But Beano is sold everywhere making it very accessible. That makes Beano a true multi-tasker. It reduces the final gravity of your batch and saves your relationships on burrito night!

NO MORE CLOUDY STAR SAN SOLUTION

Like me, you probably keep a spray bottle of Star San solution around because it's handy for all kinds of homebrew tasks. But Star San solution is known for becoming cloudy after a short time, especially if you have hard water. To keep your solution clear, simply use distilled (or reverse osmosis) water instead of tap water. Do this, and it will easily stay clear for many months to come. (Tip courtesy of Hogtown's Master-Dr-Irish George)

Use distilled water for your Star San solution to keep it clear.

Bonus tip: I also keep a half-gallon jug of Star San distilled water solution for post-brew-day tasks. The proper mix is half a gallon of distilled water to 0.6 teaspoons (3.0 mL), or a heaping half-teaspoon, of Star San.

QUICK AND EASY REMOVAL OF BEER BOTTLE LABELS

You're ready to bottle your best stuff for an upcoming homebrew competition and need some pristine bottles without labels. A quick and reliable way to remove labels from most bottles is to soak them in a solution of your favorite alkaline non-caustic cleaner (e.g., PBW, Bru-R-Ez, Cell-R-Mastr, etc.). Do this and you'll find the labels fall off the bottle within two hours (maybe even just one hour). You're welcome.

Use a solution of alkaline non-caustic cleaner to quickly remove bottle labels.

THE RIGHT WAY TO OPEN A BAG OF WEYERMANN MALT

Since I brew often, I tend to buy full bags of base malt (pale malt, Pilsner, Munich, etc.). Rahr bags of malt are incredibly easy and intuitive to open. If only all bags opened that way! But bags of Weyermann malt are almost as easy to open if you know how to properly start that process. First, choose the side where the white string ends. Then cut the red and white "tangled" string near the edge of the bag. Then grab the tip of the white string and pull across to open it all up. That's one less hassle for you!

Cut and pull the white string to easily open bags of Weyermann malt.

PITCH YEAST THE NEXT DAY

Many homebrewers strongly believe pitching yeast the same day you brew is very important. However, I long ago figured out that pitching yeast the next day is perfectly fine and offers the same quality of fermentation, if not better. It also provides several advantages. Pitching the next day has been my standard homebrewing process for more than 10 years, and as long as you practice appropriate sanitation (and don't sneeze in your carboy), all is good! Why do it? There are several reasons:

Pitch yeast the next day to save time and resources.

1. It saves ice (when chilling wort). Chill your wort as low as your tap water will allow, and then let your fermentation temperature control system finish the job overnight. By morning of the next day, the wort will be right at your desired pitching temperature.
2. It saves the hassle of procuring ice! This also saves the hassle of setting up a two-stage chiller, which we all can agree is a hassle, right?
3. Best of all, it saves time on brew day.

Make your own alkaline non-caustic cleaner

You may be thinking, "I really like having alkaline non-caustic cleaner handy, but I'd like it even better if I had a good coupon!" You're in luck because you can make your own. Here's how. Mix the following:

1. 10 ounces (285 g) Seventh Generation Dishwasher Detergent Powder, Free and Clear
2. 16 ounces (454 g) Red Devil TSP/90
3. 24 ounces (680 g) OxiClean Free (make sure to get the "free" one with the green lid, which has no dyes or perfumes).

Enjoy your abundant supply and savings! (Shout-out to Hogtown's Joe Gullett for doing the research of other people's research!)

JUST-IN-TIME YEAST STARTER

Typically, we make yeast starters by buying a bag of dried malt extract (DME), adding it to water to make starter wort, boiling the starter wort to sanitize, and then cooling the starter before finally adding yeast. Well, if I've convinced you that pitching yeast the day after brewing is okay, then you can streamline a big part of the yeast starter process. Simply do this:

Make a starter with your brew day wort and pitch the next day.

1. Just after chilling your wort on brew day, remove a portion of it to a starter flask (no DME needed!).
2. Dilute the wort in the flask to a gravity between 1.035 and 1.040 (8.8–10°P). Bottled water works great for this.
3. Add your yeast and place the flask on a stir plate (or do the shaken-not-stirred method if that's your thing).
4. The next day, pitch the entire volume of the starter into your carboy at high kräusen, which is generally the best time to pitch a starter anyway.

How do you know how much wort to collect and how much water is needed to dilute it? Simply use your brewing software's dilution calculator. For example, say you brewed a batch with an OG of 1.060 (14.7°P) and you want to make a 1.5-liter starter. Your calculator will tell you to siphon off 900 milliliters of wort and dilute it with 600 milliliters of water to make a 1.036 (9°P) starter.

USE A 40-CENT "MINI-ME" FAUCET TO DISPENSE AT EVENTS

Long ago, I figured out that using a typical 5-foot (1.5-meter) picnic faucet to dispense homebrew at a festival is not ideal. For one thing, if any significant time elapses between dispensing samples, the beer sits in the line and gets warm. Plus, it drapes awkwardly over your keg, and you have to keep leaning down to pick it back up for the next sample.

Use a shortened picnic faucet line and PVC elbow to make a portable dispenser.

Some may opt for a jockey box, but I prefer something simpler. You can buy a stainless-steel ball lock tap faucet, which will solve the problem for about $30 or more. But if you have an unused picnic faucet line, you can rig a simple faucet for about 40 cents. Simply reduce the line from 5 feet (1.5 meters) to about 6 inches (15 centimeters), add a cheap 1-inch diameter PVC pipe elbow to angle your line upwards, and you're set!

THE FRENCH PRESS IS NOT A ONE-TRICK PONY

I'm a big fan of coffee beers, and I often make homebrews with coffee. My preferred method for infusing beer with that java kick is to use cold brewed coffee. I've seen a number of recipes that recommend steeping coffee in a jar and then filtering it through a coffee filter or cheesecloth. This is too complicated and messy. Your quality of life spikes if you simply use a French press for this job. Normally you'd use hot water with a French press, but it makes a great cold brew as well. And because of the built-in filter, filtering is a breeze.

Infuse coffee (and more) into your homebrew with a French press.

The amount of coffee to use naturally depends on your beer's style and the strength of your coffee. A good starting point is 1 cup of beans (about 3 ounces or 85 grams) for a 5-gallon (18.9-liter) batch. Use twice as much water, by volume, as you do coffee beans to prepare the brew.

For example, grind 1 cup of beans into a French press and hydrate with 2 cups (just shy of 500 milliliters) of bottled or filtered water. Close the lid, cover the top of the French press with aluminum foil, and sit it on your counter for at least 12 hours. Filter the cold-brewed coffee by slowly pressing the plunger, pour it into a small pot, and heat it to 165°F (74°C) to pasteurize. Then, simply pour the coffee into a keg and rack your beer on top of it. Or pour it into beer that's already been kegged and stir it very gently with a sanitized stirrer.

Bonus pony trick: Use your French press as an instant hop Randall by filling it with leaf hops. Steep your homebrew in it and gently press down on the plunger before pouring into your pint glass.

HYDROMETER PAPER TOWEL DAB

This tip comes courtesy of Hogtown-Fry-Daddy Bill Edwards. When you take a gravity reading with your hydrometer, it's good to agitate it to degas any CO_2 and ensure an accurate reading.

Absorb the foam in your hydrometer jar with a paper towel for a quick read.

Photos courtesy of Ron Minkoff

But this causes foam to form, and you often need to wait several minutes for the foam to dissipate before you can properly read the hydrometer. If you're impatient, just take a paper towel, soak up the foam, and go read that gravity now, not later!

DIRTY FLAMES FROM YOUR BURNER? CLEAN OUT THAT CARBON

Here's another tip from Bill Edwards. If you use a burner that is similar to a Bayou Classic burner, over time you'll start getting dirty flames out of it. The flame will be orange, and the bottom of your kettle will get black carbon marks. There's an easy way to clean that up, though. Unscrew the burner from the frame and then get a tiny drill bit that will fit inside each of the burner's flame holes, probably a 5/64-inch bit. Attach the bit to a drill and

Use a drill and soft hammer to clean your burner.

drill inside each of the burner flame holes. This will scour the carbon stuck inside. Next, flip the burner upside down and with a soft hammer, vigorously pat the back side of the burner. You will be impressed with the large ant-hill pile of carbon that comes pouring out of your burner. After that, reattach the burner to its frame and clean blue flames are in your near future.

STUCK SPARGE? GRAB YOUR CO_2 TANK

The stuck sparge can easily derail an otherwise smooth brew day. To get the wort flowing again, first confirm that rogue grains haven't collected in your mash tun's ball valve. If so, clean that out and enjoy the rest of your brew day.

If you have a stuck sparge, CO_2 is your friend.

If the blockage is inside the mash tun, though, bring out the big guns, i.e., your CO_2 tank. Gently back flush the mash tun tubing with carbon dioxide to clear the tube. If that doesn't work, then don't be so gentle. This tends to take care of the majority of stuck sparges and is much better than emptying out your mash tun.

HOMEBREW CLUB HARMONY WITH "BACON!"

Homebrew club gatherings are meant to be fun oases away from the acrid stress of the outside world. Chattering about favorite styles, how tasty the beer is, what hops you used, and the best band to jam to on brew day are all fair game! But there's always that one person who has to rant on a hot-button topic because they just can't help themselves. The rant may be on politics, or gossip, or—no, it's usually politics. Everyone around them starts rolling their eyes and awkwardly waits for them to be done.

The antidote to hot-button chatter is "Bacon!"

If this happens to you, do what we do: immediately talk about bacon, your love of bacon, the über-amazingness of bacon, and so on. Everyone around you will join in to drown out the sourpuss, and you can all move on with your lives. This tactic has been our go-to standard safe-word strategy in the Hogtown Brewers homebrew club for quite a while now. We don't mind sharing it.

EASY TEMPERATURE CONTROL FOR BREW-IN-A-BAG

This tip is probably obvious to experienced brew-in-a-bag (BIAB) homebrewers, but I'm throwing it in for the newbies: If you're a foo-foo home chef (I wear that badge myself), you probably own a sous vide circulator. And, if BIAB is your method of choice for homebrewing, then you have the right equipment for easy temperature control in your BIAB mash tun. That qualifies the sous vide as an Alton Brown multi-tasker.

Use a sous vide circulator to regulate your BIAB mash temperature.

GET YEAST FROM YOUR NEIGHBORHOOD BREWERY

Our final tip comes from my buddy John Denny, who co-owns a beer factory down here in Gainesville Fla., First Magnitude Brewing.

Are you out of yeast, or not in the mood to pitch a starter? Develop a relationship with your local brewery. Breweries routinely produce more yeast than they need, especially of the Chico strain. If you ask nicely, give them plenty of advance notice, and show up with a sanitized container, your local brewer will often reward you with a healthy slurry of vigorous yeast for your next batch. Nice perk! For those of us who want to keep homebrewing as just a hobby, this illustrates why breweries are like boats. I don't want to own a boat. I just want a friend who owns a boat.

Make friends with your local brewery and get rewarded with complimentary yeast.

That's it for this can of quick-tip concentrate! I hope some of these bits of wisdom prove useful for your next batch of liquid bread, spike your brewing quality of life, and elevate your homebrew success!

Ron Minkoff has been brewing in the comfort of his driveway since 2003. He is a past president of the Hogtown Brewers (2016 Radegast Club of the Year) and a BJCP certified judge who rarely turns down the offer of a bacon-based dish.

WHY I BREW WITH BRIESS

When we asked Alec at Founders Brewing Co. why he brews with Briess he replied, **"To make the highest quality beer we need the highest quality of malt, and we know we can get that from the Briess malt coming out of Wyoming."** This is why we carefully monitor our barley supply chain from grower to brewer to ensure you **get the highest quality and most consistent specialty malt every time.**

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PLANNING A BREWERY ROAD TRIP

By Cody Gabbard

The first time I attended the Great American Beer Festival (GABF), I was so overwhelmed and excited I tried to sample as much as possible. The first hour was spent worrying about where to start, the second realizing I was not going to sample nearly as many beers as I had hoped, the third incoherently speaking into my recorder for the article I was working on, and the fourth barely even looking at the brewery names listed above the booths before having my glass filled. Suffice to say, it was still enjoyable, but quite stressful, and my article consisted of a mish-mash of half-remembered tastings.

The next time I attended, I highlighted all of my "must-see" breweries in my program and carved out some time to look for trends and revisit breweries that were pouring beers that adhered to those parameters. Knowing the last hour or so is pretty much a wash, I put down the notepad, met up with some friends, and just enjoyed the rest of the experience as a group. I didn't drink nearly as much as I had the year before, but the overall experience felt much more genuine, and I accomplished my pre-festival goals.

These experiences have helped shape how I plan for more extended tastings—brewery road trips. Without a plan, the whole trip can feel just as overwhelming as that sea of people and booths at GABF and similar festivals. So, to reduce stress and make the most of my trips, I now follow a set of basic guidelines. My main tenets are **Have a Focus, Plan Ahead, Avoid Burnout,** and **Finish Strong**. The following is a summary of those tenets →

and some considerations I've made for an upcoming trip through Oregon.

HAVE A FOCUS

This may seem like a silly statement (drink great beer, of course!), but it really does help to narrow your list when planning. With more than 9,000 breweries in the U.S. alone, choice is not at a premium. Having a focus will help you get over your fear of missing out, especially since you've likely not been able to visit nearly as many breweries in the past several years as you'd like.

Years ago, I toured the Northeast, starting in Washington, D.C., and driving through Pennsylvania to New Hampshire. I probably could have stayed in any number of cities along the way and enjoyed their plethora of breweries, but at the end of the day I really wanted to visit venues I had never heard of. I was also itching to get away from the hustle and bustle of the city, so I further narrowed my focus to areas with good hiking trails.

Even if your goal is as simple as wanting to drink the best West Coast IPAs in your state or relax at places with great outdoor venues, this really helps in the planning stages when you have to make hard decisions and choose between multiple breweries and routes. For my upcoming trip, I'm focusing on going to breweries I've never been to that are along a route that will take me through the Painted Hills of Oregon for some hiking. I'll also have my dog in tow, so if it's not dog-friendly, it's on the skip list.

PLAN AHEAD

Again, this seems like an obvious necessity, but there are some unique considerations when you're planning a trip around alcoholic beverages, especially if you'll be driving. This is a good place to note: if you will be drinking and then driving between breweries, under no circumstances get behind a wheel if you've had (or even *think* you've had) too much to drink. Breathalyzers are available for under $50 nowadays, but in my opinion, if you have to test yourself on a breathalyzer, then you shouldn't consider driving anyway. Now, onto the fun stuff.

Because driving can be dubious, sticking with a single general location each day really is the way to go unless you're spacing your visits out by several hours. If I'm looking to hit a few breweries in a single day, I either start fairly early around lunch and then wait to drive to the next location for dinner. Otherwise, I like to stick to a single location and use a ride share or taxi to reach multiple spots. During my Northeast trip years ago, I specifically chose Burlington, Vt., as one of my stops because I could hit up several breweries in one day, all within walking distance of each other and my lodging.

If you're going to use a ride share or taxi service, identify one ahead of time. Ride shares are actually banned in certain parts of the country, and are even more limited abroad, so check your apps for available locations beforehand. When I lived in Longmont, Colo., in the mid '10s, Uber and Lyft had yet to be made available, and I'm pretty sure the "taxi service" consisted of a single person who kept irregular hours. Back then, visiting a mecca of old-school beer titans in Oskar Blues and Left Hand and emerging Boulder-area breweries would have been difficult to manage by vehicle.

For my upcoming trip, I plan on hiking each morning and then finishing at a brewery in the late afternoon or evening. That way I'm in one location for all of my tasting. Since I haven't been to any of these breweries before, just pulling up a stool and going through their full offerings sounds a lot more enjoyable than bar hopping and only getting a sample at each destination.

I don't go crazy with gear, but a few key items can make a huge difference in comfort level. Having backup water bottles is always a good idea, especially when you don't know when that next rest stop is coming up (and if the vending machine will accept tattered dollar bills). Ensure you have the right apps, too. Some cities may have one service and not the other, so downloading a few ride-share apps (Uber

Ellie, Oregon coast.

and Lyft) and lodging (HotelTonight and Airbnb) may be needed. I like to add some side trips into my schedule, so AllTrails is a great app for hiking enthusiasts. And if you are using apps, take advantage of any features that allow offline use, such as downloading maps beforehand since mobile network service could be variable. Hard copies of directions could be helpful in remote areas, or you might even dust off that old road atlas your parents made you purchase years ago.

If you're collecting or transporting food and beverages, get a cooler. Springing for a better-insulated (and eco-conscious) one is worth the extra bucks in my opinion, as you'll get a ton of miles out of it. I'm sure there are also great commercially available ice packs out there, but if I'm going on a trip, I just save up on those reusable ice packs that are ubiquitous with the mail order meal kits that many of us have used (at least for the two-week trial period) in the last few years. They come in all sizes and can also be handy if you're a brew-in-a-bag (BIAB) mini-batch brewer like me who cools your kettle in the sink!

In my early 20s (and admittedly my early 30s), I was all about budget, so I was happy to shack up at the cheapest youth hostel. Nowadays, especially with COVID-19, I'm more reluctant to share my quarters, so house rentals and hotels are my preferred lodging choice. It can be easy to say, "I'm going to camp every night and then stay at a hostel when I hit the cities," but after an evening of drinking imperial stouts, that weathered tent or shared bathroom becomes less bearable. And if you aren't comfortable, you aren't having fun.

> "IF YOU AREN'T COMFORTABLE, YOU AREN'T HAVING FUN.

We all have our limits, so just know yours, and maybe treat yourself to nicer lodging as you go along, and save camping for the beginning of the trip when your optimism hasn't yet been dashed by unpredictable weather. And speaking of limits, be honest with yourself about yours.

AVOID BURNOUT

Could you reasonably visit three breweries a day for a full week in a different city each day? Would it even be fun at that point? Think about this when planning. What's your driving limit or the point at which you start to get restless? I know if I have to drive more than three hours, I'm going to be tired and irritable, so visiting that bucket list brewery at the end of the drive may lose a bit of its luster. For that reason, I either sprinkle in some activities along the way, or I just skip visiting a brewery and consider it a travel day. I also know the return on consecutive drinking days diminishes rapidly for me.

Knowing this, I front-load my visits with more breweries. Maybe you're the opposite and like to build up to more visits, but either way, make a conscious effort to

FIGURE 1:
It's helpful to plan ahead with a list of target venues, hours of operation, and special considerations.

DAY	VENUE	LOCATION	DISTANCE (HRS)	DOG-FRIENDLY?	OPEN / CLOSE TIMES
FRIDAY	Oak Creek Dimple Hill (hike)	Oak Creek Dimple Hill Trailhead	1.75	Y	
	Viking Braggot (late lunch)	2490 Willamette St., Eugene, OR	1	Y	Mo-Fr 3-9, Sa-Su 12-9
	Draper Draft House (dinner)	640 SE Jackson St, Roseburg, OR	1.25	Y	Mo-Sat 3-11 / Sun
SATURDAY	Spencer Butte (hike)	Spencer Butte Park	1.25	Y	
	3 Legged Crane	48329 E 1st St., Oakridge, OR	1	Y	Th-Mo 12-9 / Tu-Wed
SUNDAY	Painted Hills (hike)	Carrol Rim Trail & Painted Hills Overlook	3.75	Y	
	Painted Hills (hike 2)	Blue Basin Overlook / Island in Time	1	Y	
	Strawberry Mountain (hike 3)	Strawberry Mountain	1.5	Y	check weather closure
	Barley Brown's Taphouse	2200 Main St, Baker City, OR	1.75	Y	Su 12-5, Mo-Sa 2-8
MONDAY	Wallowa (hike)	China Cap	1.5	Y	check weather closure
	Pendleton (lunch)	Pendleton, OR	2		
	Thunder Island Brewing	601 NW Wa Na Pa St, Cascade Locks, OR	3	Y	Daily 11-9
	Home	Portland, OR	0.75		

understand your limits. And by no means force visits. If you're tired (or tipsy), just skip that brewery. Maybe you can visit it the next day and skip one you have less interest in. I've done just that with my upcoming trip, opting to visit more breweries and do less driving at the beginning, and then add more hiking and longer drive stints at the end.

This leads to maybe the most important piece of advice: remain flexible. Don't let unpredictability ruin your well-planned trip. Go into it knowing that you likely won't be able to visit each brewery, especially during the ongoing pandemic. I like to pick a backup for each brewery, or try to factor in two-day visits in the same city for breweries I really want to visit. Are they patio-only and there's an impending thunderstorm? Did you bring your dog only to find out they recently banned pets?

I was in the Midwest last summer and was going to tack on three days to a trip to catch a few bucket-list breweries, only to find out one was closed for the entire season and another had changed its open hours to exclude all weekdays. Sure, it'll sting to miss out on going to a place you potentially drove hours to try, but remaining flexible will ease that pain a bit.

Adding variety and breaks will also help with burnout. I like adding a morning hike or dog walk to my daily routine to get a little exercise so I'm not immediately starting the day out with a long drive. If hiking isn't your thing, look for other side excursions that may pique your interest or, better yet, ask your beertender what there is to do around town.

When I visited Bruges, Belgium, years ago, it was a last-minute detour while visiting friends in Paris. Knowing that trying to plan last minute would likely cause more stress, I let the fates decide my route, and at each restaurant or bar I visited, I just asked the bartender, "What's your favorite place to drink/eat?" By the end of my 36-hour mini-trip, I had been to a bar in the basement of a historic church, been served lambic in a traditional lambic basket, and dined at a 150-year-old brewery.

Don't be afraid to mix it up with other people, too. You'd be surprised how many other folks are on similar trips. And when someone learns you're on a trip, their local

Top to bottom:
Lake Massabesic, N.H.; A barn in New Hampshire; Mt. Mansfield, Vt.

pride typically kicks into overdrive and (unsolicited or not), you're regaled with a plethora of suggestions.

Homebrew can also act as a nice currency if you've remembered your cooler. I don't know how many times I've mentioned being a homebrewer and then been asked if I had any on hand. On the occasions when I have, I've been able to trade (usually up) with others who are also on a brew journey. My biggest score to date was a trade of a several-month's-old homebrewed Kölsch for a bottle from a still-little-known brewery in 2010 named Hill Farmstead.

FINISH STRONG

Similar to planning to avoid burnout, try to end on a high note. I'll never forget my trip from D.C. to New Hampshire, but it was actually supposed to be a trip from D.C. to Maine. By day six, my vigor (and cash) had waned, and knowing that I had a long drive back, I turned in early. So, consider again what your limits are. Can and should you drive the 17 hours back in one day at the end of your trip? Although more expensive, would you enjoy it more by renting a car one-way and then flying back at the end?

These considerations helped with my upcoming trip. I had originally thought I could do a multi-week trip that would take me to Austin, Texas, but the only feasible way to do this would be to finish with a two-day, non-stop drive back home to Portland—not a great way to end a trip. Instead, I shortened the trip extensively and decided to explore my newest home state.

A buffer day can also help you accomplish your original goals. Let's say you're traveling for seven days, going to 12 breweries, and traveling across two states. Pretty much everything has to go according to plan with no interruptions for a plan like that to work. If you factor in an extra day (whether that means trimming your trip by a day or taking an additional vacation day), you relieve the stress of being on-time for every leg of the trip, but you can also take your time and maybe hit some extra spots if your plan does pan out perfectly.

On this trip, I had originally decided to skip breweries altogether on the last day and just enjoy the last hike and drive along the Columbia River. I've noted a few breweries that I've been to in the past are on the way back, so I could stop in if I'm up for it, or if I'm tired or just restless, I could forge on home and not feel like I've missed out. Reversing my route also made this possible. Had I gone the opposite way, my final day would be spent deciding between two to three places I really want to try.

Possibly the best advice, as in most cases, and especially in these uncertain times, comes from our patron saint of homebrew. *Relax*—you're enjoying your favorite beverage after perhaps taking that privilege for granted as I certainly had in times past. *Don't worry* about not getting to go to all of the breweries on your list because, if you've followed my advice, you planned for that and have backups or alternatives! And *have a homebrew*. Or a commercial brew—I think Charlie would happily make an exception.

Cody Gabbard lives in Portland, Ore., by way of Colorado, D.C., Virginia, and Kentucky. He is a data analyst by trade and occasionally poses as a freelance writer. He is a proud member of the AHA and is in constant awe of his fellow homebrewers in the Portland Brewers Collective.

BREWING IN THE ALOHA SPIRIT

Making Beer, Mead, and Wine in the Hawaiian Islands

By David Schmidt

Given Hawai'i's location, it is virtually impossible to make a local beer with all indigenous ingredients. Like many other places, the term "local," when applied to food and drink in Hawai'i, has evolved to include other desirable features, such as small-scale or organic ingredients. None of this has prevented debates in the state over what is and what should be labeled "local" beer.

—Paul R. Kan,
Hawai'i Beer: A History of Brewing in Paradise

THE WINE OF THE TROPICS

I sat barefoot on my cousin Whitney's driveway, drinking and chatting with her neighbors. A light breeze blew in from the nearby ocean. As we reclined in folding chairs, some folks sipped Coronas, while Whitney and I opted for local brews: a coconut porter by Maui Brewing Co. and Big Wave Golden Ale by Kona.

I had just driven all the way around the island of Oahu, and we shared the homemade roadside delicacies that I had collected along the way: crispy chips made from dried *'ulu* (breadfruit), pineapple coconut cobbler, fresh guava juice, spongy 'ulu bread, and a heaping *poke* bowl, thick chunks of fresh ahi tuna swimming in creamy wasabi sauce. In the distance, the waves crashed against the cliffs of the island.

Eventually, it came time for the main event, my prized find: a bottle of wine. This was no ordinary wine; it wasn't even made from grapes. It was the sort of rare wine that is only possible in a place like Hawai'i.

I had come to the Islands in search of a truly local brew, something uniquely Hawaiian, and found more of them than I could count: breweries that draw deep from nature's tropical abundance, meaderies using Hawaii's pristine honey, and the creators of this very special island wine. For brewers looking to experiment, no place in the world matches Hawaii.

THE SMELL OF GREEN

As someone who lived 40 years without ever setting foot on Hawaii, I always thought people were exaggerating when they described it as "paradise." I assumed

it was all hyperbole and cliché, like the comment made by the postman Newman from *Seinfeld*: "The air is so dewy-sweet you don't even have to lick the stamps!" When I finally went there last November, though, I found the word "paradise" to be deficient. In fact, no words seemed adequate to describe the beauty of this place.

The first thing that hit me when I arrived was the aroma. I had smelled that sort of lush vitality in the air before, in southern Mexico, the islands of the Caribbean, and the tropical jungles of Peru, but never on U.S. territory. It was the rich, humid smell of a place teeming with life. It smelled *green*. Before exiting the airport, I treated myself to a Kona Longboard, a crisp lager that just hits different when you drink it in the Islands. It would be the first of many local beers.

My cousin Whitney met me at the Honolulu airport and greeted me with a fresh flower lei. She's a born and bred Californian like myself, but has quickly taken to island life during her years spent living there. We drove toward her home on the eastern side of the island of Oahu. I say "east," but it felt west for my West Coast mind, as we were headed towards the ocean. I quickly learned that, in the Islands, it makes more sense to give directions according to geography: you either drive *mauka*, towards the mountains, or *makai*, towards the sea.

We left the city and took Pali Highway through a long tunnel cutting through the mountainside. "It's a good thing you don't have any pork on you," Whitney said with a smile. She explained that local custom forbids crossing pork through the tunnel. According to legend, the vengeful fire goddess Pele resents her former lover, the half-pig demigod Kamapua'a, and won't allow pork to cross through the mountain. Many people swear to have tried it, only for their car to break down soon after. The old ways are ever-present in Hawaii. Like the Roman aqueducts in London, the ancient architecture of the Kingdom of Hawaii is everywhere: lava rock walls, irrigation ditches, and stone *heiau* (temples). These sacred sites are still revered today, where altars are still covered in offerings of fruit, flower leis, and ti leaves.

The highway took us past towering, otherworldly mountains of volcanic rock covered in lush, thick jungle. Mark Twain's first impressions of this same island, when he visited back in 1866, are still very applicable:

> *I saw on the one side a frame-work of tall, precipitous mountains close at hand, clad in refreshing green, and cleft by deep, cool, chasm-like valleys—and in front the grand sweep of the ocean: a brilliant, transparent green near the shore, bound and bordered by a long white line of foamy spray dashing against the reef, and further out the dead blue water of the deep sea…*

Over the next few days, as I drove up and down the rural highways of Oahu in wandering *holoholo* style, I would enjoy some of the most delicious food and drink of my life. Hawaii's cuisine and brews alike are the product of its rich cultural melange. I had plenty of native foods, including my first taste of *ono*, a fish aptly named after the Hawaiian word for "tasty," and native crops like the ubiquitous *kalo* (taro root) and *'ulu* (breadfruit). I also tried rice-based dishes with Japanese and Chinese influence, such as the handy *musubi* snack and the *poke* bowl. The Philippines contribute the soft, sweet, purple sweet potato, the *ube*. Even Spam, brought by GIs from the mainland, proved much more palatable than I imagined.

Not only do these foods pair well with local Hawaiian beers, but many of them have become brewing ingredients as well. The bounty of nature provides countless inspirations. And yet, for most of Hawaii's history, alcohol did not even exist on the Islands.

A SHORT HISTORY OF BREWING IN HAWAII

There is no conclusive evidence that native Hawaiians fermented alcohol with any regularity before colonization. It is possible that some communities may have fermented the root of the ti plant which, when baked, presents fermentable sugars that collect on the root's surface. However, author and early cultural historian David Malo wrote in 1838 that it was foreign sea-rovers who brought "lawless spirits" to the Islands.

Before Europeans came, the closest thing to a native Hawaiian brew was a drink known in Hawaii as *'awa*, known elsewhere as kava. (This drink merits its own article, forthcoming in this publication.) While not alcoholic, it does have a mild narcotic effect. Kava is made from the powdered root of the *Piper methysticum* plant, which contains the active ingredient of kavalactones. It is a traditional drink for various cultures of Polynesia and the Pacific and, like many folk brews across the globe, it was associated with the realm of the sacred and the supernatural. The primordial god Kāne, the giver of life, was the deity of agriculture and the patron of many nourishing plants: the taro root,

the banana and sugarcane, and yes, kava. Alcohol, meanwhile, seems to have been largely foreign to the Islands.

Until Europeans arrived. Then everything changed.

After Captain Cook made the first European contact with the sovereign Kingdom of Hawaii, foreigners came in droves: traders, whalers, soldiers, missionaries, and plantation owners. Along with their lust for land and riches, they brought a host of invasive species. Mark Twain describes his first night in the Islands in typical sarcastic style, as he suffered attacks from scorpions, malaria-ridden mosquitoes, and centipedes; notably, all these pests sneaked into Hawaii aboard foreign ships. However, among all these ills, outsiders did bring one good thing to the Islands: beer.

The first beer was brewed in Hawaii in 1778—albeit not on land. As author Paul R. Kan explains in his excellent book, *Hawai'i Beer: A History of Brewing in Paradise*, it was brewed aboard HMS *Resolution* while anchored off the coast of Gib Island. The beer was made to prevent scurvy, on the orders of Captain James Cook. The ship's crew were disgusted by the beer, which was made entirely from sugarcane and hops, and said that it had "an injurious effect on their health." Many folks who tried my own grandpa's sugar-based homebrew in the 1960s said the same thing. (See "My Grandfather's Crock" in the Mar/Apr 2022 issue of *Zymurgy*.).

The next beer brewed in Hawaii was made by Don Francisco de Paula Marín. Known by the locals as "Manini," he was a trusted advisor to King Kamehameha I and taught him the technology of firearms, which made it possible for the Hawaiian monarch to unify the islands under his rule. Manini practiced horticulture in Pearl Harbor and used his connections with sailors and traders to bring in new plants: coffee, guava, mango, and pineapple. He established vineyards in Hawaii and began brewing brandy and wine. The royal family was so fond of his wine that Kamehameha made it *kapu* (taboo) for anyone to touch the wine other than Manini, his workers, and the nobility.

When the Spaniard decided to try his hand at brewing beer, though, he came up against a hurdle that has plagued brewers ever since: hops won't grow in Hawaii. Manini found it difficult to grow wheat there as well and opted for corn and rice instead. All evidence suggests that Manini's beer lacked hops or any other preservatives. It would have been very weak, about 2% ABV, and was served at room temperature. No thank you.

Native Hawaiians, meanwhile, didn't take long to learn the art of distillation. Adapting it to native flora, they developed a uniquely Hawaiian spirit: *ʊkolehao*, a liquor made from baked ti root. With the arrival of large numbers of workers from Japan and China, ʊkolehao incorporated rice, as well as sugarcane and pineapple, and quickly spread across the Islands.

Of course, the arrival of alcohol was not all good news. Along with brewing and distillation came problems that were previously unknown for Hawaiians: addiction and alcohol abuse. As a result, King Kamehameha I banned the production and consumption of alcohol in 1818. His successor, King Kamehameha III established, in the 1850 Penal Code for the independent kingdom, that:

> *Whoever shall sell, give, purchase, or procure for, and in behalf of any native of this kingdom, or for his use, any spirituous liquor, or other intoxicating drink or substance, shall be punished by a fine not exceeding two hundred dollars.*

This applied to Native people. Considering that over 95 percent of the population was Native Hawaiian, this made brewing an unprofitable venture. As a result, the first mass-produced beer in Hawaii was actually non-alcoholic! Honolulu Brewery announced their new beer in 1854 in the weekly newspaper, *The Polynesian*, clarifying that "This beer is made of barley and hops only, contains no alcohol…"

The policy of prohibition persisted. When the idea of lifting it was proposed in 1865, King Kamehameha V stated, "I will never sign the death warrant of my people." It was not until the reign of King David Kalakaua (1874–1891), that prohibition was ended. Known as "the Merrie Monarch," King David even had his own personal distiller! Alcohol had been legalized for good, and ʊkolehao flourished, even during the Prohibition ordered by the United States government (1920–1933). To this day, locals recall relatives who prepared homemade ʊkolehao during that time, and it is now distilled commercially. Beer brewers, however, have not had such an easy go of it. The same difficulties that the Spaniard Manini faced continue to beset brewers on the Islands.

THE COST OF BREWING IN PARADISE

Many don't realize that beer was first put into aluminum cans in Hawaii, by Primo Beer in 1958. Primo eventually moved to the mainland, though—it was just too hard to do business in Hawaii. I spoke with seven Hawaiian breweries to find out why.

The first problem is the issue of hops, as Josh Kopp of Hana Koa Brewing Co. explained to me. "Some people have tried growing hops on the islands, but nothing has really come of it. It's difficult based on space and that we don't have a winter." Likewise, there is not enough farmland to grow sufficient barley—this, too, must be shipped in. This involves a whole series of challenges in itself, the first of which is the sheer cost of shipping.

Hawaii is home to the westernmost brewery in the United States (located on the island of Kaua'i), as well as the southernmost, on the Big Island. Not only is Hawaii the most remote state in the US, but it is also the most remote island chain in the world. This makes for several challenges.

"Supply chain is a huge problem," as Steve Haumschild of Lanikai Brewery told me. "Our islands only have enough gas on hand for two days! So we have to hold tons of inventory in grain, hops, and other raw materials, as well as equipment. If something breaks in the brewery, we can't always wait two to three weeks to get a part. If we forget to order some grain, we can't necessarily drive to the suppliers to get it!"

Given that the nearest US port is more than 2,300 miles away, all costs shoot up astronomically. Carbon dioxide costs four or five times more per pound than it does on the mainland. It costs at least $400 to ship a pallet of goods to Hawaii, and often as much as $800. Eric Chang of Kona Brewing told me, "We commonly find that we have raw materials ordered nearly four or five months in advance of our brewing schedule, depending on the ingredients and the location shipping from." Brewmaster Joe Peay Lorenzen of the Waikiki Brewing Company described this as simply "the cost of doing business in paradise!"

Shipping logistics are further complicated by the Jones Act of 1920. This federal law requires "that all goods carried between US ports be on US-built and flagged ships that also are mostly owned and crewed by Americans. This makes it significantly more expensive to transport goods to Hawaii, not only because of how the act limits foreign competition, but also because ships built in the U.S. are at least four to five times more expensive than ships on the world market.

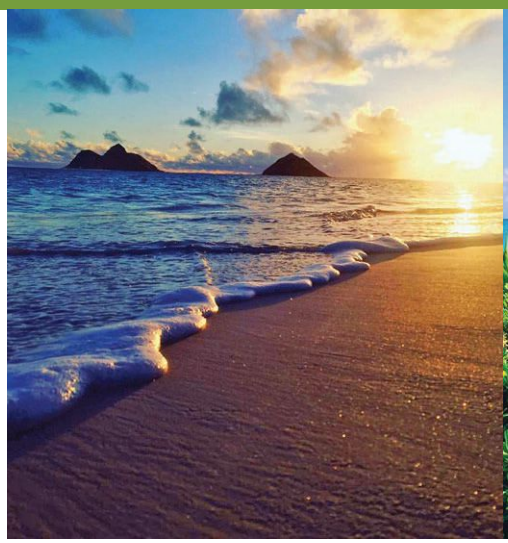
The real-world applications of this law make it much harder for any businesses in Hawaii to operate. As Kihei Carroll of Maui Brewing Co. told me, anything coming into the Islands must first be shipped through a mainland US port. This goes against logic

when we consider that the island chain is as close to New Zealand or Australia as it is to California.

"Similarly, places like Puerto Rico or the Virgin Islands wouldn't be able to get things directly from Haiti or the Dominican Republic, or any South America country, without first going to Florida. The Jones Act causes a lot of headaches for all the Islands under US control."

Sometimes, the only way around this headache is to open breweries on the mainland as well, like the Kona brewery has done. This is how Kona was able to reach nearly 40 states and 15 different countries. Even that brought a series of difficulties, though: two mainlanders sued the brewery in 2017, claiming that they "were falsely led to believe the product is produced in Hawaii."

Despite all the challenges involved, however, Hawaii is still home to 18 different breweries. They have managed to infuse local flavor into their beer every step of the way.



THE LOCAL FLAVOR OF HAWAIIAN BREWS

Local culture permeates the world of brewing in Hawaii, right down to the names of the breweries themselves. Some are named after geographical locations: specific islands (Kaua'i Beer Company), towns (Hilo Brewing, Honolulu Beerworks), regions (Kona Brewing Company), and beaches (Lanikai Brewing, Waikiki Brewery). Others incorporate the native Hawaiian language, such as Kohola Brewery, named for the humpback whale. There are poetic names like Hana Koa Brewery, which roughly translates as "continuously working towards our craft," while others are more straightforward, such as Inu Island Ales (*inu* is simply the word for "drink.")

This is much more than mere commercial gimmick or cultural window dressing. Ever since the Hawaiian Cultural Renaissance of the 1970s, the *'Ōlelo Hawai'i* (Hawaiian language) has been increasingly present on the Islands. Even folks from the mainland refer to their *ohana*, their family, used in a broader sense than just blood relatives. The headlines of local newspapers make reference to *keiki* (children) and *kupuna* (elders) without translation. The language is a natural part of daily life for all *kama'aina* (residents of the islands).

This pride is present in the ingredients of Hawaii's brews, beginning with the use of locally-grown tropical fruits. Many beers involve such emblematic crops as coconut, guava, lychee, dragonfruit, and *liliko'i*, passionfruit. Kihei of Maui Brewing Company, the largest craft brewery in the state, told me how important local production is for their Pineapple Mana Wheat: "All the pineapple is sourced directly from Maui Island, which helps us support our local ohana. Plus, we get to make a great beer."

Likewise, Oahu's Lanikai Brewing Company made the first beer brewed with the quintessential combination of pineapple, orange, and guava, known by the acronym POG. Anyone who remembers this game from the 1990s will be glad to know that POGs are back… in beer form.

Of course, it isn't always easy. "Coming from a guy that has painstakingly hand-toasted hundreds of pounds of coconut at Honolulu Beerworks," said Nick Riley, "let me assure you that this beer is a labor of love. I'd be lying if I said there weren't times I wished this beer wasn't so damn delicious and popular, but, alas, we keep winning awards for it."

Local ingredients go far beyond fruit. Breweries also use Hawaiian cucumbers, *kalo* (taro root), cinnamon, cacao, coffee, mango, and even desalinated sea water. Waikiki Brewing Company collaborates with the local company Lion Coffee to incorporate coffee roasts in their imperial stout. Kona makes an amber ale named Purple Grain, brewed with locally grown lavender and grains of paradise, resulting in a smooth and distinctive aroma and flavor very similar to a chai tea. Kohola Brewery has a stout made with local Maui taro root and macadamia nuts.

Many local brews reflect the cultural influence of Japan and other Asian nations as well. Indeed, Many of Hawaii's breweries even have a button on their websites with the familiar characters 日本語 to translate the text into Japanese. Hana Koa brewery does the Tokyo-Style Pilsner, made with

LILIKO'I PALE ALE

Liliko'i is the Hawaiian word for "passionfruit." If you really want to get authentic, make sure to pronounce the apostrophe between the *O* and the *I*: it's a soft glottal stop, like a slight hiccup. This fruit is ubiquitous in the islands, present in sweetbreads, ice creams, "shave ice," jellies, soaps, and certainly beers.

I've selected the grain, hops, and yeast for their neutral flavor and aroma profile to really allow the natural flavors of the liliko'i to shine through.

BATCH VOLUME:	5 US gal. (18.9 L)
ORIGINAL GRAVITY:	1.044 (11°P)
FINAL GRAVITY:	1.006 (1.5°P)
COLOR:	5 SRM
BITTERNESS:	40 IBU
ALCOHOL:	5% by volume

MALTS

8 lb. (3.63 kg) Briess 2-row brewer's malt or Rahr 2-row malt

HOPS

0.75 oz. (21 g) Magnum, 12% a.a. @ 90 min

YEAST

White Labs WLP900 San Diego Super Ale Yeast

ADDITIONAL ITEMS

Liliko'i (passionfruit) pulp, frozen or fresh

BREWING NOTES

Mash the grains at 158°F (70°C) for 90 minutes. Add the fruit pulp to the wort in the fermenter.

Photos courtesy of David Schmidt

Yumepirika rice from the Hokkaido region of Japan. It has notes of lemon meringue, orchids, and a slight mochi sweetness from the rice. Likewise, Maui does a Karoshi rice lager with rice sourced from a Japanese factory located on Oahu.

Lanikai Brewery took things a step further, using all the ingredients that were found in Polynesian voyaging canoes from 0 to 400 CE. Brewed with *ki* root (ti), *ko* (sugar cane), *kalo* (taro), *niu* (coconut), olena (turmeric), and *'ulu* (breadfruit), it is fermented with a native Hawaiian yeast strain harvested locally. They describe this as "a tribute to the past, present, and future of exploration." The brew is named after Kahiki, an ancient Hawaiian word for "the ancestral lands."

And that's all just the tip of the iceberg when it comes to local ingredients. Hops and barley may not grow on the islands, but this land still offers brewers a wealth of resources—starting with the diverse strains of native yeasts.

YEAST FROM SHARKS AND OUTER SPACE

One brewery that has harvested yeast from the wildest parts of Hawaii is Lanikai, located on the windward side of Oahu. I spoke with Steve Haumschild, CEO and brewmaster of Lanikai Brewing Co. and a Certified Cicerone, who told me about their daring "bioprospecting" ventures. As Hawaii's first brewer of wild and sour beers, they have collected yeast from the most unexpected of places, including the skins of wild sharks.

Steve told me how his friend was a biologist working on Coconut Island, off the coast of the Big Island. Only four people live there, all involved in scientific research. The brewers' initial idea was to collect yeast in the forests of the island; however, Steve's friend suggested a better idea: collecting the yeast from local hammerhead sharks.

His friend worked with the University of Hawaii's marine program and was already studying the bacteria cultures on the skin of wild sharks. He invited Steve to take some swabs of the sharks' skin during feeding time in the bay. (This was all PETA approved, and no animals were harmed.) After baiting the sharks, they grabbed them by dorsal and pectoral fins and swabbed their bellies, collecting a total of about 20 swabs.

It was a long shot. Steve assumed they wouldn't get any fermentable yeasts. After all, sharks have a layer of mucus on their skin, which he thought would push any yeast or bacteria away. As it turned out, that mucus had the opposite effect—it worked as a collection agent! Nearly all the samples fermented when added to wort. Two of them produced a good taste, but only one survived. This was used to ferment a whole batch of beer, named "manō" (the word for shark), a wild American ale of 7.1% ABV.

Brewers of Lanikai Brewing Company.

If that weren't enough, the folks at Lanikai decided to brew with yeasts from outer space as well. OK, not *exactly* outer space; they only went as far as our planet's stratosphere. In a collaboration with NASA, they were able to collect cultures from 70,000 feet above the earth's surface. They searched for areas that contained storms rich in ice and dust, where yeast would naturally collect, and brought it back to earth.

"At first, I didn't know what I was looking at," Steve said. He is always the first to taste-test any new yeast culture. "We exercised extreme caution with that one… It took years of DNA sequencing to see what it even *was*!" In the end, though, this yeast resulted in the UFO Beer Series (Unidentified Fermenting Object). One brew named"U.F.O.: Unidentified Fermenting Object (NASA X Space)" launched on the 50th anniversary of the moon landing.

To collect other, more terrestrial, wild yeasts in the Islands, they built a traveling coolship. They consulted with a few brewers of wild beers on the mainland—Tillamook in Portland and Black Project in Denver—but the feedback was disheartening. "They said it would be impossible to do a coolship in Hawaii, given the heat. It would just collect mold. But we realized all we had to do was adjust it to our own conditions and climate."

They developed a coolship that could disassemble and fit on a plane as cargo, along with all cooling systems and camping gear. It could hold roughly 5 barrels (5.9 hectoliters) of wort and could be flown out to any other island in the archipelago. The brewers would load it onto the back of a vehicle and head out in search of good yeast collection sites. After filling it with hot wort, they camped out around the coolship, had a few drinks and sat around chatting while the wort got down to capture temperature.

"It's like fishing," Steve told me. "If you're going deep-sea fishing for ahi or mahi, you use the right bait for each fish. Same here. You have to use the correct wort to attract the right fermenting yeast. It doesn't guarantee that you'll catch your 'ahi,' but you're more likely to. Of course, it's been a lot of trial and error. When we started out, we had a 95 percent failure rate. Now, we've got it down to a failure rate of one-third. That's pretty good."

Lanikai's efforts to collect the wild yeasts of Hawaii fascinated me, but I wondered if it was possible to brew something made exclusively from local ingredients. To answer that question, I would have to travel to the island west of Oahu: to Kaua'i, "the Garden Island."

KAUA'I MEAD: AS LOCAL AS IT GETS

Kaua'i is a fitting setting for Hawaii's first meadery. The island is home to some of Hawaii's oldest cultural relics: ancient heiaus, fishponds, walls, and irrigation ditches. Legend says they were built by the *menehune*, mythical Little People who wander the countryside late at night.

It is known as "the Garden Island" for good reason. The wettest place in the world—Mount Waialeale—is right there on Kaua'i. It is home to some of the most spectacular scenery, including Waimea Canyon, "Hawaii's Grand Canyon." There is a laid-back, country feel here, an independent streak, and a fierce loyalty to the *'aina* (land), keeping it pure and unsullied. In the face of developers who sought to build up the coastline, local building codes prohibited the construction of any building taller than a coconut tree.

When I checked into Kaua'i Shores Coral Reef Hotel in the sleepy town of Kapa'a, it felt like visiting a relative's home. A smiling older woman introduced herself as Auntie Peggy Sue, and told me to sit on the couch and "rest a while" as she waited for her daughter to come check me in. She offered me one of the pastries that she'd just bought, and we chatted to the sound of waves softly crashing in the background. Once I had my room, I

Photo courtesy of Steve Haumschild, Lanikai Brewing Company

dropped off my bags and walked down the road to Kapa'a's meadery, just a couple miles away. A pedestrian walkway ran along the coast, past locals who leisurely fished and waded in the warm water. The sun was hot even in November, and after hiking two miles, I had worked up a sweat. I was ready for a drink.

I found Nani Moon Meadery in an unremarkable strip mall on the south end of Kapa'a, past the quaint wooden storefronts of the small downtown area. I walked in and was greeted by Tiffany, a young woman with fair skin and black hair. She was a friend of Stephanie, the owner. As she poured me a flight of seven varieties of mead, I asked if they were made with many local ingredients. She laughed.

"It's all local. Every single bit of it."

Not only are their honeys from Hawaii, but most are from Kaua'i specifically. This is the benefit of making mead versus beer—when you don't depend on grain and hops, nothing needs to be shipped in from the mainland.

"The flowers and plants are just healthier here," Tiffany said, "which means the bees are healthier, too." The limited flight range of the bees—about four miles—means that each batch of honey has a unique and intensely local "fingerprint." It absorbs the character of that location's exact flora: coffee plantations, macadamia blossoms, liliko'i fruit.

The honey produced in the south of the island has a nuttier flavor, due to the coffee plantations and botanical gardens, while the north shore blooms with wildflowers. Like many other traditional brews I've tried the world over, from the *t'ej* mead of Ethiopia to the agave-based *pulque* of Mexico, mead is intimately connected to the land. I would later speak with the owner, Stephanie, who told me, "I love how extremely local it is. It's sourced from 100 percent local ingredients. If the barges ever stop coming, we know that we can still continue to make mead."

My flight started with Laka's Nektar, an off-dry, floral mead. This was the only one made from single-flower honey: Ohia Lehua blossom. Since Kaua'i lacks the necessary acreage for a single-flower honey (at least 3 square miles of the same crop), this one is brought in from the Big Island.

Local fruits and crops are incorporated into each mead as well. The mead named Pineapple-Lime includes pineapple and Tahitian limes grown on Kaua'i; Winter Sun is made with starfruit and *liliko'i* (passionfruit); Ginger Spice contains organic raw ginger; Deviant Beehavior includes Hawaiian chiles; and Buzz Squared incorporates Kona coffee from the Big Island. The semisweet Cacao Moon includes locally grown cacao and vanilla beans and was made from macadamia nut blossom honey.

Tiffany told me that her personal favorite was the Winter Sun, which she described as the "anytime mead" that pairs versatilely with many different foods. I asked if she's ever thought about going back to the mainland. "I don't know. I've been here for 20 yeast, and I would really miss that sense of local community. Here, you know that everyone looks out for each other. And if anyone does something they shouldn't, it gets out on the 'coconut wireless,' the gossip chain."

As I came to the seventh mead on the list, I was starting to feel it. Tiffany explained that mead was so pure and natural, it had a way of affecting a drinker beyond the reach of its 12% ABV. Of course, it didn't help that I enjoyed it on an empty stomach. When I left and walked down the dusty road at dusk, I had some trouble taking voice notes on my phone. At one point, I recorded the following: "Not only is this mead from local honey, but… Oh boy. I just… Damn. Them shits really sneak up on you." It's not easy to be articulate after drinking that much honey wine.

While Nani Moon's potent mead was one of the most locally sourced libations I had during my trip, it was not the most unique. That honor goes to the wine I found back on the island of Oahu.

WINE FROM CHOCOLATE

Three of our world's most important crops cannot grow in the continental United States: coffee, bananas, and cacao. All three are mostly grown in developing nations of the Global South, with one exception: Hawaii. One of Hawaii's chocolate manufacturers had the novel idea to use the fermented pulp of the cacao plant as well, and thus, the world's first cacao wine was born.

My cousin Whitney and I visited the factory of Mānoa Chocolate, located in the town of Kailua on the windward (eastern) side of Oahu. The company is named for Oahu's Mānoa Valley, an ancient place of ancient forts, fierce battles, and great *mana* (spiritual power). After taste-testing several different chocolates and roasted cocoa beans, I asked the tasting room manager, Gracie Thacker, about the cacao wine I had seen on the shelf. She explained that they came up with the idea during the lockdowns of 2020. They were looking to branch out, and someone suggested making wine out of the fruit of the cacao plant. The cacao seeds grow inside a large, fruity pod, the fruit of which is normally thrown away.

"You have to ferment the fruit anyway," she told me, "to properly separate the seeds that are roasted and made into chocolate. So it was just logical that we should put that fermented cacao pulp to good use!"

I asked what the fresh cacao fruit tasted like. "Very syrupy. I like to compare it to Skittles: you taste the full rainbow! As is the case with many tropical fruits, a broad range of flavors come through: lychee, mango, banana, and others." These flavors came through in the wine as well, she said. It would have no cocoa taste, as all the seeds were removed from the fruit and processed into chocolate.

The folks at Mānoa experimented with a few small batches of wine at first. When they'd perfected the recipe, they froze the fermented juice and pulp and shipped it off to Paso Robles, in the heart of central California's wine country. A vintner there used his conventional winemaking techniques to turn the materia prima into cacao wine. That year's cacao harvest yielded enough fruit to make 54 cases of wine.

This wine was submitted to a tasting in Napa Valley in spring of 2021. It received high marks from the tasters, many of whom described it as "something between riesling and a pinot grigio." It was a full-bodied wine, with tropical notes of guava and lemongrass, robust enough to be paired with spicy foods and red meats.

I wondered out loud if anyone had thought of doing the same thing with coffee pulp? Gracie wasn't sure about the particulars of coffee production. I later confirmed that the coffee cherry does contain sugar and is edible. As far as I know, however, no coffee growers have attempted this. I put it on my own to-do list: a naturally caffeinated coffee wine!

I bought a bottle as I was leaving the chocolate factory and left it to chill that night in my cousin Whitney's fridge. The following evening, we took it out to share with her neighbors on the driveway. As soon as we pulled out the bottle, a hush came over the crowd. Something about this entirely local drink inspired reverence. I poured a couple of fingers into everyone's glasses. The color was a sort of dark gold, lighter than honey and darker than most white wines.

We all took a deep whiff of it. The nose was reminiscent of an oaky chardonnay, very woody, with an earthy strong aroma to it, strong but pleasant. The aroma contrasted drastically with the taste, though: it was immediately sour, with lots of passion fruit, guava, tropical notes to it, and citrus. My cousin and I did not think it tasted

Continued on page 60 >

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*yinz (pronoun): variant of you all, chiefly used in Western Pennsylvania.

SKEPTICAL BREWING

3

This is the third in a series of articles called "Skeptical Brewing," a deep dive into commonly held brewing beliefs. In this series, we discuss their origin stories and review the science and research behind them to reach a verdict on their plausibility. We have chosen common brewing superstitions to try to challenge established paradigms and shed light on many supposedly unquestionable truths. We hope this helps foster the habit of questioning handed-down wisdom.

Always be skeptical!

By Leandro Meiners and Matias Cavanna

1 FIRST-WORT HOPPING PRODUCES A SMOOTHER BITTERNESS

First-wort hopping refers to the technique of adding hops to the kettle at the beginning of lautering. It is said that this technique produces a beer that has a smoother bitterness compared to adding the hops at the start of the boil. Some people also state that it has a positive effect on the aroma and its intensity.

According to a paper published by *BRAUWELT International* in 1995, which "rediscovered" this practice, first-wort hopping (FWH) used to be a common practice in the late 1800s and early 1900s, with breweries across Germany, Belgium, and England using this method to achieve higher bitterness efficiency.[1] Apparently this technique was discontinued in the 1970s.

The paper mentions that the rediscovery of FWH was an accident at a professional brewery where hops were accidentally added to the kettle while lautering the first wort. When they realized this mistake, the beer was fermented in a separate fermenter, and the finished beer had a different hop aroma and bitterness profile.

WHAT DOES SCIENCE HAVE TO SAY?

BRAUWELT International's 1995 publication includes a commercial test on two German Pilsners brewed at two different German breweries.[1] Both produced their standard recipe in two ways:

1. Using their standard start-of-boil addition
2. Adding a percentage of that addition as FWH

For the FWH addition:

- Brewery A used Tettnanger and Saaz T45 pellets. Close to 35 percent of the bittering addition was added as FWH.
- Brewery B used only Tettnanger T45 pellets. More than 50 percent of the bittering addition was added as FWH.

IBU analysis revealed that Brewery A's FWH beer had an IBU increase of almost 5 percent, and brewery B's FWH beer had an increase of almost 30 percent compared to the reference brew that used their standard start-of-boil addition.

A triangle test was made for both breweries' beers with trained tasting panels of 12 and 13 tasters, respectively. In both cases, more than 99 percent of tasters were able to tell the beers apart. Tasters were then asked to indicate their preference and a reason. Tasters who chose the FWH beer said their two main reasons were "a more harmonic beer" and "more uniform bitterness." →

More recently, in 2017, Christina Hahn and Tom Shellhammer at Oregon State University tested this methodology on an American pale ale using Cascade hops.[2] They brewed the beer twice, once with a standard start-of-boil addition, and again with FWH.

The chemical results of both beers were almost identical, except for a 10 percent increase in total polyphenol content in the FWH batch, most likely due to the extended contact time. Foam stability was also measured; the FWH beer had a 6 percent lower result in foam persistence, which could be caused by the extra polyphenol content.

From an organoleptic point of view, the study's panel of 35 tasters indicated no perceptible sensory difference between the two hopping methods.

Other anecdotal experiments are available online, such as at Brülosophy, where FWH has been tested three times—in 2015, 2017, and 2020.[3] The first two experiments revealed tasters' inability to distinguish the two beers. The third one had, due to COVID-19, very limited statistical significance; however, it is interesting to note that in two of the three experiments, samples were sent to a commercial lab for analysis. One test showed that the FWH batch had a 15 percent increase in IBUs, while in the other, the FWH produced a 30 percent increase in IBUs.

VERDICT

The 1995 study published in *BRAUWELT International,* which revived the FWH practice, indicates with detail that tasting panels were able to recognize the difference in the FWH beers compared with the standard beers. However, no data are provided about how many tasters indicated that it provided a "more uniform bitterness," thus we should not solely rely on that study to support the claim that FWH produces smoother beers.

On the other hand, more recent studies in the subject indicate no sensory difference in the quality of the bitterness, which means we can call this claim an **outright myth.**

This is not to say that FWH is detrimental for brewing, except for the potential foam stability reduction. In fact, it is probably easier (and harder to forget) from a process point of view to add bittering hops at the beginning of lautering (FWH), and one can probably get away with a smaller addition when doing so due to the higher isomerisation efficiency.

If you currently first-wort hop and you like how your beers taste, keep on doing it. If you currently don't FWH, there is nothing to worry about either—your beers won't have harsher bitterness. Most importantly, and regardless of whether or not you use or do not use the technique, it is time this myth stop spreading. Use FWH solely for improved efficiency and/or convenience!

TEST IT YOURSELF!

Still skeptical and unwilling to let all this scientific research change your mind? Make this experimental brew and challenge your and your mates' taste buds!

OL' NEW SCHOOL

WEST COAST IPA

This old/new-school IPA hybrid is bitter and malty. Its tropical aromas and citrus, resinous flavor will allow you to compare first-wort hopping to start-of-boil hopping. Or, just choose either method and enjoy!

Batch Volume: 19 L (5 US gal.)
Original Gravity: 1.064 (15.8°P)
Final Gravity: 1.014 (3.5°P)
Color: 24 SRM
Bitterness: medium-high
Alcohol: 6.5% by volume

MALTS

5.5 kg (12.1 lb.) pale ale malt (88%)
400 g (14 oz.) Weyermann Carahell malt (6%)
400 g (14 oz.) Briess Carapils malt (6%)

HOPS

15 g (0.5 oz.) Chinook hops, 12.7% a.a. @ 60 min **OR** 13.5 g Chinook hops, 12.7% a.a., FWH (20 IBU)
25 g (0.9 oz.) Chinook, whirlpool
25 g (0.9 oz.) Centennial, whirlpool
25 g (0.9 oz.) Chinook, dry hop when gravity is between 1.015 and 1.025
25 g (0.9 oz.) Centennial, dry hop when gravity is between 1.015 and 1.025
70 g (2.5 oz.) Galaxy, dry hop when gravity is < 1.015
70 g (2.5 oz.) Vic Secret, dry hop when gravity is < 1.015

YEAST

Fermentis US-05, Lallemand BRY-97, White Labs WLP001, Wyeast 1056, or other American West Coast Chico-style yeast.

WATER

Ca 100 ppm, Mg < 10 ppm, Na < 10 ppm, SO_4 100 ppm, Cl 100 ppm, HCO_3 < 10 ppm

ADDITIONAL INGREDIENTS

0.5 tablet Whirlfloc @ 10 min
½ tsp. (1.5 g) yeast nutrient @ 5 min
110 g (3.9 oz.) corn sugar if bottle conditioning

BREWING NOTES

Mash at 67°C (153°F) for 45 minutes, targeting a mash pH of 5.2–5.5. If sparging, do so at 75–78°C (167–172°F). Collect enough wort in the kettle to yield enough wort to achieve 19 liters (5 gal.) after the 60-minute boil.

Boil the wort vigorously for 60 minutes, adding the Whirlfloc and yeast nutrient as indicated. After 60 minutes, add whirlpool hops and let steep for 10 minutes before chilling the wort. Chill the wort and transfer to the fermenter. Aerate thoroughly and pitch the yeast. Ferment at 20–22°C (68–72°F).

Add the dry hops as per the indicated schedule. After 3 days with no yeast activity (no gravity change), cold crash and chill the beer to as close to 0°C (32°F) as you can. Keep chilled for a week before packaging with 2.4 vol. (4.8 g/L) CO_2.

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2

MID-FERMENTATION DRY HOPPING ENCOURAGES BIOTRANSFORMATION

The brewing world began considering biotransformation in 2003 when King and Dickinson discovered the hop monoterpene biotransformation pathway.[5] However, it was not until 2014 when Takoi studied the effect of hop addition timing on this type of biotransformation.[6] The NEIPA craze started soon after that, and brewers increasingly sought ways to achieve tropical hop profiles in beer. This led to the popularizing of Takoi's research, at least in the homebrewing community, through various blogs with a wide reach.[1,2]

What contributes to the perceived change between mid-fermentation and post-fermentation dry hopping? Let's examine what current scientific knowledge has established in terms of (1) known biotransformation reactions, (2) their potential organoleptic impacts and the effects of hop addition timing, and (3) other phenomena at play.

WHAT DOES SCIENCE HAVE TO SAY?

First things first, biotransformation is understood as the conversion of a compound in wort or beer by a microorganism. However, when brewers talk about biotransformation, we tend to think of reactions that have a sensory impact and, more specifically, concern hop compounds. Thus, we will limit ourselves to hop-related biotransformation reactions with a sensory impact. Two classes of reaction fit the bill:

- Modification of a sensory-active compound from hops into a different compound
- Release of an aromatic compound from a non-aromatic precursor coming from hops

Of the first class, we have biotransformation of monoterpene alcohols and →

TABLE 1: BIOTRANSFORMATION REACTIONS

Biotransformation Reaction	Evidence biotransformation has a sensory impact	Evidence timing has an impact on biotransformation result	Evidence against biotransformation having a sensory impact	Contribution of this type of biotransformation to beer flavor
Biotransformation of monoterpene alcohols[5]	Established reaction for multiple strains[5] Biotransformation is on compounds known to contribute to the "hoppy" profile of a beer.	Timing of the addition does not have a marked impact on resulting conversion level[6], as biotransformation continues even in packaged products	Low perception difference between monoterpene alcohols and their bio-converted counterparts	Low to medium potential for flavor profile change from floral to citrus. Low potency potential due to low difference in perception threshold between pre- and post-biotransformation compounds. A significant amount needs to be converted to be noticeable, and even if this happens, timing has little or no effect.
Glycoside hydrolysis (aglycone release)	Release of compounds, mainly monoterpenes, known to contribute to the "hoppy" profile of a beer	No studies conducted to determine impact of hop addition timing on this type of biotransformation	Depends on the type of aglycones present Low quantity of precursors (glucosides) in hops[7] Low conversion rates (regardless of yeast)[7], over 80 brewing strains tested and none achieved more than 10% glycoside hydrolysis Moderate to high perception threshold (10s or 100s ppm) of monoterpene alcohols, i.e. significant quantity needed to be noticeable)	None to very low: low conversion, low quantity of precursors and significant quantity necessary due to perception threshold make it difficult to have a sensory impact regardless if timing makes a difference on biotransformation efficiency.
Release of bound thiols	Extremely low perception threshold of thiols, thousandths or millionths of ppb High level of precursors in some varieties of hops[8]	No studies conducted to determine impact of timing of hop addition on this type of biotransformation	Low to moderate level of precursor release, yields of 0.3–10%[18]	Likely: potentially high but unknown if timing affects quantity released
Esterification reactions of hop-derived compounds	Documented bioconversion of hop-derived compounds[9]	Timing of the addition does not have a marked impact on resulting conversion level[10]	Moderate to high perception threshold in the 10s or 100s ppm for esters	More research needed: estimated low to medium for biotransformation having an impact, although timing does not have a marked effect

esterification-related reactions. For the second class, there are two documented examples: hydrolysis of glycosides and release of bound thiols. We will not go into detail regarding the historical aspect of the study of biotransformation in academia, but for a review, refer to Meiners and Cavanna, 2021.[3]

Another important aspect is whether or not there is a change in the resulting profile related to dry-hop timing, or if this is merely anecdotal from brewers' experience. Luckily, Sierra Nevada conducted a controlled study and presented it at the American Society of Brewing Chemists (ASBC) Brewing Summit in 2018.[4] The study analyzed the profiles obtained after performing three different dry-hop timings. Researchers observed significant differences between the sensory profile of beer dry hopped at the beginning of fermentation and that of one dry hopped during cold conditioning. The former was described as more "tropical" than the latter.

Table 1 summarizes the identified reactions that could contribute to perceived sensory changes of mid-fermentation dry hopping, evidence for and against its having a perceptible impact, and an educated guess, pondering the available academic literature, of their respective contribution.

Considering all the above, except for bound thiols, the other biotransformations do not seem to be marked enough to favor a change in sensory profile, more so when, for several of them, timing of the dry hop addition doesn't seem to have a significant impact, or its impact hasn't yet been investigated.

WHAT ELSE COULD BE AT PLAY?

Given the academic results summarized previously, it is worthwhile to consider other potential sources, for example, the removal of the most volatile compounds, generally of a green/herbaceous profile, due to the evolution of CO_2 and carry-over or removal[11] in yeast cell walls.[12]

Although generally ignored, factors such as CO_2 scrubbing and adhesion to yeast cells help explain their decrease during fermentation.[13] This is important because terpenes such as myrcene that exhibit a green/herbal character can mask other fruitier compounds. In 2017, Haslbeck showed that fermentation at a lower temperature leads to less loss of volatile hydrophobic compounds such as myrcene.[13]

Although not the aim of the study, Williams's results from 2019 show that the earlier the addition of dry hop, the greater the removal of myrcene.[10] This clearly indicates that this is an important phenomenon in understanding why early dry hop additions alter the finished beer's profile.

Similar results were shown by Yuri Tsuchiya at the ASBC Brewing Summit in 2018.[14] In fact, another researcher from Kirin, Yoko Noro, had previously suggested using non-viable yeast at the end of fermentation to strip out "unwanted" herbal hop compounds in 2015, due to the resulting change in perceived aroma profile.[15]

VERDICT

While it is clear that mid-fermentation dry hopping produces a different sensory profile than end-of-fermentation dry hopping, it is unlikely that the major driver is biotransformation reactions, although the jury is still out on the release of thiols. It is nevertheless important to note that when many brewers talk about biotransformation, they are thinking of monoterpene alcohol bioconversion, in which case it is false that this has a major impact on the sensory profile.

"Mid-fermentation dry hopping promotes a different dry hop profile" might be a better way of stating the reality. The assertion as originally posed is at least misleading, as it places the onus on biotransformation, when it is clear other factors are at play and likely contribute more to the perceived sensory effects. Hence, we can argue that this belief is **unfounded.**

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3
THERE IS NO ISOMERIZATION AT HOP STAND TEMPERATURES OF 150–175°F (66–79°C)

It is not possible to pinpoint a specific moment in time when this idea arose, but it is common for homebrewers to think of isomerization as an on/off reaction. After all, kettle hop additions are frequently referred to as bittering, flavor, and aroma additions. At least until the latest releases, brewing software commonly neglected a knock-out (zero-minute) addition's contribution to bitterness. Taking this reasoning to the extreme is also probably the source of the belief that dry hopping does not add bitterness, even though bittering can come from compounds that do not require isomerization.[1,3] Even non-isomerized alpha acids contribute to bitterness, although at much lower levels.[2]

WHAT DOES SCIENCE HAVE TO SAY?

In a 2008 study, Jaskula, Kafarski, Aerts, and De Cooman conducted a series of experiments to study the alpha-acid isomerization reaction in detail, including the behavior of the analogs making up the alpha-acid.[4] They confirmed previous results going back to the 1960s that alpha-acid isomerization is a first-order chemical reaction, i.e. it depends only on the concentration of its reactant,[5] and that it follows the Arrhenius equation.[6]

Given that they wanted to isolate the behavior of the isomerization reaction from other interfering factors, such as loss of iso-alpha-acids with trub, a model buffered aqueous solution mimicking standard wort boil pH was used for their study, as was the case with previous studies.[6] In practice, we will observe lower efficiencies, as these losses are not accounted for, nor are downstream processing losses that occur during fermentation or filtering.

The graph below, based on the results of the 2008 study, shows isomerization happening at different temperatures at and below boiling.[4]

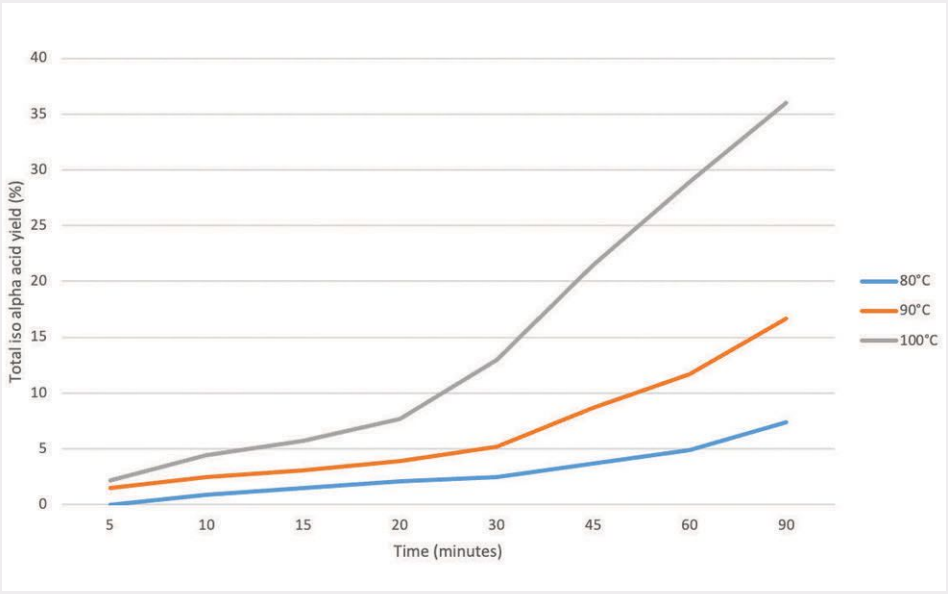
As a rule of the thumb, we can approximate the drop due to temperature with the notion that isomerization halves for every 10°C (18°F) drop in temperature. This gives us a rough idea of the effect of lengthening the knockout time, assuming the whirlpool retains heat well.

- Approximately 50–60 percent increase in isomerization yield when knockout is increased from 30 to 45 minutes
- Approximately 30 percent increase in isomerization yield when knockout is increased from 45 to 60 minutes

Hence, knockout times are an important factor to consider when understanding the isomerization yield of different brewhouses.

Matching experimental results were obtained by Malowicki and Shellhammer, however their studies only analyzed boiling and above-boiling temperatures.[6] Nevertheless, this supports the findings and, more importantly, the constants to use in the Arrhenius equation to understand the behavior of the reaction at different temperatures both above and below boiling.

FIGURE 1: TOTAL ALPHA-ACID ISOMERIZATION YIELD AT BELOW-BOILING TEMPERATURES.



Data source: Reference 4

TEST IT YOURSELF!

Still skeptical? Make an experimental brew to challenge your and your mates' taste buds! Pick your favorite bitter or pale ale recipe and brew it two different ways:

1. Leave the recipe as is.
2. Double the bittering hop addition, but add it to the whirlpool instead of at the start of the boil.

Keep the rest of the recipe the same, and when you finish, conduct a triangle test to decide whether the second version tastes bitter.

VERDICT

It is evident from the results of the different experiments that at brewing conditions, isomerization reactions occur even at temperatures cooler than boiling. Hence, we must label this belief as **outright myth.**

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Continued from *Brewing in the Aloha Spirit* on page 51

like a riesling; I'd say more like something between chardonnay and pinot grigio. The flavor was smooth and pleasant, light with a lingering sourness, but not overbearing. We never would have guessed that it wasn't made with grapes. It could have been any white wine, with a lovely, fruity citrus flavor.

Whitney and her neighbors immediately held their glasses up for a second helping, then a third. A warm, convivial mood came over all of us. There was a particular magic to this cacao wine, something different from anything we had drunk before.

BREWING WITH ALOHA

One very Hawaiian concept is the idea of *kuleana*, the sense of social solidarity and responsibility to the greater good. *Ke Ola Magazine* describes it as "one's personal sense of responsibility. It is a responsibility that we accept because we value it, and we treasure the person we become when we fulfill it." This sort of solidarity exists between the 18 breweries that do business on the Islands.

"Having a tight-knit community here has been crucial to business in the past when the boat doesn't hit the port on time," according to Nick Riley of Honolulu Beerworks. "There's always peace of mind for neighbor breweries knowing that they can hit us up for a pound of Citra hops, a few bags of base malt, or an odd seal, gasket, or clamp, and we know we can depend on them as well."

Mary Anderson of Koholā Brewery echoed this sentiment. "We have a very collaborative environment here in the islands, and it's common that a local brewery will help us out if we are in a jam. That's the benefit of brewing in the land of *aloha*!"

Kihei Carroll of Maui Brewing Co. told me how *aloha* is much more than simply "the Hawaiian word for hello and goodbye." It also embodies a philosophy of mutual love and care. "We truly do brew our beers with *aloha*, and we hope for that to come through. We strive to care about every person in our process and every detail of that process and hope it carries through. We all know how important each other are and how meaningful each of our interactions are because of how few of us there are. This reinforces what *aloha* (love) and *ohana* (family) mean to the culture of Hawaii."

For many brewers in the islands, however, being "locally minded" is a much broader concept.

Nick Riley of Honolulu Beerworks said, "I think there's an important difference between making something 'tropical' and calling it 'Hawaiian.' We feel one of the aspects of our brewery that gives us a 'Hawaiian' touch is our participation in the local community: collaborating with and employing local artists and designers for the art on our cans, beer donations to charity benefit events, and adopting needy Oahu families at Christmas."

Breweries are exercising their *kuleana* toward the planet as well. Many craft breweries of Hawaii seek to be increasingly sustainable by using photovoltaic solar panels to reduce their carbon footprints. According to author Paul R. Kan, many seek to eventually be completely off the grid. Eric of Kona Brewery said, "Due to these challenges, we've designed our new brewery in Kailua-Kona to be sustainably sufficient. We're leveraging solar power, water reclamation, and eventually planning for CO_2 reclamation as well. This can help us to offset some of the costs in the long run, while also just doing our part to minimize our carbon footprint."

By practicing responsible stewardship of the planet and its resources, Hawaii breweries teach us all a lesson in *kuleana*. We must follow their example to ensure that places like Hawaii will remain pristine and luxurious, fitting of Mark Twain's description of an evening spent there:

> *…it was tranced luxury to sit in the perfumed air and forget that there was any world but these enchanted islands.*

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“IT’S KEY FOR BREWERS TO KEEP AN EYE ON MALT CERTIFICATES OF ANALYSIS FOR THE 2021 CROP”

Key grain growing regions in North America experienced record-breaking, sustained heat in early summer 2021. resulting in damaged grain crops, causing elevated proteins, lower than expected yields, and fewer plump kernels. This year’s crop will have higher protein levels and an increase in kernel variability than we’ve seen in recent years.

The good news is that you can still make quality beer from this malt.

We’ve compiled everything you’ll need to help you produce the best beer possible this year in our whitepaper, *2021 Crop Mitigation Strategies*, now available for download.

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COLOR CALCULATIONS AND MEASUREMENTS

PART 2: PREDICTING BEER COLOR FROM RECIPES

By Thomas Kraus-Weyermann and Horst Dornbusch

BEER COLOR EQUATIONS .

This is the second article in a three-part series about the challenges of specifying beer color at the recipe design stage, as well as measuring it after the beer has been brewed. It examines the most common equations currently in use by brewers around the world for specifying beer color before the brewing process begins.

While measuring color in the finished beer is already a tricky business and thus only an imperfect science (see part 1 of this article series, [1]), predicting it at the beer design stage is fraught with even more uncertainty. Internationally, there are now several competing equations in use for this purpose, but, unfortunately, each of them produces a different beer color value if applied to the same grain bill (see Table 1). Likewise, on occasion, these formulae also produce identical predictive beer color values for finished beers of different colors.

The photo shown in Figure 1 illustrates this latter point. It was taken by the authors during an unrelated project. At the recipe design stage, one of the color formulae explained below predicted that the colors of these two Maibocks, mashed with different grain bed compositions, would be mathematically similar, in the range of roughly 22–23 EBC (11–12 SRM; the EBC and SRM units for measuring the color of liquids are explained in part 1 of this article series, [1]). In reality, however, as can be seen even with the naked eye, these two beers are of very →

different colors. When analyzed in the laboratory, the color value of the beer on the left was almost twice that of the beer on the right. In fact, it was this accidentally taken photo that was the starting point for the research presented here.

SOURCES FOR BEER COLOR CALCULATIONS

As a practical matter, when designing beer recipes, many brewers nowadays use web-based programs. Some of these are available for free; others can be accessed only for a user fee. Reference 2 lists a selection of URLs for such programs [2]. Users can enter a range of values into these online platforms, including the extract efficiency of their brew system; the beer's desired original gravity; the composition of the grain bill by weight; and—most relevant for this article—the color values of the malts in the mash as provided by the maltster. Unfortunately and surprisingly, however, several of these online applications generate different outputs for identical inputs, including for beer color; and the reasons for these differences tend to be difficult to discern because the algorithms embedded in these platforms often work only invisibly, hidden behind the user interface.

Fig. 1:
Spectrophotometric measurements show the color value of the left beer to be roughly double that of the right beer, even though one of the mathematical formulae used to calculate the two colors in advance suggested that they would be identical.

$$MCU\ \text{(wort color in SRM units)} = \frac{(MC_1 \times W_1) + (MC_2 \times W_2) + (MC_3 \times W_3) + \cdots + (MC_n \times W_n)}{V}$$

Formula 1

$$MCU\ \text{(wort color in EBC units)} = \frac{(MC_1 \times W_1) + (MC_2 \times W_2) + (MC_3 \times W_3) + \cdots + (MC_n \times W_n)}{MW} \times \frac{OG}{10}$$

Formula 2

$$C_{EBC} = \frac{(MC_1 \times W_1) + (MC_2 \times W_2) + (MC_3 \times W_3) + \cdots + (MC_n \times W_n)}{W_{total}} \times \frac{G}{10} + BT \times D + CC$$

Formula 3

$$C_W = \frac{(MC_1 \times W_1) + (MC_2 \times W_2) + (MC_3 \times W_3) + \cdots + (MC_n \times W_n)}{W_{total}} \times \frac{G}{10} + CC$$

Formula 4

MALT COLOR AS STARTING POINT

The color values of the malts in the mash always serve as the starting point for predicting the color of the beer made from a mash; and, nowadays, the measurement procedure used by maltsters for the determination of malt colors has become standardized. It involves the extraction of a standard wort from a single-malt congress mash and the spectrophotometric measurement of the liquid's color as proxy data for malt color (for detailed explanations of malt color measurements, see [1]). Maltsters report malt colors in units defined either by the European Brewing Congress, in EBC, or by the American Society of Brewing Chemists, in degrees Lovibond (°L). However, because of international measurement standardization, there are simple mathematical relationships between EBC units and non-EBC units that allow for the conversion of all of them into each other. The relevant equations are:

- 1 EBC = 0.377°L;
- 1 °L = 2.65 EBC;
- 1 SRM = 1.2992°L;
- 1 °L = 0.77 SRM;
- 1 EBC = 1.97 SRM;
- 1 SRM = 0.51 EBC.

THE MALT COLOR UNIT OF THE WORT

The aggregate color value of a composite mash is the result of the color values of each individual malt, expressed in EBC or °L units, and of the proportional share of each malt in the mash. Therefore, the wort color—often called the "malt color unit" (MCU)—is a function of the aggregate mash color and of the volume of liquid

TABLE 1: COLORS OF 20 BEERS CALCULATED BY 5 BEER COLOR FORMULAE

Beer name	Mosher formula			Daniels formula			Morey formula			Weyermann® formula			Krüger formula			Spectrophotometer value	
	EBC	SRM	% Deviation from spectrophotometer value	EBC	SRM	% Deviation from spectrophotometer value	EBC	SRM	% Deviation from spectrophotometer value	EBC	SRM	% Deviation from spectrophotometer value	EBC	SRM	% Deviation from spectrophotometer value	EBC	SRM
Hofbräu Export	23.6	12.0	143.3	26.0	13.2	168.0	25.9	13.2	167.0	11.7	6.0	20.6	14.2	7.2	46.4	9.7	4.9
Hofbräu Exquisator	31.0	15.8	-56.7	30.9	15.7	– 56.8	34.7	17.6	– 51.5	74.0	37.6	3.4	82.5	41.9	15.2	71.6	36.3
Hofbräu Lager	11.4	5.8	21.3	17.9	9.1	90.4	6.7	3.4	– 28.7	11.2	5.7	19.1	12.7	6.4	35.1	9.4	4.8
Hofbräu Pils	10.9	5.5	49.3	17.5	8.9	139.7	5.4	2.7	– 26.0	9.3	4.7	27.4	9.8	5.0	34.2	7.3	3.7
Hofbräu Rauchbier	17.0	8.6	– 52.0	21.6	10.9	– 39.0	16.8	8.6	– 52.5	31.7	16.1	– 10.5	32.4	16.4	– 8.5	35.4	18.0
Hofbräu Rotbier	18.5	9.4	– 55.7	22.6	11.5	– 45.9	19.1	9.7	– 54.3	37.4	19.0	– 10.5	36.4	18.5	– 12.9	41.8	21.2
Hofbräu Schwarzbier	25.5	12.9	– 60.6	27.2	13.8	– 58.0	28.3	14.4	– 56.3	61.9	31.4	– 4.3	54.6	27.7	– 15.6	64.7	32.8
Schlotfegerla®	30.9	15.7	– 60.3	30.8	15.6	– 60.5	34.5	17.5	– 55.7	82.8	42.0	6.3	91.3	46.3	17.2	77.9	39.5
No. 2 Black IPA	26.4	13.4	– 68.2	27.8	14.1	– 66.5	29.4	14.9	– 64.6	62.7	31.8	– 24.5	71.2	36.1	– 14.2	83	42.1
No. 3 Bohemian Pilsner	11.2	5.7	12.0	17.7	9.0	77.0	6.2	3.1	– 38.0	10.5	5.3	5.0	11.0	5.6	10.0	10	5.1
No. 4 Crazy Coriander	10.3	5.2	71.7	17.1	8.7	185.0	3.9	2.0	– 35.0	7.2	3.7	20.0	7.7	3.9	28.3	6	3.0
No. 5 Süßholz- porter	66.1	33.6	– 60.1	54.3	27.6	– 67.2	67.2	34.1	– 59.4	206.1	104.6	24.5	214.6	108.9	29.6	165.6	84.1
No. 6 Bamberg Rogg't	18.9	9.6	– 55.9	22.8	11.6	– 46.9	19.6	10.0	– 54.3	37.6	19.1	– 12.4	46.1	23.4	7.5	42.9	21.8
No. 7 Rye IPA	25.3	12.8	– 59.1	27.1	13.8	– 56.2	28.0	14.2	– 54.8	59.0	30.0	– 4.7	67.5	34.3	9.0	61.9	31.4
No. 8 Oktober- weizen	13.2	6.7	– 35.6	19.1	9.7	– 6.8	10.5	5.3	– 48.8	17.8	9.0	– 13.2	22.3	11.3	8.8	20.5	10.4
No. 9 Willy Wonka Bock	20.6	10.5	– 61.0	24.0	12.2	– 54.5	22.0	11.2	– 58.3	42.2	21.4	– 20.1	50.7	25.8	– 4.0	52.8	26.8
No. 11 Pumper- nickel Porter	43.2	21.9	– 66.3	39.1	19.8	– 69.5	47.2	23.9	– 63.1	121.6	61.7	– 5.0	130.1	66.0	1.6	128	65.0
No. 12 Wheat Wine	14.5	7.3	– 72.6	19.9	10.1	– 62.5	12.7	6.5	– 76.0	21.0	10.7	– 60.4	28.5	14.5	– 46.2	53	26.9
No. 13 Oatmeal Stout	52.7	26.7	– 56.1	45.4	23.0	– 62.2	55.8	28.3	– 53.5	174.0	88.3	45.0	169.0	86.0	40.8	120	60.9
No. 14 IPA	13.0	6.6	– 40.4	18.9	9.6	– 13.3	10.1	5.1	– 53.7	16.3	8.3	– 25.2	20.8	10.6	– 4.6	21.8	11.1
Accuracy ranking (%)	– 28.2			– 5.3			– 40.9			– 1.0			+8.9			Laboratory measurements	
Accuracy ranking without Hofbräu Export (%)	– 57.2			– 14.4			– 51.8			– 2.1			+6.9				
	Positive value = darker than laboratory spectrophotometer measurement; negative value = lighter than measurement																

Photos courtesy of Weyermann® Malzfabrik

that is extracted from the mash, expressed either as in liters or gallons or as original gravity. The MCU declines as the volume of extracted wort increases, that is, as the original gravity decreases. Because the MCU formula was first developed in the United States, it was based on the following inputs: malt colors in Lovibond scale (°L); beer colors in SRM; malt weights in U.S. pounds (lb.); and beer volumes in U.S. gallons (gal.). Please refer to Formula 1, whereby

- MC_{1-n} = the color values (in °L) of the individual malts in the grain bill;
- W_{1-n} = the weight (in lbs. of dry weight) of the individual malts in the grain bill;
- V = the wort volume (in gals.) extracted from the mash.

Rewritten in the metric system, formula 2 is the analogous MCU formula, whereby

- MC_{1-n} = the color values (in EBC) of the individual malts in the grain bill;
- W_{1-n} = the weight (in kg of dry weight) of the individual malts in the grain bill;
- MW = total grist weight (dry in kg);
- OG = original gravity in °P (which incorporates the volume of wort extracted from the mash).

The above MCU formula, however, has one critical drawback: It is a linear function. As a practical matter, it is true that 1 MCU is roughly (!) 1 SRM (or, precisely, 1.97 EBC), but only in a very narrow, pale segment of the beer color spectrum, up to approximately 6 SRM (roughly 12 EBC). Beyond this threshold, MCU values become progressively less indicative of the actual beer color, in part because several factors other than malt can contribute to beer color. These interference factors may include the effects of non-enzymatic browning from the Maillard reaction, the boil length, changes in pH, colloidal instability, and beer hazes. These influences are discussed in greater detail in part 3 of this article series. Therefore, purely linear MCU predictions before the brewing process become essentially useless as the beer color exceeds 10 SRM (roughly 20 EBC), unless the equation is adjusted by an "add-on" factor (which is discussed in detail in part 3). Logarithmic ex-post-facto spectrophotometric measurements of beer color in the laboratory, on the other hand, take these interference factors into account.

Formulae for Beer Color Predictions

Several formulae for predicting beer color before the brewing process (rather than measuring it after the brewing process) have evolved since the days of Brewmaster Lovibond [1]. Each relies on the MCU (see formula above) and incorporates mathematical correction techniques that account for process variables. Perhaps the most comprehensive of these formulae has grown out of the metric system. A fairly recent description of this formula appeared in the spring of 2019 in an article by Jörg Krüger in *Braumagazin* [6]. Because this formula has no official name, it is simply referred to here as the "Krüger formula." It starts with a calculation of the MCU of a given mash and then adds "darkening" corrections based on the length of the boil, the original gravity, and the proportional amounts of pale malts in the mash. A similar, but slightly simplified version of the Krüger formula is also used at the Weyermann® Malting Company. It combines the different add-ons of the Krüger formula into a single, variable correction factor. Again, for simplicity's sake, this formula is referred to here as the "Weyermann formula." This for-

Fig. 2: The "real" colors of three Hofbräu beers featured in table 1 (from left): Rauchbier, Schwarzbier and Exquisator.

TABLE 2: AVERAGE PERCENT DEVIATION BY FORMULA FROM SPECTROPHOTOMETER VALUES.

Ranking (for all 20 beers)	Formula	Average % deviation (for all 20 beers)	Ranking (excluding Hofbräu Export)	Average % deviation (excluding Hofbräu Export)
#1	Weyermann	–1	#1	–2.1
#2	Daniels	–5.3	#3	–14.4
#3	Krüger	+8.9	#2	+6.9
#4	Mosher	–28.2	#5	–57.2
#5	Morey	–40.9	#4	–51.8

mula is also used randomly as a reference for comparing the results generated by the other formulae in Table 1.

In addition, starting in the 1990s, there have been several other attempts—all in the United States and all based on the MCU—to construct simple and easy-to-use color prediction formulae for practical brewers. Most notable among these are three formulae developed by Randy Mosher, Ray Daniels, and Daniel Morey, who are well-known authors, brewers, and recipe designers [3, 4, 5, 6, 10]. Because these equations, too, have no names, they are referred to here as the "Mosher formula," the "Daniels formula," and the "Morey formula," Of late, these formulae have become enormously important because, as mentioned above, most online beer specification calculators have adopted at least one of them. Especially the Morey formula has become almost ubiquitous online; and many modern home- and craft brewers rely on it exclusively for their beer color predictions. Here is how they work.

The traditional Krüger formula

The Krüger formula is the most complex of the five formulae considered here. Based on a version of the MCU, it takes into account the largest number of factors that might play a role in determining a beer's color. The Krüger color value (calculated in the metric system) is expressed here as C_{EBC}. Please refer to formula 3, whereby

- MC_{1-n} = the color values (in EBC) of the individual malts in the grain bill;
- W_{1-n} = the weight (in kg of dry weight) of the individual malts in the grain bill;
- W_{total} = the total weight (in kg of dry weight) of the entire grain bill;
- G = the original gravity (in °P) of the wort as specified in the recipe;
- BT = the boil time (in hours);
- D = the wort darkening per hour in EBC (generally 1.5 EBC or 0.76 SRM per hour [7]);
- CC = a color correction factor of 2 to 4 EBC for very pale beers to capture the proportionally greater darkening effect of the kettle boil on these beers[6].

The Mosher formula

The first beer color formula for beer recipes to find wide acceptance among modern home- and craft brewers in North America was Randy Mosher's. It is a simple, linear, MCU-based equation, obviously in USA measurement units, which the author extrapolated from commercial beers with known recipes and color values. It consists of a fixed multiplier (0.3) for the MCU value and the addition of a constant (4.7). Mosher published this formula in 1994 [3]. It postulates:

$$SRM = 0.3 \times MCU + 4.7$$

The Daniels formula

The "Daniels formula" is also a different linear scale with a constant correction factor. Because the Mosher formula was found to perform poorly especially in color ranges above roughly 10 SRM (20 EBC), Ray Daniels attempted to resolve this problem by revising Mosher's formula based on his own trial-and-error calculations derived from a large number of homebrewed recipes [4, 5]. He developed his linear formula in 1995/1996. It reads as follows:

$$SRM = 0.2 \times MCU + 8.4$$

The logarithmic Morey formula

Recognizing the diminishing accuracy of both the Mosher and Daniels linear formulae for darker beers, Daniel Morey, an avid homebrewer, developed an MCU-based formula that takes the logarithmic nature of light absorption as a function of increasing darkness of the measured liquid into account. Morey crunched malt color values into a curvilinear rather than a linear model and presented it for the first time in a homebrew blog in 2000. An updated version of this blog can now be found online under the title "Approximating SRM Beer Color of Homebrew Based on Recipe Formulation" [8]. Because humans cannot detect the differences in beer colors much beyond roughly 40 SRM (80 EBC), Morey

limited the applicability of his analysis to about 50 SRM (100 EBC).

Although Morey developed his formula initially for homebrewers, it has since been adopted by many (if not most) craft brewers in the United States, in part because many brewing textbook authors have also embraced it. Most prominent among these is John Palmer in his highly successful book *How To Brew* [9]. In fact, Palmer has become one of the most influential advocates of the Morey formula. In the May/June 2003 issue of *Brew Your Own* magazine, Palmer wrote that the "data for the full spectrum of beer color … may be better fit by an exponential curve, such as the one described by D. Morey's equation" [10].

With such support, the Morey formula has become the almost universally accepted one in online recipe calculators for home- and craft brewers, including in the popular beersmith.com. Characteristically, this site justifies its choice by insisting (without proof) that the "Morey equation provides an excellent estimate of beer color throughout the range from 1 to 50 SRM and is the one used by most brewers today" [11]. In other words, the proponents of the Morey formula maintain that it can be applied beneficially to any beer from a straw-yellow Helles to a pitch-black stout. Morey's mathematical formula reads as follows:

$$SRM = 1.4922 \times MCU^{0.6859}$$

The Weyermann formula

Compared to the Krüger equation above, the Weyermann formula combines the various add-ons of the traditional formula to the beer's MCU value into just a single value. The color value generated by the Weyermann formula is expressed as C_W, and the single add-on at the end of the equation as *CC*. The *CC* value is in EBC units. It varies with the original gravities of the beers. Please refer to Formula 4, whereby

- MC_{1-n} = the color values (in EBC) of the individual malts in the grain bill;
- W_{1-n} = the weight (in kg of dry weight) of the individual malts in the grain bill;
- W_{total} = the total weight (in kg of dry weight) of the entire grain bill;
- *G* = the original gravity (in °P) of the beer as specified in the recipe;
- *CC* = a color correction factor (instead of the boil length as in the Krüger formula).

This color correction factor is based on the beer's original gravity as follows:

- 0 EBC with an original gravity up to about 7°P;
- 3 EBC within an original gravity in the range of 7.1–10°P;
- 5 EBC within an original gravity range of 10.1–15°P;
- 7 EBC within an original gravity range of 15.1–20°P;
- about 10 EBC with an original gravity over 20°P.

EVALUATION OF THE DIFFERENT FORMULAE

Table 1 consists of a list of 20 beers that were produced on various occasions in the 2.5-hectoliter Weyermann® pilot brewery in Bamberg with the color values predicted by the Mosher, Daniels, Morey, Weyermann, and Krüger formulae. The table also shows the true spectrophotometric values (2 right columns) for each beer as measured in the laboratory. In addition, it also shows the deviations of each value from the spectrophotometer measurements expressed as positive or negative percentages. Finally, the two bottom rows show the average deviations of the five formulae from the laboratory measurements.

Table 1 suggest three conclusions: First, not a single value generated by any of the formulae agrees 100 percent with the corresponding laboratory measurement. Second, the pre-calculations sometimes predicted darker and sometimes lighter beers than the actual results of the brewing process. Therefore, it is not possible to derive simple rules for the extent and the direction of the deviations from the true values. Third, it is patently clear from the summary in the bottom rows that some formulae produce much more reliable—though not 100 percent accurate—forecasts than others.

Table 2 ranks the predictive strength of the five formulae.

First, the Mosher, Daniels and Morey formulae were unusually inaccurate in the direction of dark in their predictions for the 9.7 EBC Hofbräu Export, whereas the Krüger and Weyermann formulae were off by smaller amounts. Therefore, the summary accuracy ranking of the formulae changes slightly, if the Hofbräu Export values are eliminated as statistical outliers.

Second, the Weyermann formula comes closest to the laboratory measurements, with average beer color predictions that are only a few percent lighter than the actual colors, whereas the Krüger formula pre-calculates color values that are on average 8.9 percent and 6.9 percent, respectively, darker than the laboratory measurements.

Interestingly, the Daniels formula, which generates the largest spread of deviations from the measured values, from +185 to –67.2 percent, yields a fairly small deviation of only –5.3 percent, once all the individual values are averaged. The Daniels summary deviation, however, increases to –14.4 percent, once the Hofbräu Export is removed from the calculations.

Next, the Mosher formula, which generates a spread of values from +143.3 to –72.6, errs substantially (–28.2 and –57.2 percent) in the direction of lighter beers.

Finally, the Morey formula, which has become almost ubiquitously popular among modern home and craft brewers, is off by a significant average of –40.9 and –51.8 percent, respectively, in the direction of lighter colors.

CONCLUSION

Today, many publications and online applications, including beersmith.com, "take sides" by selecting a single, predictive color formula (mostly the Morey formula) for color calculations, while other sites, such as www.brewersfriend.com, avoid taking a position by featuring predictive beer color calculations not just for the Morey formula but also for the Mosher and Daniels formulae, as well as for the simple, "pure," uncorrected MCU scale. Many sites also allow users to switch between standard metric and United States units of measurement, as for instance the site listed in [12].

Yet, the dilemma remains: Once applied to a given mash, each of these formulae predicts, as Table 1 shows, drastically different color values for the same beers and thus calls into question the practical applicability of any of these formulae. Part 3 of this three-part article series, therefore, will explore in greater detail the relationship between the variations summarized in Table 1 and the actual spectrophotometric color measurements. For this, the authors brewed three beers according to almost identical specifications, using identical

processes. Only the types and amounts of color malts differed. The grain bills were composed based on experience, with the expectation that the three test beers would be easily distinguishable as blond, amber, and dark. The final installment of this series featuring these analyses was published in *BRAUWELT International* no. 4, 2021, and will be reprinted in the Jul/Aug 2022 issue of *Zymurgy*.

ACKNOWLEDGEMENTS

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IS CIDER EDUCATION THE KEY TO THE INDUSTRY'S GROWTH?

By Kristen Kuchar

There's no denying that cider has increased in popularity in recent years. At the start of 2019, there were an estimated 900 cider producers throughout the United States.[1] Even during the COVID-19 pandemic, cider sales still grew nine percent in 2020, and the market was 10 times bigger than it had been a decade earlier.[2] Even regional cider producers saw a 15 percent increase in sales from the previous year.

Despite that growth, cider still represents less than one percent of the total alcoholic beverage market in the United States.[3] Many consumers haven't yet discovered cider, and even those who have may not recognize the wide variety of ciders available—not every cider tastes like sweet apple juice! →

The American Cider Association (ACA) aims to help the US cider and perry industry flourish, and education plays a major role in that mission. The organization provides valuable resources, information, and services to the industry and advocates on its behalf. By further educating those in the food and beverage community, the association hopes to offer patrons the best cider drinking experience.

Education and Certification

Jennie Dorsey, cider education outreach manager for the American Cider Association, says there should be more conversation about cider in the industry. She points out that when a customer asks if cider is served at a restaurant or bar, it's often met with a simple yes or no response. The same question about wine, however, may prompt a discussion in which servers explain the various styles and regions available. Ideally, the cider response would be similarly detailed—yes, we have a fruited cider from this specific region, for example.

Dorsey hopes that better consumer understanding of cider will lead to more dialogue and excitement. That's why the American Cider Association launched two professional certifications for those in the cider industry—the Certified Cider Professional (first exam offered at CiderCon 2016) and the Certified Pommelier (first exam offered at CiderCon 2019).

The Level One Certified Cider Professional, or CCP for short, is designed for people who would benefit from a deeper but still introductory level of cider knowledge. The CCP is offered online and consists of a 60-question exam with a passing score of 85 percent. Sample questions include

- What are the flavors of an oxidized cider that was improperly stored?
- Which gas should never be used in a draft system to push cider?
- True or false? France has a strong tradition of deliberately swirling the bottle and pouring cider with sediment.

"It's really for everyone in the food and beverage industry," says Dorsey. She says anyone serving cider—whether at a cidery or aboard a cruise ship—could benefit from such education.

The second level, Certified Pommelier, is more in depth and often requires months of study. While there are close to 2,000 Certified Cider Professionals, there are currently just 15 Certified Pommeliers. In order to sit for the Certified Pommelier Exam, you must already be a Level One Certified Cider Professional.

Both exams cover seven key principles, with Certified Pommelier diving into each topic more deeply.

- Apples (Orchard and History)
- Cidermaking
- Evaluation
- Families and Flavor
- Keeping and Serving
- Food and Cider
- Social Responsibility

The exams, as well as any educational content associated with them, were created by the education committee overseen by the American Cider Association, which includes professionals committed to cider and education.

"We really want people to walk into any store, from a 7-Eleven to a high-end wine shop, and be able to choose a cider for themselves based on a common language." – Jennie Dorsey

The Certified Pommelier exam must be completed in person and is offered at CiderCon. An online exam isn't an option since, in addition to the short-answer and essay questions, there is a blind sensory evaluation portion.

"Without practice, it can be challenging to evaluate a cider blind," Dorsey says. Candidates are required to identify the best-known international ciders and be able to understand flaws and faults and how they can be perceived, Dorsey explains.

Feedback for the exam has been positive thus far, Dorsey says, and it has helped many new cidermakers bring their ciders to the market using a language that everyone can understand. But benefits of such training are not just limited to cider professionals. The ACA study guide notes that anyone dealing with cider can benefit from such in-depth knowledge, including retailers, markers, distributors, and journalists. The end goal, according to the ACA, is to "educate customers on the diversity and nuances of the vast but misunderstood cider category."

"We really want people to walk into any store, from a 7-Eleven to a high-end wine shop, and be able to choose a cider for themselves based on a common language," Dorsey says.

Certification in Practice

Sara Boyd, owner and cidermaker at Loch Mór Cider Co. in Ontario, became a Certified Pommelier to help educate people that cider is a drink worthy of consideration. Sara and husband Gary focus on dry ciders at their cidery, using heritage and traditional cider apples that are pressed at harvest and fermented slowly.

"Our ciders drink much more like a wine and pair beautifully with food," she explains. Their ciders are well-received, and the cidery's offerings have won Best Cider of the Year at the 2021 WineAlign awards (Canada's national wine awards) and best-in-class rankings at the Great Lakes International Cider and Perry Competition (GLINTCAP) this year, along with other gold, silver, and bronze medals.

"It's about broadening people's horizons on cider," Boyd says. The cidermaker sees it often in their tasting room: a customer walks in and says they don't like cider. Then they give it a try and their mind is blown, she explains.

The cidery is located in Prince Edward County, a popular wine region in Ontario, along with more than 40 nearby wineries. Having the Certified Pommelier title helps elevate the cider experience and provides an education for wine

Jennie Dorsey of the American Cider Association leads a cider training group.

Sara Boyd and Gary Boyd of Loch Mór Cider Co.

tourists visiting the cidery. Achieving the rank of Certified Pommelier requires hard work, reading, and studying, she says, and adds that it is geared towards people who want to use the title professionally like a sommelier or Certified Cicerone. She and the cidery have received increasing media attention from local reporters who often include her when mentioning local female sommeliers.

Deepening the knowledge of cider means exposing people to different varieties. Boyd says it's also about taking descriptive terms that could be off-putting, such as barnyard-like or leathery, and showing what these unique flavors can truly lend to an interesting cider.

Boyd's goal is to highlight stylistic diversity and the many ways to enjoy cider. She is particularly passionate about pairing cider with food.

"Broadly, cider and food pair well because cider tends to be a bit lighter on the palate with refreshing acidity, so it doesn't dominate a meal," Boyd says. "It's also lower ABV than a wine, so it never comes across as 'hot' and a 750-milliliter bottle can easily be enjoyed over dinner."

Boyd strives to help consumers navigate the many ways to pair cider with food and how doing so elevates both the beverage and the meal. She explains that pairing cider with food follows the same principles as pairing beer. One might choose a cider that *complements* the flavors in the meal (e.g., a smoky whiskey-barrel-aged cider with a flame-grilled steak), *cuts* through dominant food flavors (e.g., a bright, acidic cider to cut through the richness of cheese or charcuterie), or *contrasts* with the main flavor (e.g., a dry-hopped cider paired with spicy tacos).

Another approach is to *match intensities*, she explains, as with a light-bodied crisp dry cider paired with a meal that features light, delicate flavors. Boyd also points out the theory that what grows together, goes together—a cider from a particular region may pair well with foods grown or produced there, such as a dry, tannic West Country British cider matched with a locally produced sharp cheddar from the same region.

Amie Fields, partner and sales director at Botanist & Barrel in Cedar Grove, N.C., wants to change the idea that all cider is the same as the mass-marketed sweet ciders many consumers associate with fermented apples.

"Cider's resurgence has allowed it to both be playful and serious, so it's fluid and ever-changing," she says. "It's an exciting time to learn about the old traditions as well as the new innovators!"

The ciders and wines produced at Botanist & Barrel are unrefined and unfiltered, with no additives. The focus for the ciders is on locally produced fruit, within 200 miles, including their own farm property, and organic whenever possible.

Fields strives to educate consumers that cider isn't always sweet, that it can be serious, and that it offers a sense of place in the beverage world. She wants to debunk some misconceptions around cider. "A lot of people believe cider is brewed. Cider is really a wine, just apple based," she notes.

She wants to expose people to different varieties of cider and create a better understanding of the beverage, which led her to pursue becoming a Certified Pommelier to complement her knowledge as a Certified Sommelier. It also was part of the inspiration that led to opening a tasting room and bottle shop in Asheville with more than 300 natural wines and ciders. Asheville's status as a busy tourist destination means even more visitors from all over the country will have access to unique ciders.

"It has given me more confidence to mentor others," she says of her certification. "Having the accreditation and the support of the ACA has also allowed cider to take a place on the worldwide stage which has brought new attention to this historic beverage."

She says the Certified Cider Professional could be beneficial to anyone in the industry. "The Certified Pommelier exam is for those who want to take their beverage programs to the next level or for those who are in beverage education and want to delve deeper into cider pairings for the service industry," she says. "Cider is really in its own category and deserves its shine."

How to Prepare

To prepare for the exam, the ACA provides a list of recommended books including: *Cider Hard & Sweet* (Ben Watson), *World's Best Ciders* (Pete Brown and Bill Bradshaw), *Craft Cider Making* (Andrew Lea), *Tasting Cider* (Erin James), *Ciderology* (Gabe Cook), *Modern British Cider* (Gabe Cook) and *American Cider* (Dan Pucci). There is also a dedicated Facebook group for those studying for the exam.

The ACA provides various helpful documents, including a cider families guide, an overview on cider cocktails, and a practice sensory worksheet. The study guide advises knowing the various regions and types of apples listed, different harvesting techniques and cider making by region, an understanding of pairing food and cider, and the history of the apple, among numerous other topics. The guide also emphasizes an in-depth understanding of cidermaking and the best practices for serving cider.

In addition to the resources already mentioned, Fields also recommends *The Big Book of Cidermaking: Expert Techniques for Fermenting and Flavoring Your Favorite Hard Cider* (Christopher Shockey, Kirsten K. Shockey). Cider podcasts, such as *CiderChat* and *Neutral Cider Hotel* (led by Ciderology author Gabe Cook), could be good resources, too, adds Boyd.

Both Boyd and Fields stress the importance of preparing for the blind tasting, which can be a challenge even for those in the industry already making cider. It's helpful to taste as many different regional styles of cider as possible, they both add. Candidates should know how to evaluate a cider on appearance, aroma, taste, mouthfeel, and finish, and be able to identify various flaws such as cork taint, oxidation, and extreme acetification. It's also vital to know the various regional styles.

"If possible, start a tasting group with someone that has a background in wine or with a cider or winemaker that knows the common faults and can show you examples of them," Fields suggests. She also points out that the ACA has a sensory evaluation workshop you can take in preparation as well.

Dorsey suggests that home cidermakers preparing for either certification, in addition to seeking out the above resources, get involved with the local cider community. "We encourage you to engage with cideries and cider professionals in your area to taste with them or even to join our online community to immerse yourself in the language of cider," she adds.

It's not just about being able to say they're certified but what that actually means, Dorsey says. They truly know about cider, and it shows.

Resources

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Kristen Kuchar has covered the food and beverage industries for the past 14 years. She has written for* Brew Your Own, BeerAdvocate, *CraftBeer.com,* The Beer Connoisseur, DRAFT, All About Beer, *VinePair, and many more.


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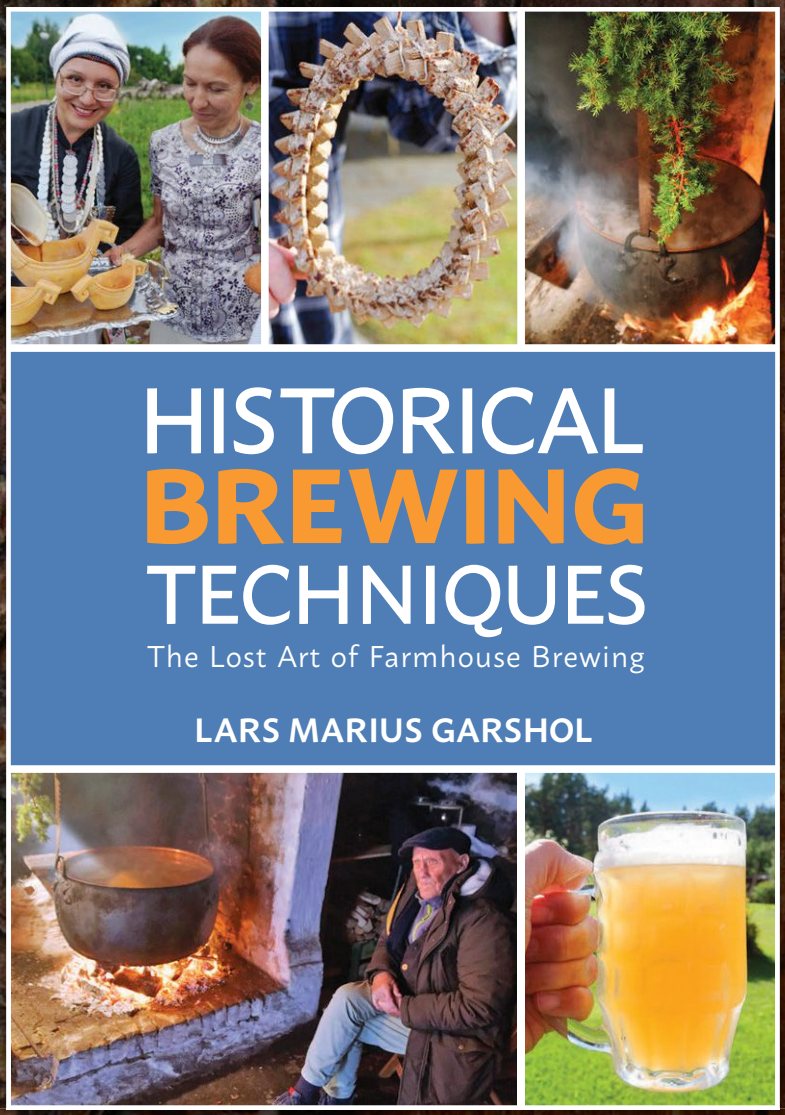

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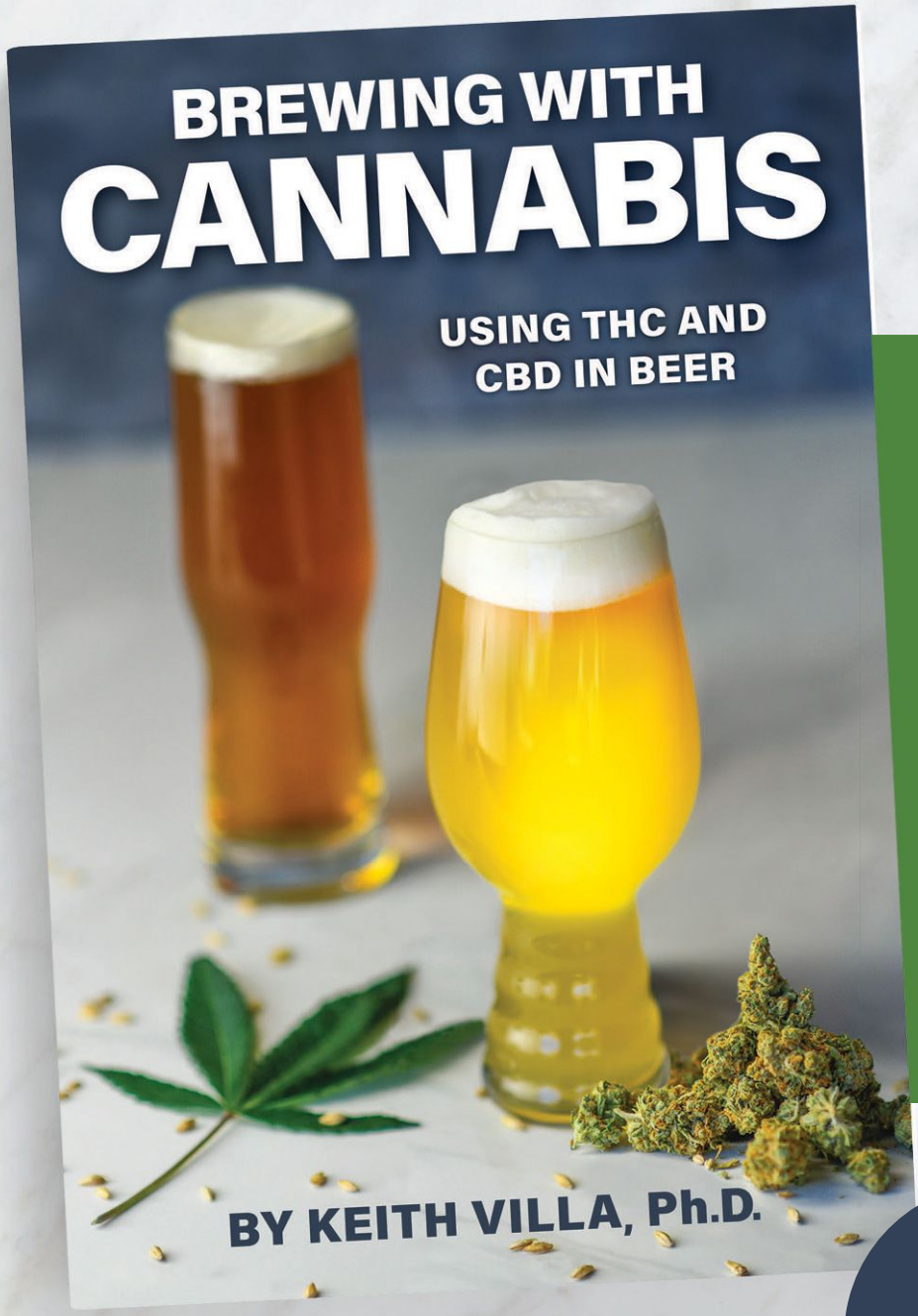

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Engineering a Beer Competition

By Bethany Kersten, William Dean, and Drace Penley

Chemical engineering essentially breaks down into three fundamental subjects: reactions, thermodynamics, and transport. While these subjects are critical to understanding the deep-rooted science and math that chemical engineers do, it is the combination of the three that drives many of the processes we study.

The first undergraduate course that really combines all of these topics is "separations." This course is key to understanding all the unit operations that chemical engineers oversee across the world. For many students, a large part of this course focuses on distillation, which is the most widely used separation technique.

In industry, distillation is mainly used to separate organic materials for use in applications such as energy and plastics, but most people's first reactions to the word distillation are in reference to the production of spirits. Unfortunately, distillation of alcohol for consumption is illegal to do without proper licensing, but this is not the case for brewing beer.

Brewing may not involve multiple-story towers that separate chemicals based on their boiling points, but there are still many fundamental chemical engineering theories that drive the process and attract those studying the subjects to it. From extracting sugars from grain and flavors from hops to the kinetics of yeast's conversion of sugar to ethanol and the diffusion of carbon dioxide into the beverage, the list goes on. No matter your focus or specific interests, as a chemical engineer, homebrewing is exciting. →

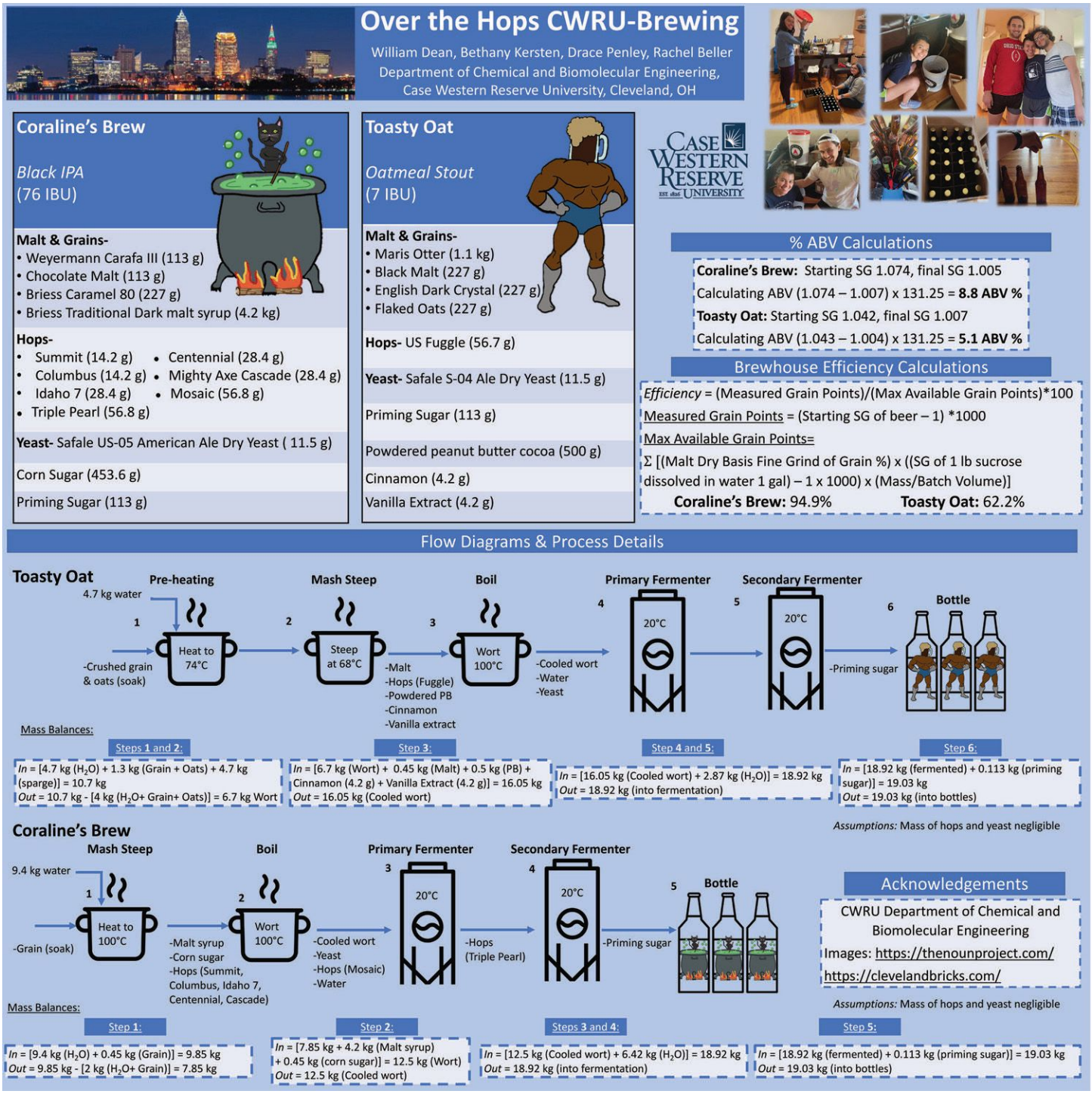
Photos courtesy of authors

QUARANTINE BREWING

Our quarantine started like many others' did—bored at home, with not much to do and few people to interact with. Many of my fellow students and I enjoy visiting new breweries and trying out all the exciting seasonal creations of local brewers, but this was no longer an option. Luckily the student body of Case Western Reserve University (CWRU) offered us opportunities to find a new outlet during these times.

Our beer-brewing adventure began with a campus-run meadmaking class, in which each registered person was given the materials to make 1 gallon (3.8 liters) of mead. The three of us had some prior brewing experience, having brewed with friends on one or two occasions, but we'd enjoyed minimal success. With a renewed sense of passion for fermentation and no option to visit breweries, we were left with a simple choice: make good beer at home.

This decision led to our brewing multiple beers at a time, testing recipes, and enjoying the fruits of our labor as we went. The more we brewed, the more confident we became, and we allowed ourselves more creative freedom. This led to Dr. Christopher Wirth, assistant professor of chemical and biomolecular engineering at CWRU, reaching out to us about an opportunity to brew and compete at the annual American Institute



of Chemical Engineers (AIChE) Beer Brewing Competition.

The first step was to decide on our competition beers. We all have different preferences when it comes to beer, so we wanted to make sure our entries had characteristics all beer enthusiasts could enjoy. The two beers we ultimately decided on fell on either end of the preference spectrum: a very hoppy black IPA called Coraline's Brew and a sweeter, mild toasted oatmeal stout we named Toasty Oat.

Our brewing process differed slightly between the two beers. The IPA was primarily extract-based because we were aiming for a relatively high alcohol percentage, and equipment limitations made it difficult to achieve the required original gravity using all-grain methods. Toasty Oat, on the other hand, would be lower in alcohol, and we were able to directly extract sugars from a mixture of grains in a mash.

We used seven varieties of hops in our black IPA, all of which worked together to create a complex flavor profile that included notes of pine, citrus, garlic, and pepper. In addition to the interesting flavor profile they contributed, the hops were also specifically selected according to where they had been grown.

Idaho 7 hops were chosen because Bethany did her undergraduate degree in Idaho. Columbus hops were used as Drace had earned his his undergraduate and master's degrees at The Ohio State University. Mighty Ax hops were chosen because they are grown in Minnesota, which is where William is from. We also included two dry-hop steps—one during fermentation and one during conditioning—to add additional aroma.

Despite the IPA's high bitterness, it was still balanced by dark-malt sweetness. In contrast, the Toasty Oat beer used very few hops, which resulted in a much milder flavor. Additional flavoring was used to add to the flavor profile, including vanilla, cinnamon, cacao, and peanut butter to complement the sweetness of the beer. The result was an easy-drinking beer that almost anyone would enjoy.

AICHE BEER BREWING COMPETITION

We submitted our two brews—Coraline's Brew black IPA and Toasty Oat oatmeal stout—to the AIChE Annual Conference Beer Brewing Competition. This was the fourth time the conference had held this competition, in which any AIChE member over the age of 21 can compete.

The competition featured chemical engineers from all walks of life, including graduate students, newly employed chemical engineers, chemical engineers who have practiced for 40 or more years, and professors. We competed as a brand-new team, but there were teams that had competed all four years and had used all-grain systems. However, we were not intimidated. We were excited to get a chance for our new hobby to take off and receive real feedback from other beer enthusiasts.

The competition was split into a few different parts. First, we dropped off eight bottles per brew at the competition early in the afternoon. Later, we set up our poster, which detailed the brewing processes for both beers and featured the logos we designed, and reported the essential stats for the brews.

Our brewhouse efficiency for the black IPA was 94.9%, with an ABV of 8.8%, and original and final gravities of 1.074 (18°P) and 1.005 (1.3°P), respectively. The oatmeal stout had 62.2% brewhouse efficiency, measured 5.1% ABV, and had original and final gravities of 1.042 (10.5°P) and 1.007 (1.8°P), respectively. During the competition, we stood by our poster and presented it to other competitors and judges. In addition, anyone was allowed to come to the competition and act as a judge for certain awards like the people's choice award.

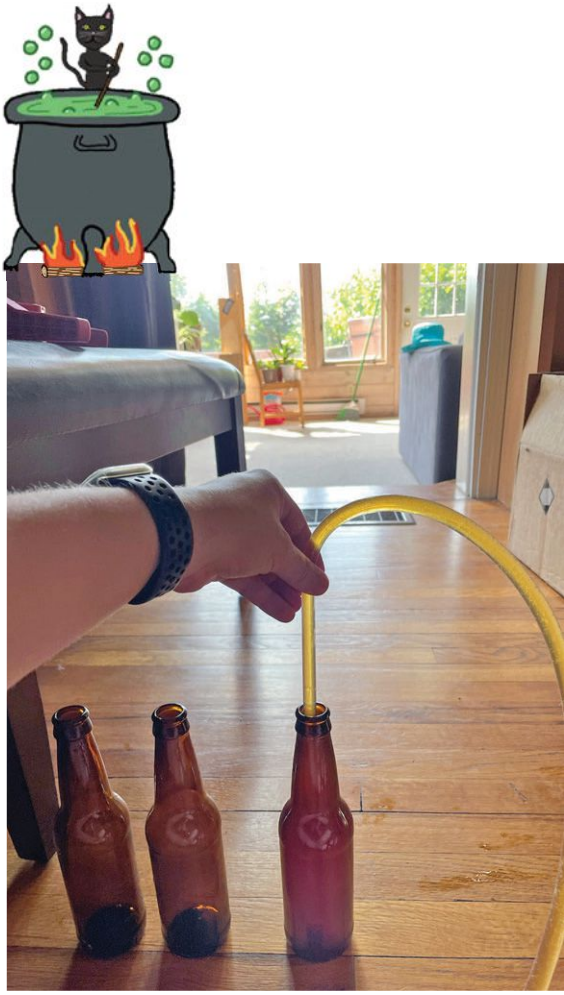
Once the poster session was over, a blind tasting began. All the competition brews were defaced of any labeling and categorized by beer style. Unlimited 4-ounce (118 mL) samples were given out for every competitor, judge, and audience member of the competition to try. After two hours of tasting, the award ceremony began.

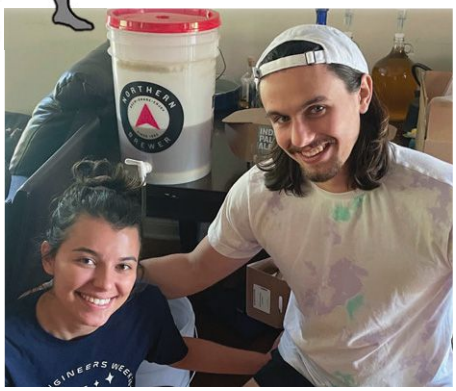
We won best new team, which was a huge accomplishment, and highest brewhouse efficiency for Coraline's Brew. At the end of the competition, we felt proud of ourselves for trying something new and were thankful to have competed with the other amazing teams. In talking to other competitors and trying their beers, we found ourselves even more excited to brew again and had a few ideas for new types of beers to try and new ways to brew.

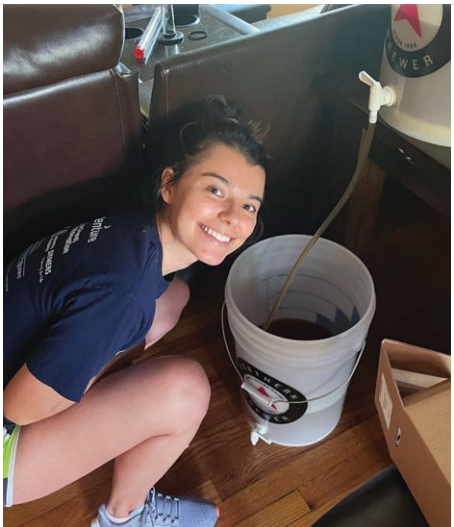
We hope to upgrade to an all-grain system soon. In addition, we are currently mapping out plans to start our own brewery after we complete our PhDs. Through this process, we have learned that brewing is really a bread-and-butter hobby for chemical engineers. We use our knowledge of extraction, separation, and fermentation, topics we have learned through classes and projects, and apply them to making a fun and satisfying product.

We've also learned that a brewer does not have to be a chemical engineer or chemist. As long as you are able to keep your equipment clean and can read a recipe, almost anyone can brew. We hope to inspire others to try this rewarding hobby and see where they can take it, just as we have and hope to keep doing.

Bethany Kersten is a PhD candidate in the department of chemical engineering at Case Western Reserve University. Her research focuses on studying the electrochemistry of actinides for the recycling of nuclear fuel. William Dean is a PhD student whose research focuses on understanding the bulk and interfacial properties of new electrolytes for energy storage devices. Drace Penley is a PhD student whose research focuses on developing electrolytes for lithium batteries.







Left to right: Bethany and Will brewing; Bethany bottling.

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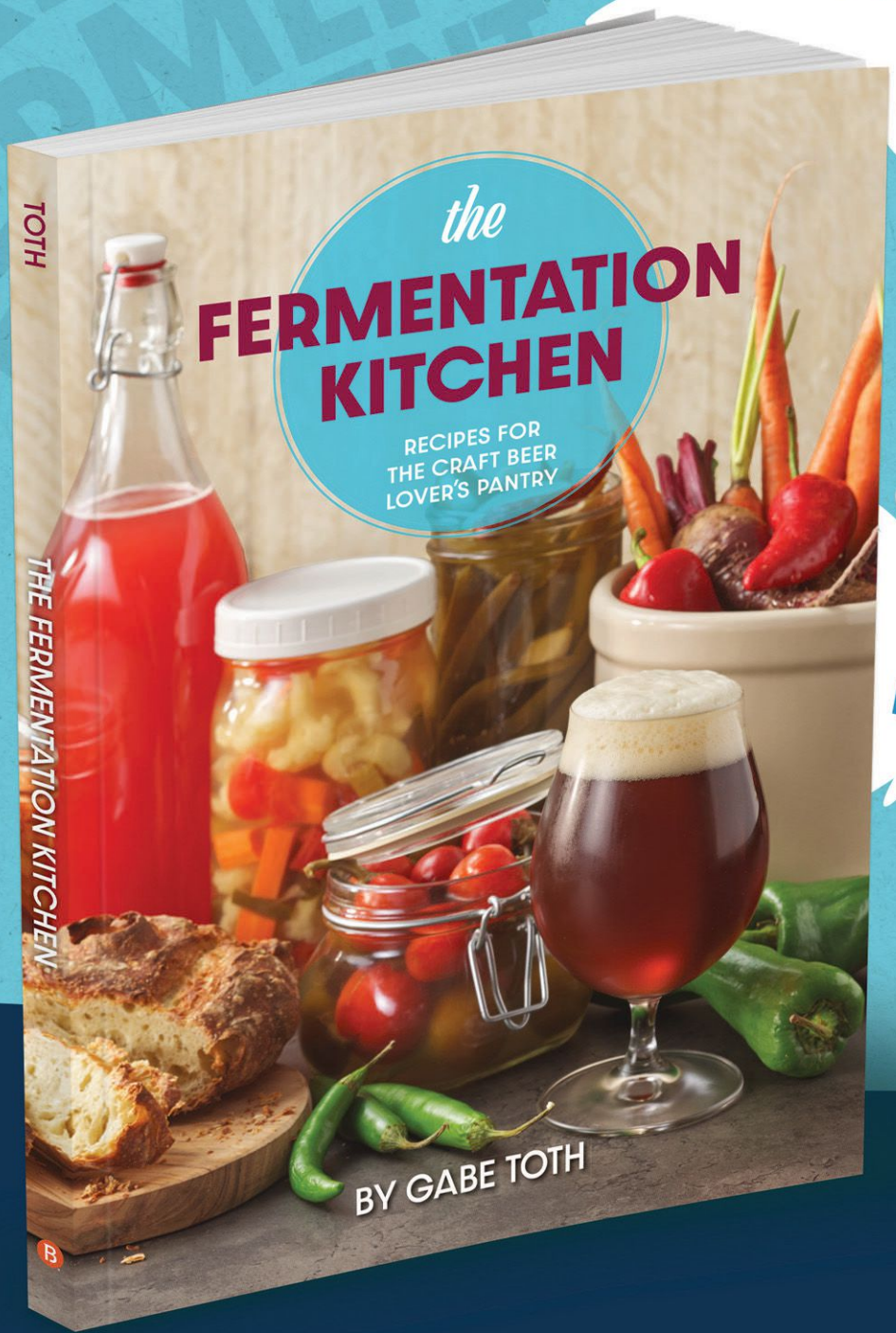

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Arizona Brewing

My Most Out-There Brewing Adventure!

Gold Canyon, Arizona, must be one of the strangest spots to brew when you consider I live in Ontario, Canada, and it takes 36 hours of driving to get there. It all started around a campfire in Arizona at an RV park with a few couples enjoying beer I had brought from Canada. I usually travel with two Corny kegs of beer and about 50 plastic bottles—plastic so they don't burst on the road in subzero temperatures. Two camper friends said they would like to learn to brew, so in a weak moment, I volunteered to bring a brewing rig down for lessons the next year.

So what was the problem? Fifth wheels are big. I had a 32-foot Cedar Creek unit that measured 37.5 feet stem to stern. But try stuffing in a converted keggle, a propane brewing stand, a plate chiller, primary fermenters, CO_2 tank, propane tank, bottle capper, and beer dispensing unit, as well as freshly milled malt, Star San, yeast, hops, and so on. It was a trick. The mash tun was another space grabber. Thankfully, my wife was on board with this crazy idea.

The plan was to serve the two kegs I travel with to friends at two socials and fill them with wort from the primary pails in three separate brewing days. The primary pails had holes with rubber grommets to install the airlocks that I could stack to bring along. What could go wrong?

For one thing, I could not get an answer from the local brew shop about obtaining the malt and having them mill it for me. So I decided to crush my own malt, put it in separate batches, and include the recipe in case the border guard thought it was a bad batch of drugs traveling south. Oddly enough, in all the time I have crossed the border, they have only ever asked about spirits and wine. They also have standard other questions. When I declare my wine, I usually say I have "some" wine. Once I heard "Some?" as a reply, and I said, "Yes, sir, some." He did not pursue it further. "Some" is a great answer, by the way!

One of my brewing students camped beside me and told me the neighbor behind me was not a friendly person. I said that I usually get along with most fellow campers, so I said, "Let's see what happens." I went over to meet Peter, who had a very English accent, and said he was probably wondering what all the stainless-steel equipment was doing sitting behind my fifth wheel. Promptly, I told him I was a brewer and that some of the guys in the park wanted to learn how to brew. I assured him I would be quiet and would probably wait until 7 a.m. to start. He said that would be fine as he would be up at 6:30. No problem!

Guess what? He became my third student! His wife Linda even served the beer, as she had not operated a beer handle since they had gotten married in England. They married in the pub and worked off their wedding bill by serving beer and doing all the stuff you do to run a pub on weekends. She actually cried tears of joy when I announced that she was my new "official" pourer. Brew days went smoothly, and the primary ferment buckets bubbled away in the one bay (storage unit in an RV) that I made into a fermentation cabinet with ¾-inch foam and duct tape. This allowed me to control the cool temperatures at night with a temperature controller and Rhino heaters in this foam cabinet.

We used ice from the rec hall to cool the kegs when we bottled. The first time, we bottled one keg and everything went fairly smoothly, with 50 bottles capped. The next time, we filled two kegs in two more brew days, with a plan to bottle at 11 a.m. It sure was funny when, after we had everything ready to go, a large contingent of campfire friends all showed up with beer mugs. We ended up with only 50 bottles from two kegs and a bunch of happy beer lovers.

I had donated all the ingredients and couldn't care less when the beer was consumed. I decided to make fast-turnaround beers, as our normal stay was for two-and-a-half months, even though we had paid for three. Two students said that brewing was too much work and they would just stick to buying beer. The third student, Peter, was mostly interested in assisting, but he was a super bottle cap operator. The other guys washed bottles, sanitized them with Star San, and deployed a Fast Rack to dry the rinsed bottles.

One other problem was the javelina (which resemble pigs) who entered the park to smell my spent grain one night while we were at our campfire. A whole family of animals came in to investigate the new aroma of malted grain. You never know what can happen with these things. At least no rattlesnakes hid under my brewing equipment.

We have camped in the same RV park for 11 winters. Recently, we wintered in Texas near the Mexican border and in Madeira and the Azores. I helped a craft brewery in Madeira with recipes and processes, but that is another tale for another time. I would never do that packing trick ever again, but it sure was fun to have my recipes enjoyed in the desert southwest. Dare to dream, and you can brew almost anywhere!

Norm Ryder lives in Ontario, Canada, and has been homebrewing for 50 years.

Photos courtesy of Norm Ryder

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